Examining Group Process through an Information Behaviour Lens: How
Student Groups Work with Information to Accomplish Tasks

by

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In memory of my Father, Philip James Toze, who always encouraged me to follow my dreams, and, like my mother, showed me it was possible to balance higher education, work and family. In memory also of Mildred Jane Outhit, my mother in law; she would have loved to celebrate this achievement.

This PhD dissertation is dedicated to my girls, Elizabeth and Emily, to my husband Tim Outhit, to my mother Gladys June Toze and my sister Dr. Cynthia Toze. You are the team that has seen me through this incredible journey. Your love, support and guidance has cheered me on to the finish line.

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ABSTRACT

Organizations increasingly rely on groups of knowledge workers to make decisions, design products, manage projects, and develop strategy. Information is central to group task accomplishment. Typical models of information seeking have focused on the individual, or on social or collaborative seeking. Groups represent a unique level, with specific attributes (interaction, interdependence, awareness and shared understanding) that need to be better understood and supported. The objective of this research was to understand information needs, seeking and use in groups.

Group work was deconstructed to identify how groups, working on multiple tasks over time, identified their information needs, found and used information. Seven groups were observed as they spent 60 hours in 25 different sessions in a Group Work lab completing course assigned projects independent of this study. Group interactions were recorded on video, and computer-based activities were captured in log files. This method addressed a key methodological challenge of studying groups, allowing the complex details of group work to be captured as they unfolded naturally over time.

The first phase of analysis examined the procedural aspects of group work and found that groups shifted between three phases: Planning, Doing, and Monitoring. Within each phase the following elements of group information process were identified and described: the information tasks, information task goals, information activities, sources, tools, artefacts, roles and shifts in participation. Groups looked for information to satisfy eight different goals, requiring 19 different information activities, as well as specific sources and tools to generate new artefacts. Ten roles were observed within the groups to manage their information activities, and participation fluctuated from individual through to the group. The relationship between these elements was described.

Finally integrative analysis revealed that the groups did not have good mechanisms for managing information needs, and encountered the greatest difficulties trying to use information. Suggestions were made for tools and processes to facilitate more effective group work. Group information process was defined and conceptually modelled extending our understanding of information use by groups, and adding to theories and models in Information Science and Group Research. Additionally this research contributed a new method for studying groups.

LIST OF ABBREVIATIONS USED

CIB	Collaborative Information Behaviour
CIS	Collaborative Information Seeking
CIS & R	Collaborative Information Seeking and Retrieval
CIR	Collaborative Information Retrieval
CSCW	Computer Supported Cooperative Work
CWA	Cognitive Work Analysis
GIP	Group Information Process
IR	Information Retrieval
IRT	Information Retrieval Task
IST	Information Seeking Task
IS&R	Information Seeking and Retrieval Episode

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CHAPTER 1   INTRODUCTION

1.0 Motivation for this Study

Organizations across all sectors (public, private, not for profit) commonly rely on groups of knowledge workers to make decisions, to design products, to manage projects, and to create strategies (e.g., Edmondston, 2012, Rousseau, Aubé, & Savoie, 2006, Stewart & Barrick, 2000). Increasingly, the tasks these groups are asked to accomplish are complex and involve a high degree of uncertainty (e.g., Edmondston, 2012; Gardner, Gino & Staats, 2012; Hackman, 2012). To accomplish these tasks groups work with and manipulate information engaging in a process. This information process includes three main tasks: 1) identifying the need for information, 2) searching through documents and for people, and 3) using information. Frequently this process is mediated by technology, and facilitated by group interactions (e.g., Fidel, Mark Pejtersen, Cleal & Bruce, 2004; Hertzum, 2008).

The promise of groups is in part linked to how they accomplish this information related process. Through collaborating, group members *should* be able to bring more diverse information to bear, and more critically evaluate information, to make better decisions, to be more innovative, and to produce better results (Gardner et al, 2012, Moreland, 2006; Stasser & Titus, 2003). Yet this promise is not always achieved; groups do not always process and use information effectively. When groups work well, the product of groups – this new information or knowledge – becomes a competitive advantage for the organizations (e.g., Gardner et al, 2012, Kochan, Orlikowski, & Cutcher-Gershenfeld, 2002). The information process at the heart of group work has been linked to group innovation, to creativity and learning, as well as serendipitous or accidental discoveries (Edmondson, 2002; Haythornthwaite, 2006; Mohammed & Dumville, 2001; Stahl, 2006). Ineffective or inefficient information process can result in diminished group effectiveness (e.g., Kerr & Tindale, 2004), and at the far extreme, has contributed to organizational failures such as the space shuttle Challenger disaster (Choo, 2008). In any event, information is clearly central to group task accomplishment, but we

do not fully understand the process through which a *group*, rather than an individual, or an organization, transforms information.

Within the last couple of decades, groups have increasingly been examined from an interdisciplinary perspective as highlighted by Poole, Hollingshead, McGrath, Moreland & Rorhbaugh (2004). Researchers use different perspectives to better understand groups by focusing or highlighting specific group phenomena including the functional (e.g., Wittenbaum, et al, 2005), temporal (e.g., Arrow, Poole, Henry, Wheelan, & Moreland, 2004), conflict-power-status (e.g., Sell, Lovaglia, Mannix, Samuelson & Wilson, 2004), social identity (e.g., Hogg, Abrams, Otten & Hinkle, 2004) and social network (Katz, Lazer, Arrow & Contractor, 2004). Each perspective differs in the attention paid to social and emotional aspects of groups, compared to the tasks, activities or functions of groups. Currently, no conceptualization of groups that examines the process through which groups "integrate and transform knowledge into novel solutions to address complex problems" (Gardner et al, 2012, p. 1000) has been found. By applying the lens of information behaviour, as defined by Wilson (2000) as the "totality of human behaviour in relation to sources and channels of information, including both active and passive information seeking, and information use" (p. 49) this process through which groups work with information to accomplish tasks can be deconstructed. This lens provides a way of gaining a more robust understanding of the mechanics of new knowledge creation. This current research focuses on examining group interactions related to identifying information needs, seeking information through multiple channels, and then using information, to better understand the emerging concept "group information process" (GIP).

To date, models of information behaviour have mainly focused on individuals (e.g., Ellis, 1989) or on organizations (e.g. Choo, 2006). While the recognition of the social and collaborative aspects of information seeking is growing (e.g., Foster, 2010; Hertzum, 2008; Karamuftuoglu 1998; Kling, Rosenbaum, & Hert, 1998; Shah, 2012; Spence, 2013; Talja & Hansen, 2006; Widén-Wulff, & Ginman, 2004), there has been limited research focused directly on the information process of small groups. The incentives and barriers to information sharing have been examined in the small group research, (e.g., Janis, 1972; Stasser & Titus, 2003), as well as how groups can use

transactive memory systems to manage their resources efficiently (e.g., Lewis, Lange & Gillis, 2005; Moreland 2006; Wegner, 1987). These models have focused on information sharing from a cognitive perspective, but have not examined how groups find and integrate external information. Conversely Fidel et al (2004) examined how groups seek external information, but not information sharing within the group. Except for Blake and Pratt (2006a) who examined collaboration during synthesis, there is no model of group information process comparable to the individual stages produced by, for example, Kuhlthau (1991). Tools exist to support many aspects of group collaboration including communication, co-ordination and awareness (e.g., Pinelle, Gutwin, & Greenberg, 2003) but tools to support group information seeking are not widely available. Existing tools have only been tested in small studies, frequently with artificial tasks and with pairs (e.g., Morris & Horvitz, 2007; Shah, 2012), and have not been integrated with generic group tools. The research that examines the heart of what groups do – how they discover and use information, is incomplete. It is scattered among multiple disciplines (e.g., information science, organizational behaviour, and computer supported cooperative work (CSCW)), almost in silo fashion.

This current research seeks to examine the information behaviour of groups in a holistic fashion and in situ. The information behaviour lens highlighted above, and described Section 2.4 was used to deconstruct group work to understand the process through which information needs emerge and are resolved at the group level, providing a more robust understanding of groups, how they work with information, and the tools needed to support their information process.

1.1 What is a Group?

As this research is focused at the group level, a central question is what exactly is a group? The term "group" is commonly used and understood. Yet there is huge variation in what is considered a group. Individuals, for example, may be members of many groups from sports teams, to book clubs, to interest groups or political groups, as well as work based groups. We can see an individual within a group, but when does a collection of people become a "group", and when does a group become something larger such as a community or an organization? Is a pair a group? Is a department a group or something

different? What is the difference between a group and a community? It is difficult to establish a clear break or cutting point on the continuum between a collection of individuals, and a true "group" as commented by Hare (1976) and Hackman (2012).

The term "group" is a changing and amorphous concept. To narrow the scope for this research, a specific type of group was the topic of interest, work groups, which are sometimes called teams. Some researchers distinguish between the two terms (e.g., Guzzo & Dickson, 1996), but the more common practice is to use the terms interchangeably. This practice is followed in this dissertation.

> Work groups or teams have been defined by Kozlowski & Bell (2003) as: collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, maintain and manage boundaries, and are embedded in an organizational context that sets the boundaries, constrains the team, and influences exchanges with other units in the broader entity (p. 334).

In other words, work groups are task based social organisms, whose members identify themselves as part of the group, while being constrained by their organizational environment. But even within work based groups there can be much variation. Work groups can vary by many factors including size, the diversity of individual members, their tasks, duration (ongoing or ad hoc), structure, degree of authority and autonomy, level of cohesion, and space (i.e. collocated, distributed, mixed) (e.g. Cohen & Bailey, 1997; Hackman, 2012). For example a rapid task force can have a very short life span, but a management team may continue for years.

Recent research suggests that groups in organizations are changing (e.g., Edmonston, 2012; Hackman, 2012; Tannenbaum, Mathieu, Salas & Cohen, 2012). Instead of stable groups who exist within a single organization and work on well-defined problems or processes, work groups are now more frequently assembled quickly to solve complex problems with a high degree of uncertainty, including negotiating, or managing organizational change (e.g., Edmondston, 2012; Hackman, 2012; Tannenbaum et al., 2012). These new groups may involve members from multiple disciplines, locations, and even multiple organizations and sectors (not for profit, government, academic, industrial), and may exist only for a short time.

While acknowledging these differences, a group can be understood as a unique level, with particular attributes that differentiate a group from a community for example. Hackman (2012) reflecting on the unique elements of groups suggests that "a group is an intact social system, complete with boundaries, interdependence for some shared purpose, and differentiated member roles" (p. 429). Reviewing the extensive literature on groups the following characteristics that best describe the group level emerge. Table 1 highlights these unique characteristics of groups.

Table 1   Group Characteristics

Characteristic	Description	References
Bounded	Work groups are intermediate level phenomena; they are composed of individuals, with their biological, social, and psychological properties, and exist in larger entities such as organizations that also have their own physical, socio-cultural, and technological properties. Work groups are typically considered to range in size between 3 and 12 members.	Devine et al., 1999; Hackman, 2012; Kraut, 2003; McGrath, 1984; McGrath, Arrow & Berdahl, 2000; Stahl, 2009.
Shared goals	Work groups exist to achieve particular goals and objectives, which are generally set by the organization, and shared by all members.	Hare, 1976; Salas, Burke, & Cannon-Bowers, 2000
Access to a greater range of resources	Groups bring a diverse range of resources to bear on shared problems. This allows for the division of labour, efficiencies of effort, for members to learn from each other, and potentially for a more informed outcome.	Collins & Guetzkow, 1964; Hackman, 2012; Lewis, Lange, & Gillis, 2005; McGrath et al., 2000; Steiner, 1972; Wegner, 1987
Socially motivated and influenced	Individuals may be motivated to change their behaviour as part of a group, both positively and negatively (i.e., social loafing) and group members influence each other, which can also have both positive and negative results (i.e., groupthink).	Choo, 2007; Collins & Guetzkow, 1964; Hackman & Kaplan, 1974; Janis, 1972; Kerr & Tinsdale, 2004; McGrath, 1984; Steiner, 1972
Develop norms	Groups establish norms, which help to counteract some of the social effects, and create a set of expectations for behaviours.	Hare, 1976; Kerr & Tindale, 2004; McGrath, 1984

Characteristic	Description	References
Complex adaptive social organisms	Groups develop, adapt and change over time. This involves processes including monitoring the groups progress and providing back up for members.	Hackman, 2012; Ilgen, Hollenbeck, Johnson, & Jundt, 2005; McGraw et al., 2000

1.2 Groups and Collaboration

The characteristics of groups outlined above in Table 1 influence the ways in which groups operate, which is frequently described as collaboration. There are clear overlaps among the various definitions of groups and collaboration. For example, Terveen (1995) defines collaboration as "a process in which two or more agents work together to achieve shared goals" (p. 67). To achieve these goals Terveen suggests collaborators must agree to the shared goals, determine who will do which parts, and then coordinate the work, which frequently involves adaptation and learning. This definition mirrors many of the characteristics of groups outlined in Table 1 above. Thomson & Perry (2006) suggest collaboration involves autonomous or semi-autonomous actors, who interact both formally and informally, and involves the joint creation of rules and structures and norms, to support mutually beneficial relationships. Soliman, Braun and Simoff (2005) isolated eight essential ingredients of collaboration: "two or more people, shared space, time, a common objective, focus on the objective, common language, knowledge in the area of the objective and interaction" (p. 366). These definitions provide specific criteria, including interaction between people, common goals, and the development of shared understanding of the task and process that must be present for "collaboration".

However, in practice the term "collaboration", particularly in information and CSCW research, has been used as an all-encompassing term for any activities that are accomplished by more than one person (e.g., Golovchinsy, Qvarfordt and Pickens, 2009; Foster, 2010; Shah, 2012). Collaboration has been examined in terms of key factors such as degree of integration (formal vs. informal), location (co-located vs. distance) and time (synchronous vs. asynchronous). For example individuals using the social tags or recommendations of others are also described as "collaborating", yet there may not be a joint task or formal agreement, the collaborators may not be in the same space or time, or even know each other.

The use of collaboration in this study will be limited to the collaboration of groups working on shared goals over time. Collaboration in communities and social collaboration such as tagging or crowdsourcing will be excluded.

1.3 Attributes of Group Based Collaboration

To clarify further, the collaboration being examined in this current research is focused at the group level, and specifically synchronous collocated groups who are working on complex knowledge based tasks. To complete complex tasks, the specific characteristics of work groups identified in Table 1 combine to create a pattern of collaboration, which can be described in terms of the following attributes: 1) Interaction (e.g., McGrath, 1984); 2) Interdependence (e.g., Salas et al., 2000); 3) Shared Understanding (e.g., Mulder, Swaak & Kessels, 2000); and 4) Awareness (e.g., Gutwin & Greenberg, 2001). Individual group members work together to plan how they will accomplish tasks, and coordinate their actions, as they work towards their goals (e.g., Marks, Mathieu, & Zaccaro, 2001). Groups require interaction including talking, sharing documents, or acknowledging non-verbal cues. As work in groups, even collocated groups, is often distributed (i.e. work is divided into individual tasks), individual members rely on others to do their parts, and need to manage their interdependence, including their awareness of what others are doing, especially if there are problems. Groups construct a shared understanding of their goals, tasks and outcomes through their interactions. This shared understanding emerges and changes over time (e.g.; Cohen & Bailey, 1997; Convertino, Neale, Hobby, Carroll, & Rosson, 2004; Hackman, 2012, McGrath, et al., 2000). Each of these attributes will be discussed briefly below.

1.3.1 Interaction

The first attribute of group collaboration is interaction. McGrath (1984) suggests that interaction is the essence of group work, and defines group interactive processes as the "patterned behaviour of members of a standing group in a behaviour setting, in relation to task/situation and environment" (p. 13). In other words, interaction involves the ongoing actions, communication and behaviours between group members working on a task, which influence and affect the development of the group and the relationship between

members. Interaction is essential to allow groups to manage their diverse resources, and work together to achieve their shared goals (e.g., Salas et al., 2000). These interactions can occur face to face, or virtually, but are essential for a group to actually work together. Social motivation and influence can be traced within interactions, and groups develop a set of norms through their interactions (e.g., Kerr & Tinsdale, 2004; Kozlowski & Bell, 2003).

Factors that can influence group interactive processes include: the characteristics of individual members; the structure of the group; the task; as well as the context or environment. In addition the technologies and resources available to the group can affect group processes (Olsen & Olsen, 1997; McGrath & Berdahl, 1998).

Through these interactions, groups change and develop over time (Hackman, 2012; McGrath et al., 2000). Individuals also develop, but in groups the development cannot be explained by the change in one person but rather on the adaptations necessary to work together. Organizations also develop, but the process is more complex.

Hundreds of models have emerged that try to classify or categorize the patterns of interactions (e.g., Chang, Bordia & Duck, 2006) to better understand the concept of group development. Bales (1950) created the Interaction Process Analysis (IPA), a tool that has been widely used to classify small group communication. Still, progress on the understanding and measurement of group interactive processes has been difficult, due to the lack of consistency with the conceptualization as noted by Ilgen et al. (2005). This current research will focus on the information related interactions in groups, including how information needs emerge, are supported, and translated into group products.

1.3.2 Interdependence

The second attribute of groups is interdependence. Hinds & Weisband (2003) define interdependence as the need for members to mutually rely and depend on each other and to coordinate their activities to achieve their common goal. Working in a group is more complicated than individual work, as it requires extra processes related to managing, coordinating and integrating resources from individual members. Even when group members work on tasks in a serial fashion, with little interaction, they are still interdependent to some degree, as their goal is shared (e.g., Hare, 1976; Salas et al.,

2000). All members must agree or sign off on the final product. When individuals leave a group, they are still connected to the product, reports or decisions that the group made.

To manage their interdependence, effective groups strive to work through cooperation, consensus and collaboration, and they create formal and informal roles and structures that define their relationships, including "acceptable" ways to act, or their group "norms" (Thomson, Perry & Miller, 2009). Interdependence also creates the need for mutual performance monitoring and for back up behaviour (e.g. Salas et al., 2000). Work and resources may be divided, but members need to feel that others are doing their share, to trust that the work will be done well, and to have contingency plans if this does not occur. Trust itself is a critical aspect of group work (e.g., Hertzum, 2002; Jarvenpaa & Leidner, 1999; Javanmardi, & Lopes, 2007).

How groups organize themselves and their work, sequentially, in parallel, or collectively, affects their information process. Jensen (2009) noted that when tasks are accomplished largely by individual group members, then integrated serially (i.e., in a specific order), the need for information sharing, communication and co-ordination is minimal. To reduce the cognitive load related to interdependence, groups can develop unique systems including transactive memory systems (e.g., Wegner, 1987), where each member is responsible for a certain type of information, or part of the task, and all members are aware of this distribution, and rely on each other. The relationship between interdependence and GIP will be examined in this current research.

1.3.3 Shared Understanding

The third attribute of group collaboration is shared understanding. To work together groups have to share, at some level, a common conception of the task and their goals. A range of comparative terms have been used to describe this "sharing" including: team mental models (e.g., Mohammed & Dumville, 2001), shared understanding (e.g., Mulder, Swaak, & Kessels, 2002), distributed cognition (e.g., Hutchins, 1995), collective mind (Yoo & Kanawattanachai, 2001) or collaborative grounding (Hertzum, 2008) which all have subtle differences, but focus on a "collective" cognition as noted by Akkerman et al. (2007). All embrace the idea that there is "cognition" in groups greater than the sum of all individual understanding. For this study the term "shared understanding" is used to refer to the development within the groups, of a common or overlapping understanding of the

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task, the groups' processes and each other. Shared understanding is built through sharing information, and from learning through the interactions, practices, and the development of norms with other group members.

When groups are most effective, groups can create meanings and act based on a joint level of cognition that is more than just additive (Akkerman et al., 2007; Stahl, 2006). This collective cognition is a unique property of groups, which creates the potential to deliver something "more" that is the promise of groups (e.g., Gardner et al., 2012). To date the identification and measuring of this group level cognition or shared understanding is still emerging (see for example the work of Stahl (2006; 2009) on student math groups. There also is evidence that GIP contributes to group cognition or shared understanding (e.g., Hertzum, 2008, Saleh, 2012; Spence, 2013), which will be considered in this study.

1.3.4 Awareness

The fourth unique attribute of group collaboration is the concept of "awareness". To stay on target (i.e., meet deadlines, accomplish goals), group members frequently need to know and understand what others are doing, when they are available, the tools and resources they may have access to, and their current attitudes and concerns regarding the task (Carroll, Rosson, Convertino & Ganoe, 2006; Gutwin & Greenberg, 2001). Dourish and Bellotti (1992) describe awareness as the "understanding of the activities of others, which provides a context for your own activity" (p. 107). In other words, awareness involves gathering information from the external environment, including other group members', to ground an individual member's own work. More specifically, awareness, according to Gutwin & Greenburg (2004) includes four basic characteristics: 1) it involves knowledge about the state of a particular environment; 2) it must be kept up to date to reflect the fact that environments change; 3) it is maintained through interactions; and 4) awareness is a secondary goal to aid the primary goal of task completion. As such, awareness is constantly evolving and being re-negotiated during the work process. Awareness also refers to scanning the environment to anticipate future events (e.g., Sonnenwald & Pierce, 2000).

As the understanding of awareness has developed, the concept has become more robust, with different types of awareness being identified including social awareness,

presence awareness, action awareness, workspace awareness and situation awareness (e.g., Carroll et al., 2006; Gutwin & Greenberg, 2001; Neale, Carroll & Rosson, 2004). In this current research the term "awareness" is used to refer to the need within groups for consistent information about group members' progress, both currently, and in the future. Information is a core part of awareness but has not been fully modelled.

1.3.5 Summary of the Attributes of Group Collaboration

Group members work together interdependently and build norms and patterns through their interactions. To work as a "group" members must remain aware of what others are doing, and build a level of shared understanding (e.g., Sonnenwald & Pierce, 2000; Stahl, 2006). In a sense groups are a balancing act; members act individually, but remain connected. Groups need to find and share enough information to accomplish their goals, and maintain their processes. These attributes are essential to understanding a group, rather than an individual or an organization.

1.4 Framing the Research Problem

This study integrates a process-focused approach to examining groups, focusing on describing, classifying and charting what groups actually do during their interaction processes in the tradition of Bales (1950), while recognizing groups as complex adaptive systems (McGrath et al., 2000). Rather than focusing on all interactions, the aim is to use the information behaviour lens to highlight and examine interactions related to information, and to examine how these information interactions are generated from the task and group work process. As such, this research involves examining group information interactions longitudinally, as they emerge in response to groups working on multiple complex and unstructured knowledge based tasks over time, to provide a richer understanding of group workflow. This is in contrast to research that has for example, examined a particular task such as synthesis (Blake & Pratt, 2006a) or the patent process (Hansen & Järvelin, 2005), research that has examined only one information behaviour such as sharing (Stasser & Titus, 1985, 2003) or research that has looked specifically at the moments of collaborative information retrieval (Fidel et al, 2004).

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This research looks at the information process of groups holistically.To accomplish their complex work tasks, and work together, groups need to manage their resources over time. Information is a key resource for groups, they need to integrate information from multiple sources (including each other), and synthesize and transform information over time to produce novel results. Little is known about how this practice actually occurs (Gardner et al., 2012).

Given this context of the research problem, a framework is needed which allows for the examination of the information process of groups, as they collaborate on tasks, over time. The theoretical framework needed should incorporate the following key elements: 1) group processes, 2) work tasks, and 3) information tasks. An ideal framework allows for the examination of all activities, mechanisms and technologies related to the key information tasks (identifying needs, finding and using information), as they emerge. Two potential approaches are discussed below: 1) groups as information processers, and 2) Cognitive Work Analysis (CWA). Following, the framework developed for this research, to better accommodate the need to examine group level interactions longitudinally, is described.

1.4.1 Groups as Information Processor Perspective

Within social psychology research, groups have been examined as information processers, focusing on the cognitive process of sharing information. The "groups as information processors" perspective articulated by Hinsz, Tindale & Vollrath (1997) involves examining "the degree to which information, ideas, or cognitive processes are shared, and are being shared, among the group members and how this sharing of information affects both individual and group level outcomes" (p. 43). While this cognitive perspective has allowed for the examination of the barriers and incentives to information sharing in groups (e.g., Stasser & Titus, 1985) it does not address when and how groups decide to seek information external to the group. Further, most of the research within the "groups as information processors perspective" has used artificial groups in a lab, working on a discrete problem. It is not clear if the information process of these groups would reflect "natural" practices. This framework does not easily accommodate changes in behaviours and processes over multiple tasks and time, as noted by Wittenbaum et al, (2004).

1.4.2 Cognitive Work Analysis (CWA)

In contrast, multi-perspective approaches such as Cognitive Work Analysis (CWA) have been used to examine collaborative aspects of human information behaviour by researchers such as Fidel and colleagues (2004). CWA is a conceptual framework designed to help understand complex work situations by examining multiple dimensions, and their relationships. Fidel et al (2004) created the framework below to highlight the different dimensions they examined in their work on collaborative information seeking in design teams.
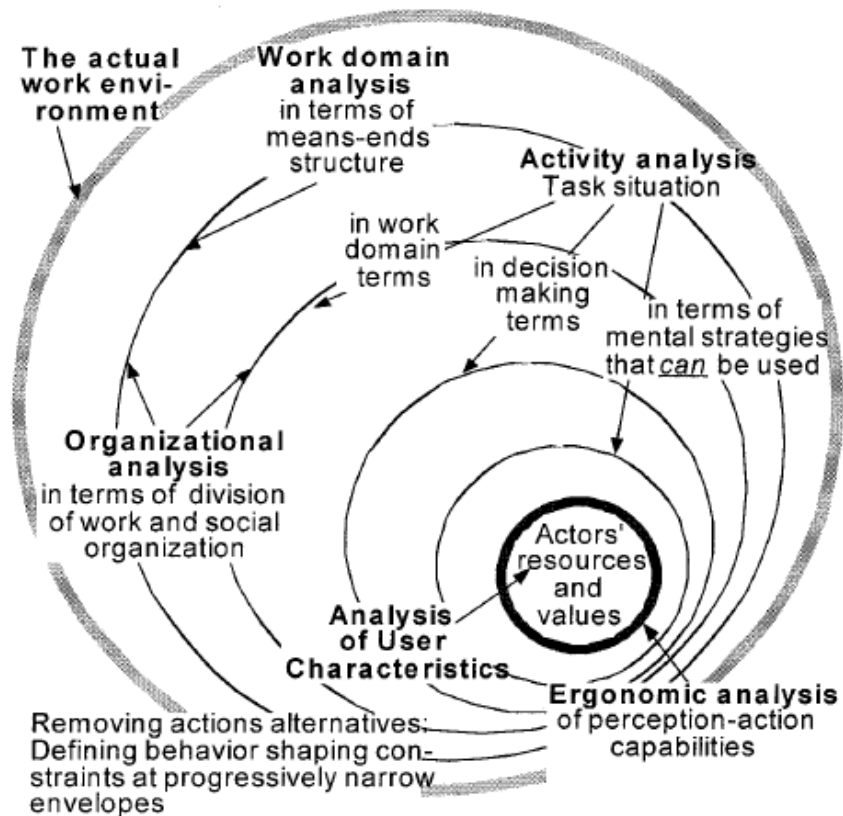
Figure 1   Cognitive Work Analysis (Fidel et al, 2004)

At illustrated, the highest level considers the environment within which the organization works, including highlighting the factors that may affect the organization. Next the work domain itself is considered including the resources available, the priorities of the organization and any constraints, as well as the organization level. The framework includes the analysis of the activity level of the particular task situation, as well as the actor level. As stated by the authors, their goal in using CWA was to "illustrate how

employing it can reveal not only the various factors involved in an information-behaviour phenomenon, but also interdependencies among these factors " (Fidel et al, 2004, p 942).

This framework is very helpful for examining particular moments or decisions. For example the authors used the approach to better understand one specific collaborative seeking incident - why one employee invited colleagues to collaborate with him to find the information he needed, and the challenges they faced during their collaborative information seeking. The layers of analysis and rich detail necessary for this approach would be difficult, if not impossible, to reproduce for all the information related interactions that emerge as groups work on tasks over time. Also this framework puts work at the centre, but does not specifically address the group level.

1.4.3 Information Behaviour Lens

In contrast to the above frameworks, the information behaviour lens (Choo, 2006; Marchionini, 1995; Wilson, 2000) chosen for this research focuses attention on ***all*** behaviours related to sources and channels of information. Using this lens extends the focus beyond a cognitive framework to also include: the examination of external sources; the use of tools; the process of collectively assessing and using information; the changing levels of participation; the development of specialized roles, and the creation of complex group artefacts.

The information behaviour lens used in this research involves examining three key information tasks: 1) when and how information needs emerge and are understood; 2) the process of seeking information which may include interactions with information systems; and 3) how information is used which involves examining how information is incorporated into existing knowledge bases. These three tasks were identified by looking across multiple models of information behaviour, seeking and searching. For example Marchionini's identified three subprocesses within his Information Seeking Model (1995): 1) understand, 2) plan and execution and 3) evaluation and use (p. 59). Underpinning Wilson's (1997) general model of information behaviour are three information related phases: 1) context of information need, 2) information seeking behaviour, and 3) information processing and use which are affected by specific intervening variables and activating mechanisms, which can also be linked to need, find and use. Similarly Choo (2006) identified three key concepts underlying information

seeking models: "the recognition of information needs, looking for information, and the use of information" (p. 57). Marchionini (1995) and Wilson (1997) were examining individual information behaviour, while Choo (2006) was examining organizations. To date this information behaviour lens has not been systematically applied to groups.

In both the "groups as information processors" and "information behaviour" perspectives part of the process occurs in the heads of individual members. However the information behaviour lens provides a way of identifying and examining the mechanisms that support complex information process in groups, by focusing on how the key information tasks are accomplished at the level of group interaction. Further, through the examination of group interactions, the cognitive processes of individual members at times become visible, and can be examined. Similar to the CWA approach, the information lens allows the information tasks to be examined within a particular context and situation, providing a way of looking at the connections between information tasks and work. The information behaviour lens can accommodate examination of behaviour over time.

1.4.4 Application of the Information Behaviour Lens to Group Work

To highlight the particular problem posed in this research, Figure 2 below, modified from Toms, Toze, & Kelley (2007) was used to help frame the key elements, applying the information behaviour lens to make *information* within group work visible. This figure synthesizes elements from the process focused approach to groups; specifically, it puts group processes, the work task and group information process at the core, and tries to understand how the unique characteristics of groups (summarized in Table 1) in contrast to individuals, affects the process of identifying information needs, finding, and using information, during task work and over time.

The common input, process output (IPO) model of groups (i.e., Kraut, 2003) has been adapted in Figure 2 to highlight the key elements related to how groups work with information, and integrate them into a holistic framework. As highlighted above, groups exist within a particular environment, which may include a particular organization or set of organizations, but also an industry, a country (or countries), and other contextual factors. The key ingredients of groups include: 1) the individual members, who bring their own prior knowledge, skills, and history; 2) the tools and technologies the group has available to them; 3) as well as the information resources; and 4) the objectives and goals

the group needs to accomplish. Individual group members work together over time, using these resources to achieve their particular objectives and goals (McGrath, et al., 2000).

Work tasks represent the specific piece(s) of work that groups need to accomplish. The work task is the centre, as it is through the process of completing the tasks that individuals must interact, work together, and apply their resources (e.g., Cohen, 1994). For example a group could be created to evaluate a program. Members might be assigned to the group to reflect all the various stakeholders. The group may be given a specific set of tools, according to the organizational standards, to use to accomplish their task. The members would each bring their unique knowledge, aptitudes and skills. The group would need to identify all the different types of information required to accomplish their evaluation, and then collect this information, analyzing and synthesizing it to complete their task. As part of their work, the group would need to build a shared understanding of this task, through discussion and sharing information. Members would need to remain aware of what others were doing, and any changes in their environment. The group might decide to distribute specific pieces of the task to individuals, based on their specific prior knowledge or experience. These pieces would need to be integrated into the final report. Depending on the complexity of the evaluation, there may need to be multiple cycles of information seeking, and report drafting. In all likelihood, this evaluation task would include multiple subtasks, each with their own conditions and deadlines. This process might be repeated multiple times. In summary, to accomplish their goals, groups need to develop a shared understanding of the task requirements, individual responsibilities, how the work should be done, and remain aware of the activities of other members (Kozlowski & Ilgen, 2006; Soliman, Braun & Simoff, 2005).

Work tasks structure the actions of groups, and the outcomes reflect their objectives. Three of the outcomes illustrated below are familiar to group models (e.g., Hackman, 1987; Ilgen et al., 2005; Kraut, 2003) identifying organizational (task completion), group (group sustainability and individual (individual goals/motivation) effectiveness measures. Knowledge transfer has been added as an explicit outcome to emphasize the need to manage the knowledge gained through groups as an organizational resource. While the model is drawn in the form of an input/process/output, time has been added as an element. The IPO cycle is iterative and adaptive over time.
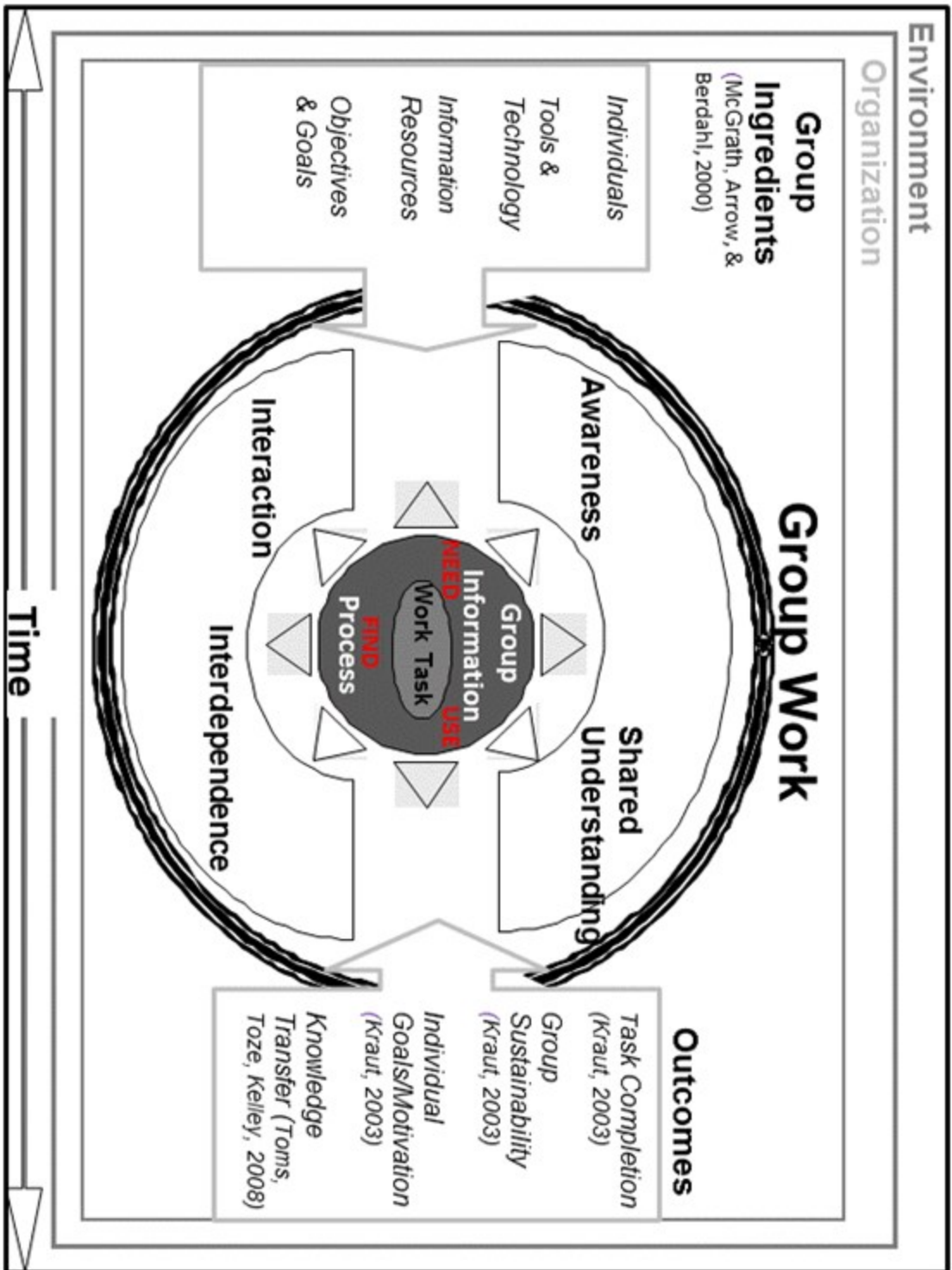
Figure 2   Positioning Group Information Process in Group Work

Figure 2 (above) helps to frame GIP. In addition it helps us "see" information in group work. Information is often present only in the minds of group members, making it challenging to examine and understand. In this figure, information is present within individual group members, within the information resources available to the group, as well as within the organization and environment. Ideally the group determines its needs, finds information, taking bits and molding them into something novel to complete their task, creating new knowledge, enhancing the knowledge base of each individual member, and coordinating their work processes. This information process is achieved through group interactions, and facilitates interdependence, awareness, and shared understanding. Exactly how this happens - the centre of Figure 2 - is the subject of this research. Both the task and the process of the group act as a stimulus. They create the need for information and trigger the information process that results in the achievement of the group outcomes. The information process, as illustrated, is constrained by many factors including: the information resources available to the group; the information known by individual members (e.g., Stasser & Titus, 2003); the willingness of members to share information (e.g., Choo, 2007; Widén-Wulff, & Davenport, 2005); the ability of the group to evaluate and assess information (Tindale, & Sheffey, 2002), as well as the context of the task (Fidel et al., 2004). The focus of this research will be on the *mechanics* of the process. What is required at the group level for groups to be able to accomplish their information tasks effectively? It is this level of detail that the information behaviour lens is able to reveal.

McGrath (1984) suggests that conceptual frameworks are helpful when studying groups, as they provide a map or a guide through the complex layers that could affect the research problem. This framework (Figure 2) provides the following advantages: 1) it situates GIP within the entire system, including the environment, the organization, the individual, time, technology, and the work task, 2) it focuses attention on the group level, 3) it includes consideration of the three key information tasks, and 4) it allows information to be traced.

However, it would be impossible to examine the whole system at one time. The frame also allows parts of the whole to be isolated and examined separately, recognizing they will have to be fit back into the model. This current research focuses on the centre,

examining how groups work with information to accomplish tasks. The relationships between tasks, groups, and information are systematically examined in this study, to identify the mechanisms through which groups seek and use information.

1.5 Studying Students

As noted by McGraw et al. (2000), it is not possible, or useful, to study a generic "group". Situation and context matter. The original plan for this research was to recruit work groups from private organizations. However the need for rich longitudinal data, and the concern with time, resources and confidentiality, meant that using a workplace setting would have been problematic. Obtaining informed consent to record all interactions in corporate groups meetings would have been challenging.

Instead an academic setting was purposefully chosen. In an academic setting, the work of students is to complete assignments. The recruitment of groups of students who were working on real course assigned projects, outside of this study, enabled rich observational data from motivated participants to be collected and analyzed.

The use of student work groups was intentional. Group work has increasingly become a common element of higher education. Practical issues such as larger class sizes, as well as pressure from the workplace for students who have "team skills" are partially responsible for this increase in group work in universities (Burdett, 2003; Colbeck, Campbell & Bjorkland, 2000; O'Farrell & Bates, 2009). There are also pedagogical reasons; cooperative and collaborative learning have consistently been linked to deep learning, and developing higher order thinking skills, social skills and civic values (Johnson, Johnson & Smith, 2007; Shimazoe & Aldrich, 2010). Student based group work however, does not always meet expected goals (e.g.; Batra, Walvoord & Krishnan, 1997; Burdett, 2003), in part because of the lack of tools to support student based project work, as noted by Whatley (2009), and because we do not have good models of how groups work with information to complete complex, cognitive learning tasks (Tanni & Sormunen, 2008). As noted by Johnson and colleagues (2007) we need a much fuller understanding of student group work as a process. The decision to use students allowed for data at the group level to be captured from multiple groups in an efficient manner, and answered a specific research need.

1.6 Research Objective and Questions

Knowledge based groups use information at their main resource for accomplishing tasks. To date we do not have strong conceptualization of the process through which a group, rather than an individual, or an organization, identifies information needs, seeks and works with information to transform it into something new. Yet this information process is at the heart of what makes a group effective (e.g., Gardner et al, 2012; Hackman and Katz; 2010).

The objective of this research is to address this gap by deconstructing knowledge intensive group work at the level of group interaction, by applying an information behaviour lens to better understand when and how information needs emerge during group work, when and how groups find information, and how this found information is evaluated and integrated by student groups to create something new. By deconstructing knowledge work in this way, a more robust understanding of information process within student group work will be gained, which can guide the development of tools and interventions to better facilitate GIP, ultimately leading to more effective groups.

To address this objective three main research questions are posed:

Question 1: Which phases of group and task activities prompt students to identify information needs, find and use information, and how can these phases be characterized?

Question 2: How are the key information tasks (need, find and use) negotiated within each of the phases of student group and task activities?

Question 3: How can the information process of student groups be defined and modelled?

The first question is procedural. Information is required to complete tasks and manage group processes. The first priority is to identify the common phases of activity within student groups which trigger the need for information. The second question applies an information behaviour lens to filter group work and identify *how* groups identify needs, find and use information to accomplish complex knowledge based tasks. The third question seeks to describe and model student GIP. These questions are discussed in detail in Section 3.2.

Studying the information process associated with groups is a relatively new concept with very little comprehensive research completed to date, as noted by Saleh (2012). This current research extends our fundamental understanding of information behaviour by examining information seeking, sharing and use at the group level. The findings can be used to ground future research on group information behaviour. This study adds to the knowledge of the information aspects of group processes. In addition, the output of this study may influence the development of group knowledge systems from intranets to search engines, and specialized software such as decision support systems, libraries, and collaborative search systems.

1.7 Research Design

The objective of this research is to illuminate a group level phenomenon. Studying groups presents particular methodological challenges (i.e., Hackman & Katz, 2010, Convertino et al, 2004; McGrath et al., 2000). It is currently recognized that groups are complex adaptive systems, yet they have frequently been studied by creating "ad hoc" groups for a single meeting, introducing them to tools, or to an intervention, and giving them artificial tasks and limited time (e.g., Hackman, 2012; Stasser & Titus, 2003). The experimental method allows variables to be controlled, but group members are not motivated as they would be in the real world, and their work processes might not reflect authentic practice (McGrath et al, 2000; Kraut, 2003). This method does not allow for changes in groups over time. Alternatively, groups have been observed in the field, often over time, generating rich detailed descriptions of group processes. Such ethnographic methods can be challenged by the time and space dimensions and by the constraints of real world settings, including privacy (e.g., Fidel et al., 2004). Additionally the findings of these studies may be difficult to transfer to other settings.

To overcome these limitations, a new method for studying groups was designed and tested in this research to bring the "real" world into the lab; a "Naturalistic Lab Study". This method allowed the unique attributes of the group level (interaction, interdependence, awareness and shared understanding) to be observed and analyzed. The Naturalistic Lab Study design involved examining real groups, working on authentic tasks and interacting over time, and allowed for the monitoring the group and its

activities in a controlled setting. The study design represented a final contribution of this work.

1.8 Outline of the Dissertation

This dissertation is organized to reflect the multi-study design. Chapter Two begins by defining group information process and its key constructs (group processes, work tasks, information tasks) and introducing the information lens used in this research. Prior research on groups and information is reviewed from three perspectives: group seeking, group search, and group sharing. Chapter Three discusses the key research objective and questions, compares the common data collection methods for groups, and provides the details of the Naturalistic Lab Group Study design, which was used to collect the data for the two studies. The research protocol is presented in detail. Chapter Four (Single Session Groups) includes the details and findings of four groups that required a single session to complete their tasks. Chapter Five (Multi Session Groups) has a similar format, presenting the participants and results of three groups that completed their course based assignments over multiple sessions. Chapter Six allows for the synthesis across both studies providing integration and discussion of the main findings. Chapter Seven presents the contributions, limitations, and future research plans.

2.0 Introduction

As illustrated in Figure 2, examining group information process (GIP) involves unraveling the relationship between group processes, work tasks and information tasks (need, find, use). This dissertation is focused on the centre of the figure, specifically on the phenomena depicted below (Figure 3).
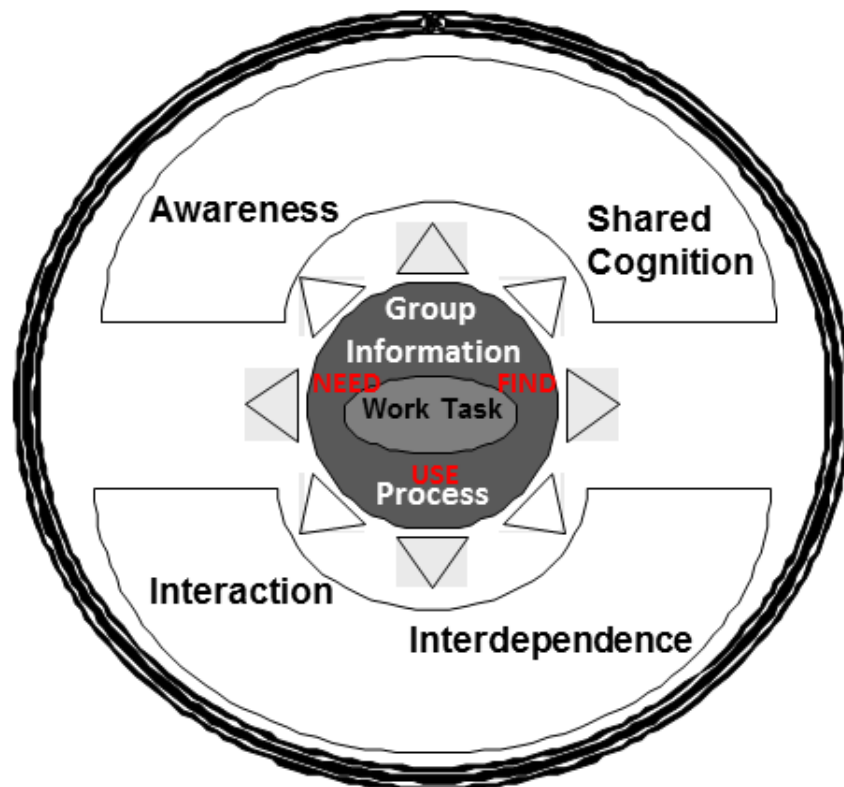
Figure 3   Group Information Process within Group Work

This chapter provides a review and synthesis of these key constructs: group processes, work tasks and information tasks, and provides details regarding the information behaviour lens used in this research. Each of these constructs incorporates a large body of research. For this study, the scope has been narrowed to include research that directly relates to how knowledge based groups identify their information needs, find and use information to accomplish intellectual tasks. The focus is specifically on collocated

synchronous groups. For this reason research on the social interactions in groups, including the examination of conflict, power, status and leadership has been excluded. So has the research that examines changes in the individual in group situations, and on virtual groups. Further the phenomenon of interest is the mechanisms through which groups work with information, rather than the contextual factors. As noted in Chapter 1 (Section 1.4) the social and contextual aspects of group work are critical, but they are outside the scope of this study. Spence (2013) has recently examined the contextual factors of collaborative information seeking, while Tsai (2012) and Choo (2007) have examined social aspects of information sharing in groups.

This chapter begins by examining the proposed construct central to this work - "group information process". GIP is not an end in itself, but results from the need to coordinate group processes and accomplish work tasks. These constructs are examined next. Information Behaviour, the perspective used to frame this research is then described. Following, the information tasks and the information activities necessary to accomplish the work tasks are discussed in terms of how they apply at the group level. Prior research on information and groups is presented from three perspectives: group seeking; group search; and group sharing. Then the prior research on information behaviour of student groups is highlighted. The chapter ends with a summary which identifies the gaps this research seeks to address.

2.1 Group Information Process

This section first explores how collaboration during information needs, finding and use tasks has been conceptualized. Emerging definitions of collaborative information are examined and reviewed in terms of how well they fit the group level, as defined in Chapter 1 (Sections 1.1 to 1.3). An initial definition of GIP is suggested, as a starting point for this current research.

2.1.1 Examining Definitions of Information Collaboration in Groups
As Table 2 below (adapted and updated from Toms, Toze & Kelley, 2008) illustrates, the emerging work on collaboration and information has generated overlapping definitions and concepts with no overarching or integrative framework. These definitions were

collected from relevant work in multiple disciplines (e.g., Information Science and CSCW, and Social Psychology). The table is not intended to be exhaustive, but represents the range of phrases deployed to represent similar concepts or processes.

The definitions have been organized from higher concepts to more specific. The first several definitions (1-7) are at a higher conceptual level, and represent collaborative information behaviour, or collaborative needs and seeking. The next several (8-12) are more specific, but still refer to information seeking and retrieval. Definitions 13 through 19 are specifically about search. Information sharing (20-22) is an area of growing interest, not only within information science but also in small group research. Definition 23 is specific to the synthesis process of scientists.

Some of the concepts of collaborative information seeking mirror those from the study of individuals (i.e., Wilson's (1999) nested model and definitions of information behaviour, information seeking behaviour and information search behaviour). Others relate specifically to collaborative environments (information sharing, information synthesis). The same words are used in multiple definitions, (information behaviour, information retrieval), but not necessarily in the same way. For example in the work of the Washington Group (Bruce et al., 2003; Fidel et al., 2004; Poltrock et al., 2003), the authors state that they are examining information retrieval, while their definitions seem to indicate a broader scope, one that includes seeking.

Given the unique characteristics of groups identified in Chapter 1 (Table 1), and the attributes of group collaboration (Section 1.3) the definitions below provide a good starting point, but none seem complete. For example, the combined definitions of Collaborative Information Behaviour of Talja & Hansen (2006) (2) are potentially useful. The first part focuses on communication and identifying information seems too narrow; the second part provides a good overview of the range of necessary activities, except for sharing, which they define separately. They use the word "interaction", which does indicate collaboration, but it doesn't indicate shared views and goals, which are needed to fully support awareness in group work.

Alternatively, Hyldegard's (2006) definition (4) highlights the activities, thoughts and feelings of users, but focuses on the "individual as group member" not on the group level. Defining the task as "problem solving" is too narrow, and the use of the term

"involving" may be too passive, and one directional. The concept of sharing, essential for group work is missing. Hertzum's (2008) definition (6) of Collaborative Information comments directly on what makes group level information processes unique; the need for information seeking and sharing, which involves not just sharing information but shared understanding. However, this definition seems to lack a broad definition of information tasks. Foster's (2006) definition (7) focuses on systems and practices but does not acknowledge needs or sharing as essential stages, or include context. Also while this definition is broad enough to encompass many types of collaborative activities, it does not reflect the unique qualities of groups.

Fidel et al.'s (2004) definition (11) focuses on acquiring new knowledge through external resources. It does not include sharing, which might be too restrictive. Their research objective was to isolate collaboration in information seeking and retrieval, but in a collaborative situation sharing is necessary to let others know what has been found, and potentially how it was found. In contrast, Hinsz et al.'s (1997) Group as Information Processors definition (21) emphasizes the cognitive aspects, but does not include the affective or behavioural elements, and only includes information sharing.

Some of the definitions focus on particular processes. The idea of Collaborative Indexing (22) is unique, and Blake & Pratt's (2006a) definition (23) of Collaborative Information Synthesis is helpful for understanding collaboration in science and research based fields. Within the definitions of search there is a clear differentiation between activities where there is a shared goal, and less tightly coupled searching.

The definition from Wikipedia (5) was added as it demonstrates the range of definitions, concepts, and the overlaps between them which indicate that this area of research is still developing. There is no clear consensus on a definition, or a set of definitions, as recently noted by Shah (2014).

Table 2   Representations of Collaborative and Group Information Concepts

	Concept and Source	Definition
1	**Collaborative Information Behaviour (CIB)** (Foster, 2010, p. xiii)	"the study of collaboration with, through, and in relation to information; along with the systems and practices that support this"

	Concept and Source	Definition
2	**CIB** (Talja & Hansen, 2006) (p. 114)	"broadly defined as an activity where two or more actors communicate to identify information for accomplishing a task or solving a problem" AND "CIB includes processes of problem identification, analysis of information need, query formulation, retrieval interactions, evaluation, presentation of results, and applying results to resolve an information problem"
3	**CIB** (Saleh, 2012, p. 20)	"the totality of human behavior, when two or more people work together, in relation to sources and channels of information, including both active and passive information seeking and information use
4	**CIB (**Hyldegård, 2006, p. 277)	"The physical activities and cognitive and emotional experiences of individuals acting as group members, engaged in a collaborative problem solving process involving information (seeking) behaviour."
5	**Collaborative information seeking (CIS)- Wikipedia, Wikipedia** (accessed November 28th, 2011)	"Collaborative information seeking (CIS) is a field of research that involves studying situations, motivations, and methods for people working in collaborative groups for information seeking projects, as well as building systems for supporting such activities. Such projects often involve information searching or information retrieval (IR), information gathering, and information sharing. Beyond that, CIS can extend to collaborative information synthesis and collaborative sense-making."
6	**Collaborative Information Seeking (CIS)** (Hertzum, 2008, p. 960)	"information –seeking activities performed by actors to inform their collaborative work combined with the collaborative-grounding activities involved in making this information part of the actors' shared understanding of their work"
7	**Collaborative Information Seeking and Retrieval** (CIS&R) (Foster, 2006, p. 330)	"The study of the systems and practices that enable individuals to collaborate during the seeking, searching, and retrieval of information".
8	**CIS** (Shah, 2008, p. 1)	A process of information seeking "that is defined explicitly among the participants, interactive, and mutually beneficial"
9	**CIS&R** - (Hansen & Klas, 2007 p. 67)	"Collaboration related to information seeking and retrieval may include sharing the same need for information, search strategies and results and further processing of the retrieved information: interpretation, filtering, synthesis or archiving potentially useful information into group repositories"
10	**Collaborative Information Retrieval** (CIR) (Poltrock et al, 2003, p. 239)	"the activities that a group or team of people undertakes to identify and resolve a shared information need" [NOTE – scope is broader than just retrieval. More aligned with **CIS&R**]
11	**CIR** (Fidel et al, 2004, p. 944).	"any event in which actors who participated in the same work process collaborated to resolve an information problem that required them to use resources external to their knowledge"

	Concept and Source	Definition
12	**CIR** (Hansen & Järvelin, 2005, p. 1102)	"CIR is an information access activity related to a specific problem solving activity that, implicitly or explicitly, involves human beings interacting with other human(s) directly and/or through texts (e.g., documents, notes, figures) as information sources in an work task related information seeking and retrieval process either in a specific workplace setting or in a more open community or environment". [*NOTE – scope is broader than just retrieval. More aligned with CIS&R*]
13	**Information Acquisition** (Deeter-Schmelz & Ramsey, 2003, p. 411)	"collection of information from sources external to the team" [*Note – Equivalent to CIS&R, but from an group perspective*]
14	**Group Searching** (Twidale, Nichols, & Paice, 1997)	"Group searching takes place when two or more people share a common aim, and choose to coordinate their searching efforts. For group searching to be efficient, frequent interchanges need to take place between the members concerned." [Note - *Equivalent to CIS&R*]
15	**Synchronous Collaborative Information Retrieval** (Foley, Smeaton, & Lee, 2006 p. 42)	"group of users who are searching together at the same time in order to satisfy the same, shared information need" [Note - *Equivalent to CIS&R*]
16	**Joint Information Seeking** (Veinot, 2009, p. 2318)	"two people with a shared information need simultaneously (and voluntarily) looking for information from print sources, the Internet and/or other people". [Note - Equivalent to CIS&R]
17	**CIR** (Foley, Smeaton, & Lee, 2006 p. 42)	"the user-user collaboration which can occur in the information retrieval process
18	**Collaborative Search** (Morris & Teevan, 2010, p. 73)	The subset of social search where several users share an information need, and actively work together to fulfill that need.
19	**Differentiated Group Searching** (Twidale, Nichols & Paice, 1997 p. 768)	"when members of a group are working in the same area - perhaps the same project-but their specific searching aims are different"
20	**Information Sharing** (Talja & Hansen, 2006 p. 114)	"incorporates both active and explicit and less goal oriented and implicit information exchanges". "Information sharing is about sharing already acquired information…" *[Note - contrast to CIS&R]*
21	**Groups as Information Processors** (Hinsz, Tindale, & Vollrath, 1997, p. 43)	"At the group level information processing involves the degree to which information, ideas, or cognitive processes are shared, and are being shared among the group members and how this sharing of information affects both the individual and group level out-comes." [*Note - Equivalent to sharing*]
22	**Collaborative indexing** (Ehrlich & Cash, 1994 p. 7)	"In group meetings as well as face-to-face discussions, analysts would freely refer to people inside and outside the organization, to information in the "knowledge" database or other databases as sources of solutions to a particular problem. This is one of the ways in which people help each other sift through information and can be thought of as a form of collaborative indexing" [*Note - Equivalent to sharing*]

	Concept and Source	Definition
23	**Collaborative Information Synthesis** (Blake & Pratt, 2006a, p. 1748)	"during synthesis activities, scientists provide two information constructs (the hypothesis projection and context information) and engage in four critical tasks (retrieval, extraction, verification and analysis). Our results suggest that synthesis is a collaborative rather than an individual activity, and that a scientist will iterate both within and between critical tasks."

2.1.2 Defining Group Information Process

None of these emerging definitions fully reflect the group level. A definition specific to groups needed to be developed for this research to reflect how *groups* work with information to accomplish tasks, referred to as "group information process". The word "process" was deliberatively chosen for this research rather than "behaviour". Process is defined in the Oxford English Dictionary as "a continuous and regular action or succession of actions occurring or performed in a definite manner, and having a particular result or outcome; a sustained operation or series of operations." (OED Online, June 2013). Additionally, in reference to social science, the OED adds the following definition: "The continuing interaction of human groups and institutions, esp. as observed through its effects in social, political, cultural, etc., life, with the aim of finding underlying patterns of behaviour in the available data"(OED Online, June 2013). The word "process" integrates the key group elements of interaction and interdependence, and refers to patterns of behaviour, which is appropriate given the objectives of this research.

As such, this research seeks to provide a robust definition of GIP that recognizes and incorporates the unique characteristics of groups. As a starting point the following definition is proposed: *GIP involves members' interdependent acts involving information tasks and activities, tools and sources that enable groups to manage their work tasks and work together over time.* This definition has been revised and extended through the process of this research (see Section 6.3).

2.2 Group Processes

As illustrated in Figure 3 above, GIP emerges from the work task and from group processes. To investigate GIP these relationships needed to be unravelled. The next

section examines the construct of group processes, and identifies a model that was used in this current research.

2.2.1 Definition of Group Processes

"Group processes" is a construct used to broadly describe how individual members work together to combine their individual resources, knowledge and skills to facilitate task accomplishment over time (Kozlowski & Ilgen, 2006). Essentially the term "group processes" is used to describe *how* groups work together. Given that groups are complex adaptive organisms, much of group processes are emergent; they are created through the way members work together, and become patterned or structured over time (e.g., Cohen & Bailey, 1997; Hackman, 2012; Marks et al., 2001; McGrath, 1984). The concept has been examined, defined, and modelled for the last century; however it remains elusive. As noted by Ilgen et al (2005), the goal of understanding group interactive processes has been hampered by a proliferation of overlapping constructs, fragmentation and issues with measurement. There has also been a lack of distinction between the individual and the group level. To clarify the concept, Marks and colleagues (2001) investigated how "group processes" had been examined in group literature over time. Based on their meta-analysis of the construct, they suggest the following definition of group or team process which is used in this study: "members' interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward organizing task work to achieve collective goals" (p. 357).

2.2.2 Group Process Models and Frameworks

In addition to a lack of definitional clarity, there have been multiple attempts to model group processes, from varying perspectives. These models emerged in response to the recognition that interaction in small groups appears to be structural in nature; while group interactions are complex, dynamic and episodic, patterns can be identified (e.g. Crawford & LePine, 2013; Ilgen et al, 2005; McGrath et al, 2000). Perhaps the most well-known model of how group members work together is Tuckman's development sequence in small groups (Tuckman, 1965; Tuckman & Jenson, 1977), which describes how groups evolve through stages of forming (orientation), storming (intergroup conflict), norming (development of group cohesion), performing (productive) and adjourning (separation).

This model has been used in the examination of information seeking in student groups (e.g., Hyldegård, 2009). However the development sequence focuses more on the social development in groups, which is not the focus of this study, and suggests a linear progression in groups, which has been questioned (e.g., Gersick 1988, 1989).

Gersick (1988, 1989), based on her examination of the interactions of eight field and eight laboratory groups proposed an alternative model. In contrast to the development described by Tuckman (1965; Tuckman & Jenson, 1977) she found groups alternated between two different patterns of activity. Gersisk described how groups would experience long periods of stasis, where there was little activity. This would be followed by a brief periods of transition, where there were concentrated bursts of activity, new perspectives adopted, and progress was made. After these transition periods, the group would resume an inert stage. The transition periods were found to occur at precise points. At the midpoint between their start and deadline, groups would experience their first transition phase, then a second as right before their finish. Gersick suggested this pattern of work could be described as punctuated equilibrium. The midpoint of the work task was identified as the critical factor, and this temporal point created the need for re-evaluation and change in the group.

Gersick's model was generated from her detailed analysis of group interactions in both the field, and the laboratory. While this model suggested an entirely new way of understanding how group processes are organized in time, Chang, Bordia, & Duck (2003) suggested the two perspectives (punctuated equilibrium and the development sequence) could be reconciled. They examined groups and found some evidence that the changes in time and task awareness followed the punctuated equilibrium model. Changes in structure, the process on the task, and social aspects of the group, followed a linear model.

Both approaches described above appear to link changes in the group to the progress through a single or main task over time. Yet groups more commonly work on complex tasks with multiple subtasks which may have different deadlines, and which may or may not be interdependent. As noted by Crawford & LePine (2013) "at any point in time, teams must manage task accomplishment in the pursuit of multiple goals requiring different contributions from their members" (p. 34). The models above do fully

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explain the processes required to manage multiple tasks and coordinate fluctuations in participation.

2.2.3 Recurring Phase Model of Group Processes

Recognizing the need for new models that better reflect the complex reality of groups (e.g. McGrath et al, 2000) prompted Marks and colleagues (2001) to develop a model that incorporated the dynamic and episodic aspects of group work (shown in Figure 4 below). Their model incorporated multiple cycles of inputs, processes and outputs, to accomplish phases of activity, within multiple tasks, and focused on the relationship between time and goal attainment.

The authors separated *how* groups work together from *what* they do (task work) which is discussed in Section 2.3 below. Noting that in practice the difference between process and task work is blurred, the authors separated the two in order to focus attention on the processes essential within groups to enable the completion of tasks. As depicted in Figure 4 below, their framework illustrated how groups manage multiple tasks, each with their own unique trajectory. Within each trajectory, however, there are recognizable shifts between recurring phases of transition and action. The transition phases are defined as "periods of time when teams focus primarily on evaluation or planning activities to guide their accomplishment of a team goal or objective" (p. 364), and are characterized by three sub activities: 1) Mission Analysis, 2) Goal Specification, 3) Strategy Formulation and Planning. In contrast the action phases involve coordination and are characterized by four processes: 1) Monitoring Progress; 2) Systems Monitoring; 3) Team Monitoring/Back up Behaviour; and 4) Coordination. Within each of these phases there are inputs, which are processed into specific outputs. This model identifies cycles of I-P-O relationships that occur within the different phases of activity.

Their framework also included interpersonal processes (not depicted) which occur across both phases and include processes related to conflict management (preemptive and reactive); motivation/confidence building and affect management.

This conceptual framework synthesizes and integrates previous work but has not been empirically tested. LePine, Piccolo, Jackson, Mathieu & Saul (2008) tested the framework through meta- analysis and found support for these three dimensions of team processes. This framework is useful for this research as it allows for the key phases of

group activities to be characterized and examined in terms of information related tasks and activities. It recognizes that each phase has individual cycles where information is added, processed and turned into outputs.

The Rhythm of Team Task Accomplishment
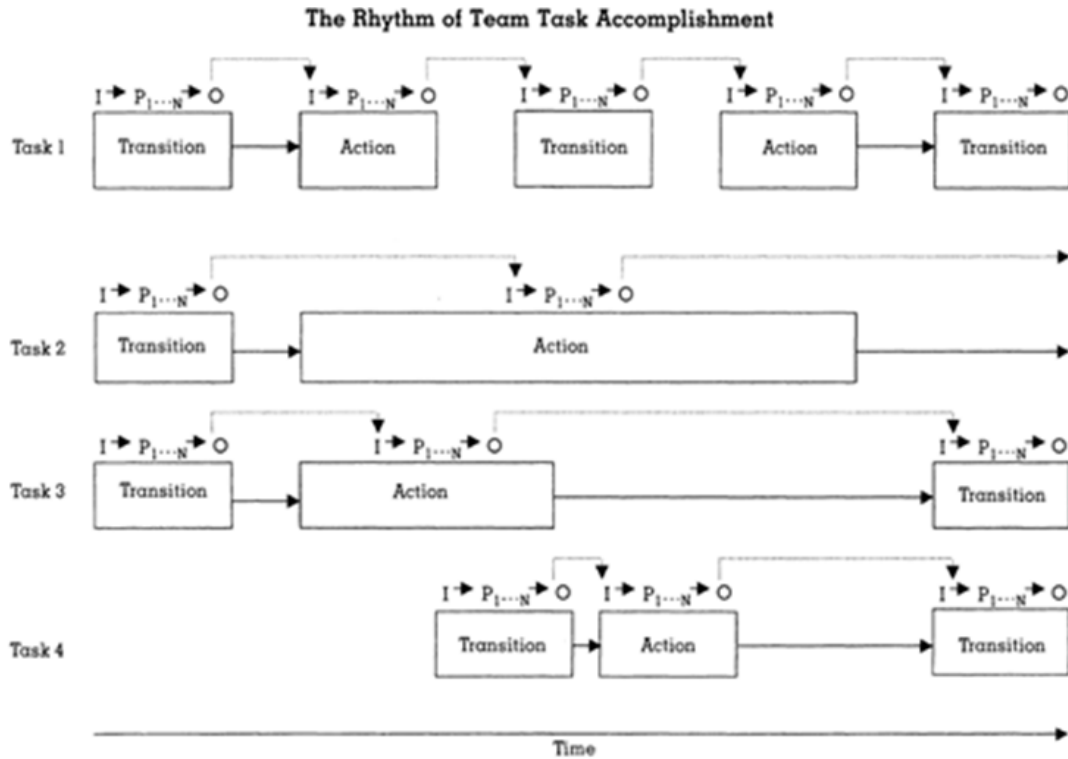
Figure 4   Rhythm of Team Task Accomplishment (Marks, et al., 2001 p. 361)

2.3 Work Tasks

Mark's et al.'s (2001) model helps identify phases in group work where information enters the system. Groups work with information to plan and coordinate their processes, but also to accomplish their work tasks. This next section looks at work tasks, and in particular group work tasks, to examine how a task based approach could be used to understand GIP.

2.3.1 Conceptualizing Work Task

In his Principles of Scientific Management, Taylor (1911) commented, "perhaps the most prominent single element in modern scientific management is the task idea" (p. 15). Research on groups and information comes from multiple disciplines, but work task remains a central concept across all. A work task is commonly understood to indicate a

specific piece of work that needs to be accomplished to meet a goal (Freund, 2008; Byström & Hansen, 2005). However, moving from this common understanding of a work task is problematic. "Task" is used to describe a specific piece of work at various levels of granularity, depending on the goal. For example in CSCW the moving a curser is called a "task"; while in group research a "task" might be a complex assignment given to a group.

Regardless of the level, work tasks have a beginning and an end, and have requirements, which may be conditional or unconditional (e.g., Byström and Hansen, 2005; Toms, 2011). Gill and Hicks (2006) provide a very general idea of a task, suggesting it is a set of assigned: a) goals to be achieved, b) instructions to be performed, or c) a mix of the two. Tasks involve physical, cognitive, and affective actions. There is a goal or reason associated with the purpose of a task, and an outcome or result expected at the end (Toms, 2011; Byström & Hansen, 2005).

Toms (2011) provided an anatomy of a task (Figure 5 below) that identifies the key elements and provides a common framework and language for the discussion of task in information seeking research. This was used as a base for this research, but with a focus on the group as the actor.
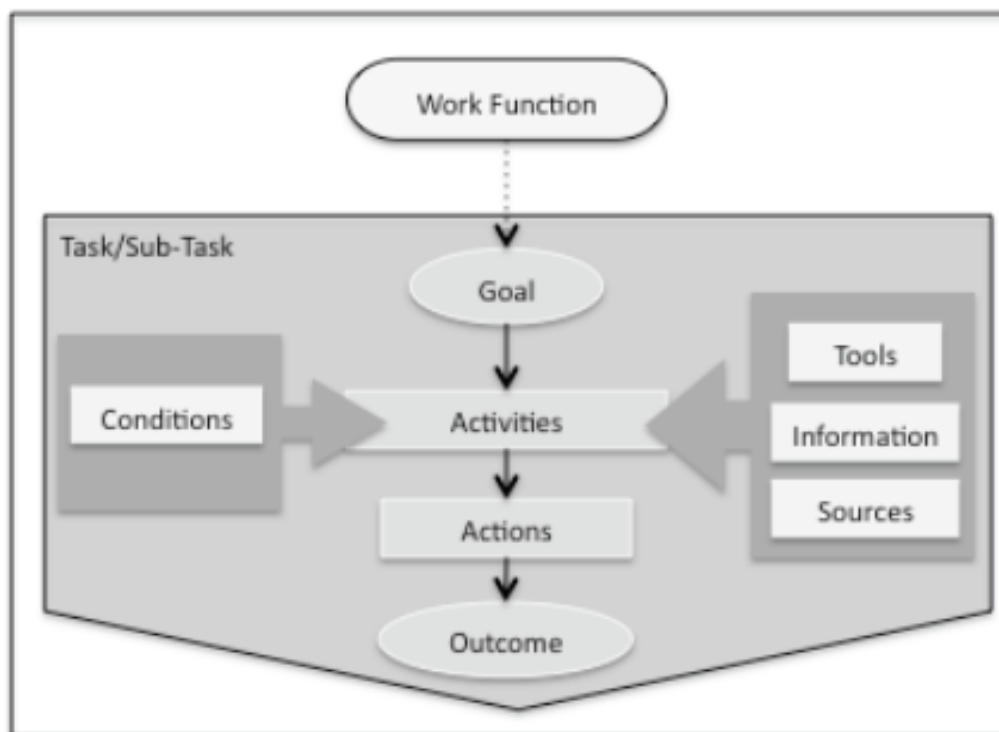
Figure 5   Anatomy of a Task (Toms, 2011 p. 46)

2.3.2 Group Work Tasks

Task work in groups involves "members' interactions with tasks, tools, machines and systems to carry out the team's work" (Crawford & LePine, 2013, p. 32). Work tasks provide groups with their goals and determine the roles and exchanges that will be necessary for the group (Kozlowski & Ilgen, 2006), as well as the tools that may be required. For example a group working on a design task may organize itself differently than a group working on a strategic task, and their use of technology may vary. Task has been identified and included in models of group effectiveness, and taxonomies of generic group tasks have been created (e.g., McGrath, 1984 and Hackman, 1987). These models have not been extended to include information search and seeking based tasks and activities. To date there have been no systematic examinations of group tasks and the resulting group information process.

To unravel GIP it is essential to understand if there are common types or categories of work tasks performed by groups. Many attempts have been made to identify and categorize the common or generic types of tasks that may be common across groups (i.e. Hackman, 1969; McGrath, 1984; Kim & Soergel, 2005), yet there is still not one agreed on, and consistently used taxonomy.

McGrath's group task circumplex (1984) has been used as a theoretical basis for numerous empirical and conceptual articles (i.e. Straus, 1999). It identifies four key task types, each with two subtypes: Generate (planning tasks, creativity tasks); Choose (intellectual task, decision making task); Negotiate (cognitive conflict task, mixed-motive task); and Execute (contests/battle; performance).

This taxonomy grew out of previous group research, including Hackman (1969), who identified three distinct group task types: Production tasks, Discussion tasks and Problem Solving tasks. The aim of McGrath's (1984) task circumplex was to create categories that were mutually exclusive. For example, under the category *Choose*, whether a task is classified as a decision making task or an intellectual task depends on the nature of the problem. If the task involves group members choosing an outcome where there is a knowable or correct answer, it is an intellective task. Alternatively, if the task involves making a decision where there is no real answer, it would be classified as decision making. This taxonomy has been used frequently in research where there is an

assigned task, where the task could be created to fit the relevant category (i.e. Straus, 1999).

Another scheme was proposed by Campbell (1988), who classified tasks into four categories: Decision, Judgment, Problem, and Fuzzy, based on the task complexity. Task complexity was defined as a function of the following criteria: the number of paths to the solution; the number of goals; the interrelated subtasks; and the degree of uncertainty.

Algon (1999), in her examination of the effects of task on the information-related behaviors of individuals in work groups in a drug company used McGrath as a starting point. She found seven categories of tasks, which were then organized into three "meta categories". The first, Administrative and Communicative/Facilitative tasks related to Interactions with People. The second, Information Manipulative, Analytic, Strategic Formulative/Design tasks involved Interactions with Ideas. The third category, Operative/Generative tasks were linked with Interactions with Things.

Group or collaborative tasks have also been examined at the procedural level or mechanical level; identifying the "small scale actions and interactions that group members must carry out in order to get a task done in a collaborative fashion" (Pinelle et al., 2003, p.287). The authors identified, for example, the mechanical activities related to communication and coordination in groups. Communication included both explicit communication and information gathering. Explicit communication included actions related to talking and writing through to drawing, pointing, or stylized actions. Information gathering was not defined in terms of searching for information (as in Information Science), but related to awareness issues, to being able to "see" who was in the workspace, see what they were doing, being aware of changes to objects or documents, or noticing gazes and informal chat. Coordination referred to how tools, objects, space and time were shared, as well as how objects or documents could be deposited and transferred. The authors did not include a description of the mechanics related to identifying information needs, or seeking information, core aspects of GIP. This study attempts to bridge this gap.

2.4 Information Behaviour Lens

2.4.1 Overview of Information Behaviour Research

The above sections provided an overview of the relevant research and theory on group processes and work tasks. The next sections focus on information. This research applies an information behaviour lens to group work to better understand new knowledge creation. The phrase "information behaviour" is used as an overarching concept to "describe the many ways in which humans interact with information, in particular, the ways in which people seek and utilize information (Bates, 2010, p. 2381). Information behaviour is considered an essential human behaviour (e.g., Case, 2012), but one that is not an end in itself. For example in a group situation, group members work with information to accomplish their tasks, and manage the process of working together. The challenge is how to unravel these layers. Reflecting on their case studies of collaborative information retrieval in design terms, Bruce et al, (2003) concluded that, "(f)irst and foremost, the concept of CIR became increasingly elusive as the researchers gained more knowledge about it" (p. 152). How can models and theories from information behaviour help with this challenge?

Information behaviour research began with studies of how specific user groups used particular sources, shifting then to the examination of how formal information systems were used, and more recently focusing on the user, and investigating all the ways they find and incorporate information, including concepts such as serendipity, information avoidance, and use of social tools (e.g., Case, 2012). The focus has broadened from examining professionals to looking at everyday life information seeking, and use of social media.

As the types of studies and phenomenon of interest have increased, there has also been a growth in models and theories to help understand information behaviour in specific contexts. To help organize and understand these models, Wilson (1999a) created a nested model to illustrate the relationships between models in the field (Figure 6 below). Information behaviour is the highest concept, which includes the examination of all activities related to identifying the need for information, searching through any means for that information, and then using or transferring the information (Wilson, 1999b).

There are few models that attempt to explain this level, with the exception perhaps of Wilson's 1981 model shown in Figure 7 below. Information seeking is a more specific concept, and relates to "the purposive seeking for information as a consequence of a need to satisfy some goal" (Wilson, 2000, p. 49). Kuhlthau's (1991) information seeking process model and Ellis's (1989) behavioural model are examples from this level, as well as Choo's integrated model illustrated below (Figure 8). Information searching behaviour is the most specific, as it examines the set of activities or processes that people use to search for information in electronic resources, databases, or through the internet. This level considers humans and tools, and involves examining interfaces for information searching. Marchionini's 1995 model, illustrated in Figure 9 below is an example of a model designed to explain human behaviour while searching.
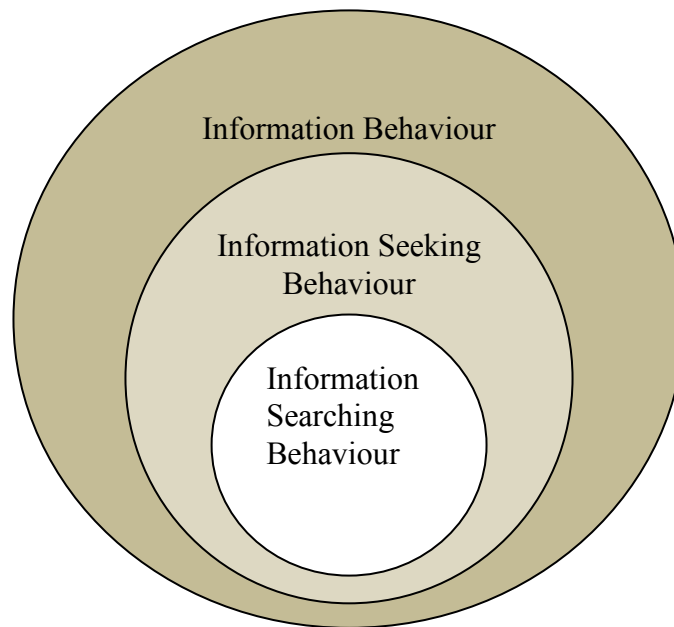
Figure 6   Adapted from Wilson's Nested Model of Conceptual Areas

This current research is interested in group information process at the highest conceptual level, and encompasses information seeking, and information search behaviours.

In addition to the nested conceptual model illustrated above (Figure 6), models in information behaviour can be organized in terms of other key attributes, including whether they are conceptual or process focused, and the degree to which they identify components and the relationships between these components (Toms et al, 2008).

Wilson's (1999) nested model is a conceptual one, while Marchionini's (1995) model is a process model that identifies specific stages in the search process, as well as the relationship between them. Almost all models to date focus on the individual as the information actor, except for Choo (2006) who has applied an integrated information seeking model at the organizational level.

To understand how information models can be used at the group level, three key models, one from each level, are examined below. First Wilson's (1981) model of information behaviour is considered (Section 2.4.2), followed by Choo's (2006) model (Section 2.4.3) and then Marchionini's (1995) model (Section 2.4.4). These models were chosen as they represent "general" models, and do not reflect a particular task or group of people (e.g. engineers). The goal of Wilson's model for example was to position all the key elements of interest in the examination of information behaviour, to guide future research. Choo's (2006) model looks at information seeking in organizations at a general level, and Marchionini's (1995) model of search emerged reflection of from multiple studies. From these models the focus on the core information tasks (need, find, used) used in this research emerged.

2.4.2 Wilson's First Model of Information Behaviour

While the model below (Figure 7) is called a model of information behaviour, Wilson (1981) clarifies that his aim was not to model information behaviour so much as to show the relationships between the concepts in the field at that time. Of note within this model is the attempt to look at the user experience holistically, recognizing that systems represent only one potential source of information. Further this model highlights the fact that "success" and "failure" at one stage might affect other steps or stages that users take. In terms of the application of this model for a group context, the use of the terms information exchange and information transfer are especially interesting. These terms highlight the communication and information sharing activities that are an essential part of group work. Information exchange within this model recognizes reciprocity; people don't just ask others for information, but can form mutually beneficial information relationships with them. Information transfer occurs when the information found by one individual is recognized as potentially useful to another person, and is passed on to them. This activity which could also be called "sharing" is discussed in Section 2.6.3 below.

Wilson' model is also useful in terms of recognizing the potential complexity of group information processes. For example, he suggests that information found through information seeking activities might satisfy the original need of the user (or users), or might satisfy another prior need. In outlining this holistic model Wilson also comments that much study has focused on users and formal information systems, and that studies of information use has been neglected. Wilson (1981) identifies that the mechanisms around information exchange have been studied more in sociology or in organizational theory rather than in information science. It is interesting that while Wilson noted this in 1981, these comments are still valid today. A goal of this research is to look at information seeking and sharing (or exchange) holistically and naturally, and to include a focus on information use.
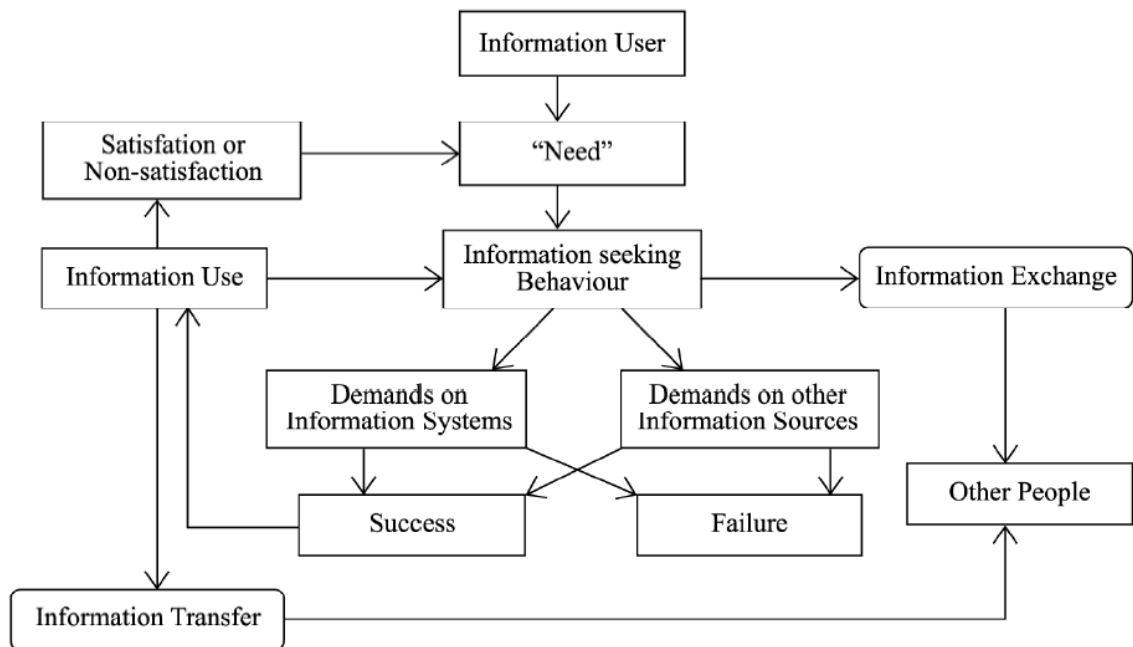
Figure 7   Wilson's First Model of Information Behaviour (Wilson, 1981, p. 5)

2.4.3 Choo's Integrated Model of Information Seeking Behaviour

As a framework for understanding information seeking within organizations, Choo (2006) created an "Integrated Model of Information Seeking Behaviour" (Figure 8 below), which brought together theories and models, including identifying cognitive, behavioural and affective factors as noted by Kuhlthau (1991). This integrated model is

defined in terms of three linked triangles, representing the three areas of information needs, seeking and use.

The information needs triangle reflects the process of perceiving a gap, working to clarify the need, and feeling the stress related to the uncertainly. Individuals within organizations will perceive information needs differently, based on their experiences and knowledge. In a given situation an individual may decide to suppress or avoid the problem, and not look for information. If the decision is made to actively seek information, then the individual moves to the information seeking triangle. Defined by their specific motivation or interest (the user is directed towards a goal), the individual would look for and assesses information. While this purposeful information seeking process is continuing, the individual may also receive incidental information, that they did not actively seek, but that impacts or affects their search process. Once information has been selected, the individual moves to information use, for example acting on the information gained to solve the problem. At the use stage, Choo (2006) suggests that how information is utilized is influenced by several factors including 1) the cognitive style of the individual, 2) their emotional responses to the information, 3) and the organizational or social context.
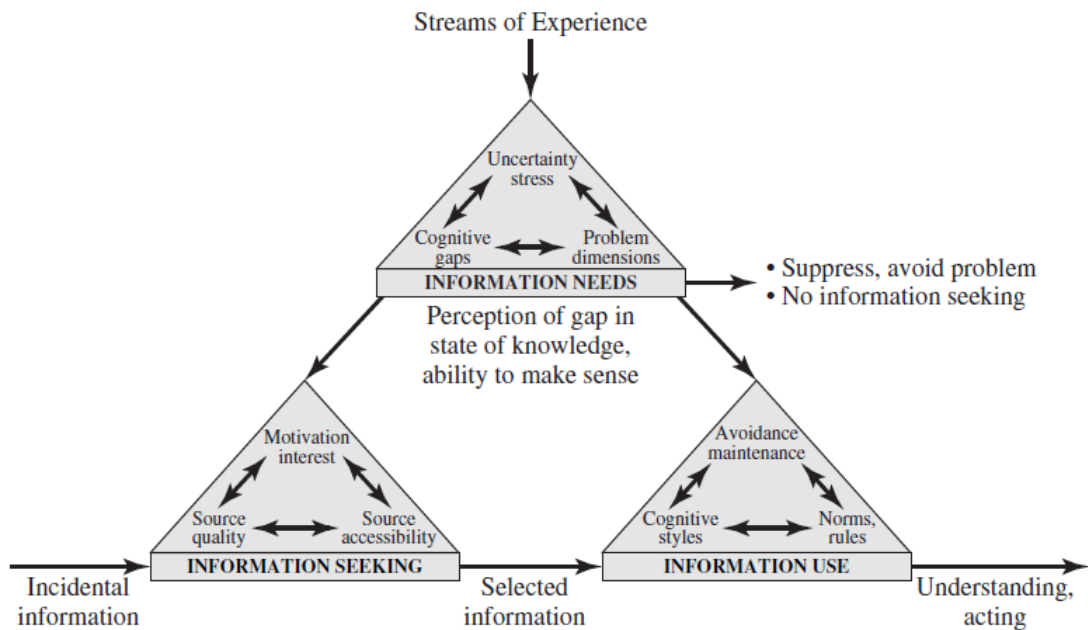
Figure 8   Information Seeking Behavior: An Integrated Model (Choo, 2006, p. 69)

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This model (Figure 8) examines the three key tasks involved in information seeking, and how they interact, as well as integrating and building on prior models of information seeking (e.g., Dervin, 1998). It does not specifically examine the systems level; if for example there is a difference in information seeking processes from people, versus through databases or internet sources. This model has several advantages as a tool to examine the group level. The representation of information seeking in terms of three core tasks provides a flexible platform without specifying a particular set of stages or processes, or being tied to a particular task. Instead of an individual, the model could be used to examine what happens to a need when it emerges in a group, which processes move the group towards active information seeking, when and how incidental information is considered, and the mechanisms around the information use task within a group.

2.4.4 Marchionini's Information Seeking Process

Marchionini's information seeking process (Figure 9) describes the information seeking process as both systematic and opportunistic, and the degree to which it is either depends on decisions of the information seeker and the way the search factors relate as the searcher works through the search process. His model breaks information seeking in electronic environment (search) into three parallel subprocesses, which each have multiple steps: 1) Understand, 2) Plan and Execute and 3) Evaluation and Use. These three categories overlap with Choo's (2006) Information Needs, Information Seeking and Information Use, but provide more details on the processes or stages involved in searching through systems.

Understanding, the first subprocess, includes actions related to recognizing a problem or a need, accepting the problem, and defining the problem. In a group setting it would be interesting to examine if these activities were accomplished by an individual, the entire group, or if there were shifts in participation. Plan and execution, the second subprocess, includes a set of specific activities related to selecting a search system, formulating a query and determining an entry point, executing a query and examining the results. Evaluation and Use, the third subprocess, also involves examining the results, but additionally extracting information, reflecting, and potentially iterating through another search episode. These three processes, as seen in Figure 9 overlap in time, so that

defining the problem links to the plan and execution stage, while examine, as noted, is part of both the plan and execution stage and evaluation and use stage. Understanding relates to cognition, while plan and execution as well as evaluation and use include cognitive and behavioural components. Users may differ in their strategies used at each subprocess based on their skills, experience, and individual judgment of relevance. The development of this model is not tied specifically to one study, but emerged from examination of a range of experiments and prior theories.
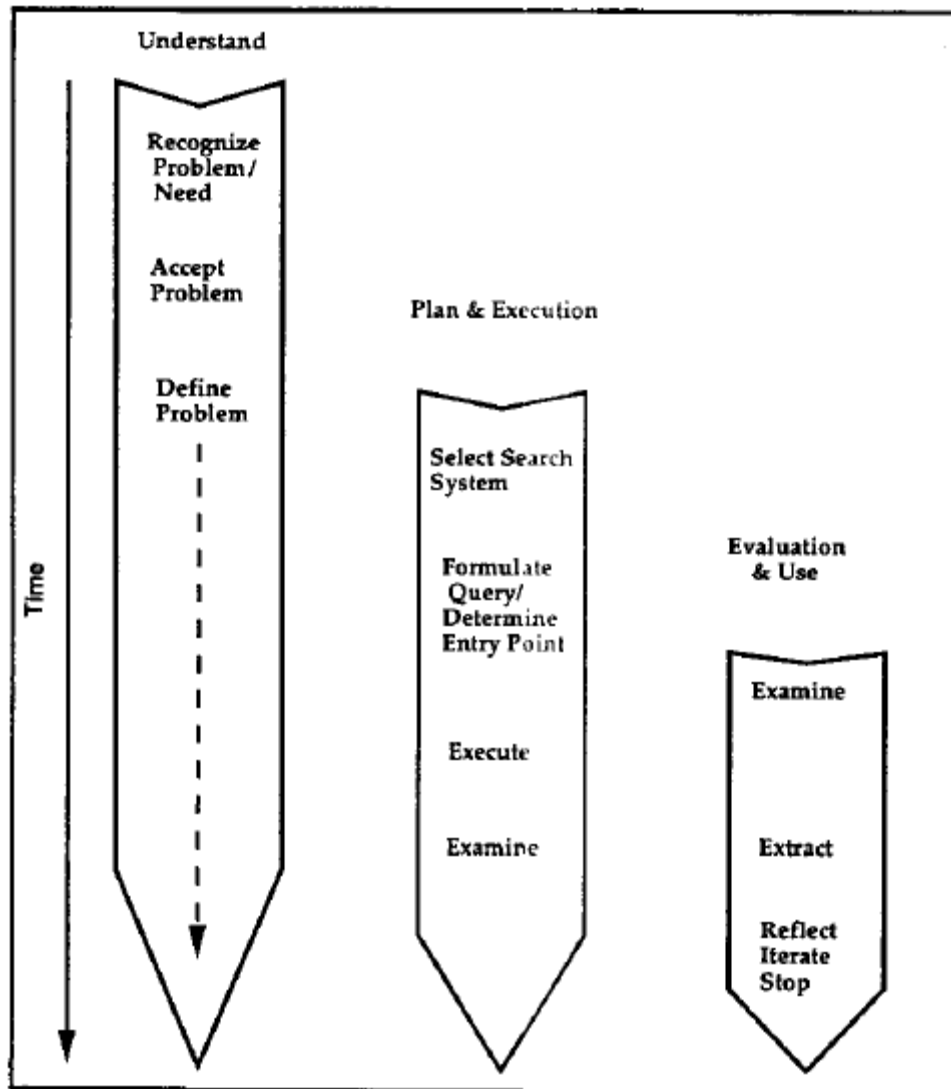
Figure 9   Parallel Information Seeking Sub-Processes (Marchionini, 1995, p. 59)

This model has been applied to groups by Toze et al, (2011). Their study examined search episodes within group work, to examine how participation shifted over the three subprocesses. Findings included that the plan and execution of search (Find) were most

frequently individual activities. In terms of this research, the model can be used to help examine search within the group process, suggesting common activities within search, which may also reflect the group level.

2.4.5 Information Behaviour Lens to Examine Groups

Shared across all these models is the identification of three key subprocesses or tasks, which are the essential components of information behaviour. The names for these tasks chosen in this work (need, find and use) connect to past models, and provide a fundamental level of analysis to use to investigate the group level. The goal in this research is to better understand how each of these tasks is negotiated in a group setting, including the set of information activities required to accomplish the three information tasks. As such, the particular barriers from the prior models were not included. Instead the barriers associated with the group level will be examined as they emerge from group interactions. This information lens, focused on these three tasks, allows for the integration of research from separate domains, bridging across information science (Need), organizational behaviour (Use) and CSWC (Find), and providing a holistic framework for examining group information process. Further the models examined above identify that information exchange and transfer are essential components that should be considered, and the information behaviour is often complex, iterative, and that information gets lost or not considered throughout the process. These factors were also considered in this work. The approach to examining the information task and activities is discussed in the next section, and the application of this information lens to the data is discussed in Sections 3.2.2 and 3.6.6, and illustrated in Figure 17.

2.5 Information Tasks

Given the larger context of information behaviour discussed above, the next section examines the constructs of information tasks and information activities. Groups need to work with information both to manage their processes and to complete their work tasks (e.g., Gardner et al, 2012; Kelly, McCarty & Iannone, 2013). Within information science, it is a generally agreed principle that information seeking depends on the work task, and problems encountered in completing the task (e.g., Byström & Järvelin, 1995). Yet much

research on information searching starts with the examination of humans or systems, and ignores the task (Vakkari, 2003). As noted in Section 2.1 it is only recently that the collaborative aspects of information tasks have been considered. Information activities are the specific activities that are required to accomplish an information task, for example identifying a need (Toms, 2011). Information activities have been modelled at the individual level, but not for groups. This section examines information tasks, and in particular information tasks within group work and the information activities that are required to complete information tasks.

2.5.1 Defining Information Tasks

As with work tasks, the term "information task" has not been consistently used or applied; it has also been used to describe multiple levels. Byström & Hanson (2005) suggest work tasks generate information seeking tasks, and information retrieval tasks. Algon (1999) used the term "information related behaviors" as a higher level integrative term that could include information seeking and information integration related behaviors. Information tasks have also been considered both in concrete and abstract terms. In a concrete sense, information tasks have been defined as the sequence of actions that are performed by a searcher in order to find information to satisfy a need (Gwizdka and Spence, 2006). In their view the information task starts after information needs are generated or given to the searcher. It stops when the desired information is found, or when the searcher fails to find the desired information and gives up.

Alternatively Marchionini (1995) suggests that information tasks are "manifestations of an information seeker's problem and what drives information seeking actions" (p. 36), incorporating abstract or cognitive aspects. This definition fits with the scope of this research as it identifies a tiered process; the work task creates a situation or need for information, which then prompts the actor(s) into specific action(s). Marchionini was not specifically referring to group activities, but this definition will help identify relationships between group tasks, information tasks and actions.

Information tasks are intertwined with the work task, so that it is difficult to examine them in isolation of the task (e.g. Fidel et al, 2004). A task analysis approach has been used to develop a protocol for bioinformatics analysis (Bartlett & Toms, 2005); as a framework for examining collaborate information behaviours of patent workers

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(Hansen & Järvelin, 2005); and to model the information behaviour of software engineers (Freund, Toms & Waterhouse, 2005). A faceted conceptualization of task has been created, to provide a common framework for examining tasks and search (Li & Belkin, 2008).

A number of studies have emerged that have examined information tasks within collaboration tasks or group work (e.g., Fidel et al, 2004). The information tasks within the patent task have been examined for example, identifying collaborative information seeking activities (Hansen & Järvelin, 2005). Collaboration (human and document) was found during the following task stages: task initiation; task preparation and planning; as well as the within the information seeking task and information retrieval task. Interestingly, there was more collaboration during the information seeking task than any task, but it was document related collaboration, rather than human. This suggests people need help determining their needs and seeking information, but it does not necessarily mean people actually search for information with others. This work task however, was not a group one, as patent officers had individual responsibility for their files.

A task model has been used to examine student groups. Hyldegård (2006) used Byström's (1997) task stages (construction, performance and completing), and Vakkari's (2001) research process (pre-focus, focus formulation, post-focus) to investigate how being a member of a group affected the *individual* experience of information seeking. Hyldegård found that initially (pre-focus or construction stage) members started out discussing their task as a group, but quickly moved to a process of dividing the task and individual work. During the next two task stages (focus formulation (performance) and post focus (completing)) there was more individual than group work. At the end members were working as a group again. This pattern of fragmented group work was explained by the following factors: 1) each group member had other tasks and deadlines for other courses; 2) the disparity between the individual tasks (some were more complex requiring more analysis and decision making, while other members had more descriptive tasks); and 3) the differing knowledge levels among members. The need to accommodate shifts between individual and group work was highlighted by this research. The focus of this work however, was not on the group level, but on the individual experience of being a group member. There was no attempt to model a group level information process.

Recently Saleh (2012) examined the collaborative information behaviour of engineering students working on group design projects. He examined how seeking, searching and use were negotiated over the lifespan of the projects. He found a strong relationship between the learning task stages, task complexity and collaboration on information tasks. This study also involved collecting data at the individual rather than the group level. To date models of group process have not been used to examine the information process of groups.

2.5.2 Conceptualizing Information Tasks

Byström & Hansen (2005) provide a conceptual framework for information based research on task which can be modified to examine groups. They identified that research on task frequently views tasks in two different ways, either as an abstract construction, or as a process. The first, viewing task as an abstract construction, involves describing the task and identifying the goals and requirements. The second, task as process involves identifying the concrete set of actions necessary to actually complete the piece of work. Both of these conceptions of task are necessary for this research on groups.

Byström & Hansen's (2005) model (Figure 10) represents how search might be integrated with the work task. The work task is the larger circle, and within this work task there are multiple information seeking tasks (IST). Some of these seeking tasks require information search (IRT). The IRT circles represent specific search tasks required to complete the seeking task. The information seeking task (IST) is the broader information task, and includes two key components, the recognition of a need, and a decision to act on it. The concrete steps within a specific information task depend on the work task, and on the information norms within the specific work context. A particular seeking task might require multiple information search tasks (IRT), as shown. The information seeking and searching tasks frequently involve discovering information within multiple channels and sources, which are depicted in the lower circle. The information seeking task involves selecting particular pieces of information within a source, or across several sources. Byström and Hansen (2005) identify that there are situational, contextual, and individual attributes that affect this process, and that the work tasks themselves can be divided into three distinct phases, task construction, performance and completion. This

framework was developed to understand individual work, but the authors suggest the concept of task is equally relevant for cooperative work.
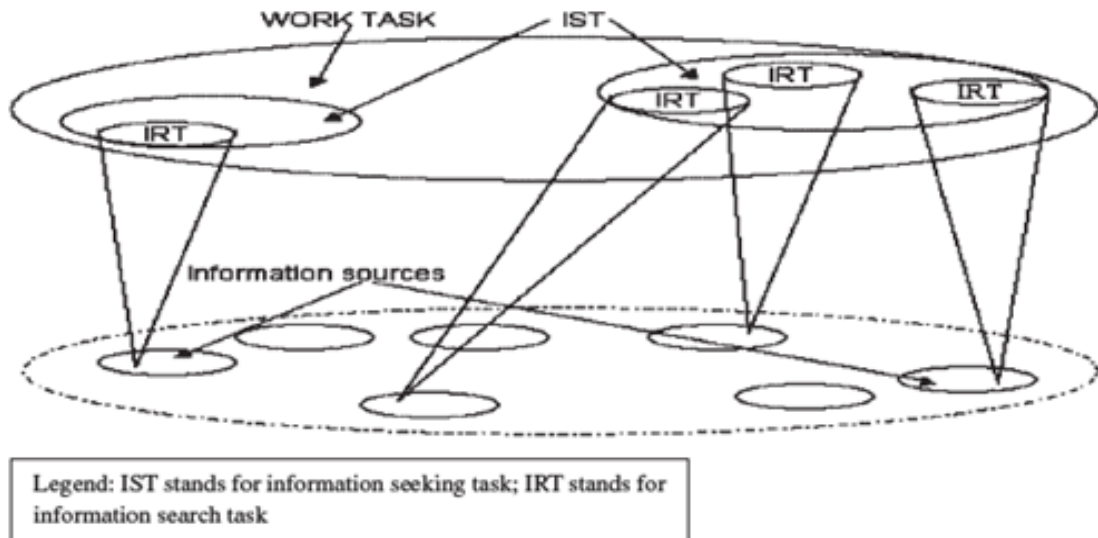
Figure 10   Conceptual Framework of Information Tasks within Work Tasks (Byström & Hansen, 2005, p. 1051)

For this research the model in Figure 10 was used as a starting point. As the focus was to look at the information process of groups, including information sharing, the information tasks were separated into the three essential information related tasks: the identification of needs and trigger for seeking (Need); the process of looking for information (Find); which is then used (Use). This division into three tasks mirrors Marchionini (1995) also Choo, (2006) as noted above (Section 2.4).

The group framework depicted in Figure 11 identifies that during group work information is needed to coordinate group processes and to accomplish tasks. Three main information tasks are triggered which generate activities related to selecting and using sources. The relationship between the levels is the subject of this current research.
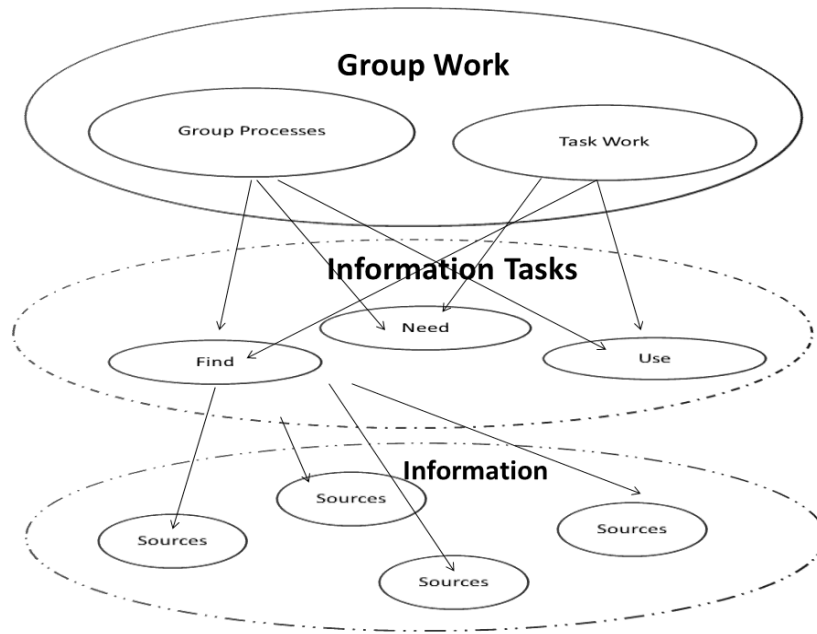
Figure 11   Information Tasks Embedded in Group Work

2.5.3 Classifying Information Tasks in Group Work

Within information science researchers have examined information tasks in terms of their goals, as the goal or use of the information is often the relevant characteristic. Table 3 below identifies relevant studies that have taken a goal based approach to classifying information tasks. The information task goals presented were generated from the examination of individual work. This research investigated how they apply at the group level. There is no one accepted list; the selections below were used to provide a starting point for this research.

Table 3   Information Task Goals

Taylor (1991)	Limberg (1999)	Kellar, Watters & Shepherd (2006)	Freund (2008)
• Enlightenment • Problem Understanding • Instrumental • Factual • Confirmational • Projective • Motivational • Personal or Political	• Fact Finding • Balancing Information • Scrutinizing and Analyzing	• Maintenance • Information Seeking • Information Exchange	• Learning • Making Decisions • Find Facts • Solve Problems • How To

Taylor's (1991) list represents the earliest attempt to examine information use in terms of goals, and grew from his direct experience, examination of the literature, as well as some interviews. It remains the most comprehensive list of potential information goals. Limberg (1999) and Freund (2008) also provide lists of tasks, but based on specific contexts. Limberg's set of tasks grew from her investigation into how students use information, while Freund's (2008) list came from her work involving the information behaviour of software engineers. The information tasks identified by Keller, Watters & Shepherd (2006) deal with a specific channel, web based searching.

2.5.4 Defining Information Activities

Information tasks represent the goals; to understand how groups work with information it is also necessary to identify and classify the activities taken to accomplish task goals. Information activities represent the process necessary to carry out information tasks (i.e. identify a need, extract information, synthesize) (Toms, 2011). A goal of a group information task might be to find a fact. To achieve this, a group member might ask another, they might check their notes, or they might turn to the internet and execute a series of steps to find the answer. They may complete these activities alone, or with others. Each of these steps would be a separate information activity.

From work on individual information behaviour, there are many models that itemize information activities at different levels including Ellis's (1989) behavioural model which identifies eight stages, Kuhlthau's ISP model (1991) and Marchionini's (1995) information seeking process. At the collaborative level, models that include information activities are just emerging. Table 4 below highlights emerging lists that were used as a foundation for this work.

Blake and Pratt's (2006a) list came from their examination of groups of scientists working on synthesis tasks. They found four specific processes that were necessary to complete the synthesis task, and two over-arching behaviours of collaboration and interaction. Talja and Hansen's (2006) proposed model was suggested in their conceptual model of the "social practices of collaborative information behaviour" in both the workplace and everyday life, but has not been validated by empirical research. These

lists provide a starting point for the analysis of group information activities. Through this research a description of student group information activities has been generated.

Table 4   Group Information Activities

Blake & Pratt, 2006 (Collaborate - Synthesis Task)	Talja & Hansen, 2006 (Collaborate)
Retrieval	Seeking
Extraction	Retrieving
Verification	Filtering
Analysis	Analyzing, Interpreting, Extracting
	Synthesizing
	Archiving
	Indexing

2.5.5 Deconstructing Group Work

To bring together the constructs discussed so far: group processes, work tasks, information tasks and information activities, Figure 12 (below) was created. As noted above, group work involves two constructs: task related work, and the processes within the group necessary to allow for collaborative work. Both these group activities generate the need for information. Groups seek information to satisfy different goals requiring a range of information activities. There is limited research that has directly examined the links between group processes, work tasks and information tasks and activities, as noted by Gardner and colleagues (2012). Figure 12 depicts the framework used in this research to deconstruct group work and make information tasks visible. This approach builds upon information task approaches to individual work (e.g., Byström & Hansen, 2005), and applied an information behaviour lens (Choo, 2006; Wilson, 2000) to groups.
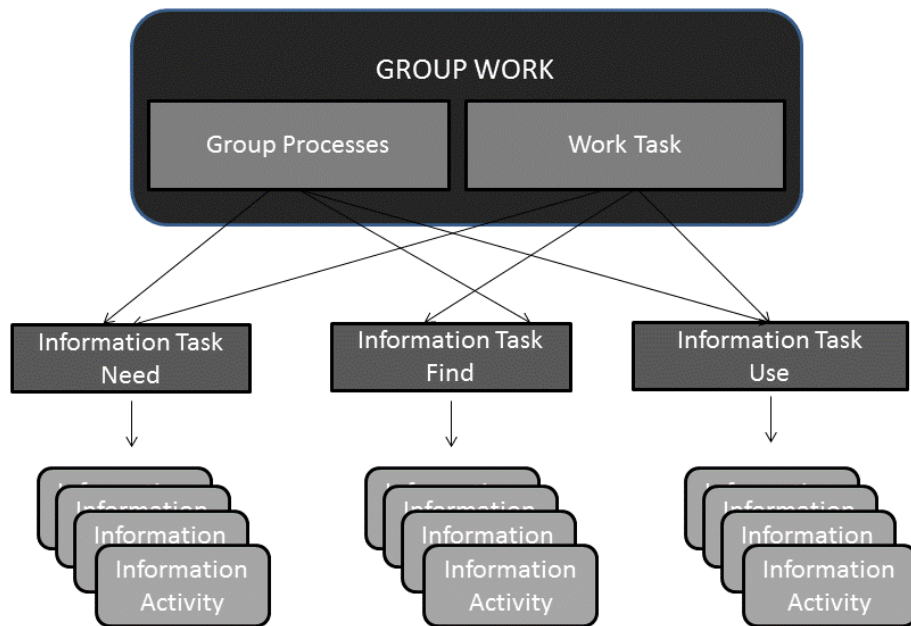
Figure 12   Deconstructing Group Work

2.6 Prior Research on Groups and Information

2.6.0 Overview

What do we know about the phenomena depicted in Figure 12 – the relationship between information tasks and activities and group work? As noted in Chapter 1, the relevant research is distributed across disciplines. In this next section the prior research is presented from the three main perspectives. The first perspective, *Group Seeking*, involves reviewing the research on collaborative seeking within small groups. Research from this perspective examines how external information is found and used, in collaborative settings (e.g., Fidel et al, 2004; Prekop, 2002; Reddy & Spence, 2008), and has largely been conducted within Information Science. The second perspective, *Group Search*, looks more specifically at how collaboration occurs during the information retrieval task including searching on the web, or through electronic databases. Research from this perspective has been generated within CSCW, and the information retrieval community within information science. This perspective has focused on the technological aspects, particularly the development and testing of tools to support collaborative or

group search (e.g., Morris & Horvitz, 2007; Shah 2012). The third perspective, *Group Sharing*, has emerged from fields including social psychology, organizational behaviour and communication studies as well as information science, and considers groups as information processors, focusing on understanding the barriers and challenges to information sharing in groups (e.g., Dahlin, Weingart & Hinds, 2005; Hinsz et al, 1997; Stasser and Titus, 1985). A goal of this perspective is to better understand the relationship between information processing and group effectiveness. These three threads of research have progressed largely independently of each other. Each thread will be explained separately. Next the research that has examined information seeking in student groups will be presented. A final section integrates these threads.

2.6.1 Group Seeking

Information seeking, as noted above is a narrower construct than information behaviour (Section 2.4.1). Included in the study of seeking is the investigation the range of channels (e.g., physical sources, electronic, human) and strategies (e.g., Ellis's 1989 behavioural framework including starting, browsing, monitoring, chaining, differentiating, extracting, verifying, ending) individuals use to discover, and gain access to information. Collaborative information seeking, as noted in Section 2.1.1, does not yet have a single accepted definition. For the purpose of this research the focus was on the research within collaborative information seeking that has focused on groups. In particular, the focus is synchronous collocated groups working on knowledge tasks, rather than instances of collaboration during individual tasks (e.g. Hansen & Järvelin, 2005).

There are relatively few examinations of information collaboration at the group level. Aspects have been examined within a range of domains including: military units (e.g., Prekop, 2002, Sonnenwald & Pierce, 2000;); engineers (Bruce et al, 2003; Fidel et al, 2004; Hertzum, 2002; Hertzum & Pejtersen, 2000; Poltrock et al, 2003) academic researchers (Spence, Reddy & Hall, 2005); and most frequently medical or health settings (Blake & Pratt, 2006a&b; Gorman et al, 2000; Reddy & Dourish, 2002; Reddy & Jansen, 2007, 2008; Reddy & Spence, 2006, 2008; Sarcevic, 2007; Sarcevic, Marsic, Lesk & Burd, 2008; Spence & Reddy, 2007; Spence 2012). There is limited conceptual or theoretical work, most notably Hertzum (2008) and Reddy and Jansen (2008). Foster

(2006) provides a review of collaborative seeking, searching, and navigation, and Shah (2012) provides an overview of collaborative information seeking, but focused more on search.

It is challenging to compare across the studies identified above, as noted by Kim (2013). All involve the investigation of collaboration during information seeking, but the unit of analysis varies. Fidel et al (2004) examined groups, Reddy & Spence examined information events, or questions, while Sarcevic examined conversations, and Hertzum looked at meetings. The tasks being examined are also diverse. There are design tasks (Fidel et al, 2004), command and control tasks (Prekop, 2002; Sonnenwald & Pierce, 2000), decision making tasks involving trauma or critical care situations (Sarcevic, 2007), project based tasks (i.e. Hertzum, 2002), and an information synthesis task (Blake & Pratt, 2006). These differences in task, domain, and level of analysis make it difficult to compare findings, except at a very high level.

Military Domain

One of the first examinations of collaborative information seeking can be found in Sonnenwald and Pierce's (2000) study of a command and control battalion. Their level of analysis was a large unit, rather than a small group as defined in this study. However their work is included due to the relevance of their key findings. Through their research Sonnenwald & Pierce identified three key themes: 1) interwoven situational awareness, 2) dense social networks, and 3) contested collaboration, which are potentially of interest to the study of small work groups. The authors found that to make decisions within the command and control battalion, there needed to be a shared understanding of a situation at three levels: individual, intragroup and intergroup, which the authors called interwoven situational awareness. This interwoven situational awareness was built through frequent communication (information exchange) between unit members about the work context, the situation, and the work process, as well as domain specific information, creating a pattern of dense social networks. The authors also identified "contested collaboration" to describe times when members would challenge or contest another's contributions based on their different past experiences or backgrounds. Sonnenwald and Pierce (2000) focused on the social aspects of information seeking, while this current research is concerned with *how* such seeking occurs. Important for this research is recognition that it

is essential to consider communication (information sharing), as well as information seeking, to understand how groups maintain awareness, build shared understanding, and complete their tasks. Further, the idea of contested collaboration emphasizes that information use at the group level may be problematic, and that groups need mechanisms to negotiate information.

Prekop (2002) also studied collaborative information seeking in a military environment. This study is particularly noteworthy, as Prekop studied the working group over time (three years), using a qualitative methodology, basing his analysis on minutes of the working group's meetings, and semi-structured interviews. The study examined an information intensive task. The working group studied was created to collect all the information, and conduct the analysis required to review the Australian defence forces command and control capability. Perhaps most interesting is the description of collaborative information seeking as a system where individual members take on specific roles. Prekop highlighted how specific information activities within the group were often explicitly distributed, with members taking on roles including: info seeking instigator, info verifier, info gatherer, information referrer, as well as information indexer/abstractor. These roles were sometimes assigned, but at other times adopted through explicit and tacit negotiation. These particular roles might not generalize beyond this study, however the findings emphasize that roles may be a key part of how a group information process.

Prekop also identified three different information seeking patterns that described the actions, interactions and behaviours of the group members assuming the information roles. The three patterns were 1) information seeking by recommendation, 2) direct questioning and 3) advertising information paths. The first pattern, information seeking by recommendation, related to times when one member would state a need, or an interest in a particular type of information. Another member (information referrer role) would respond to the need, forwarding the requested information, or an information gatherer would be tasked with the search. The second pattern, direct questioning, refers to times when the information seeking instigator determined specific needs, and asked for information to resolve the needs. This was a more formal and explicit path than the first. The final path, advertising information paths, describes times when group members

volunteered their ability to provide information on specific topics, based on their prior knowledge or roles.

The use of information seeking roles, and specific patterns of behaviour provided a structure for information seeking within this group; what Prekop called a collaborative information seeking context. Prekop used the concept "collaborative information seeking context" was to represent the creation of a context which "captures what is collectively known, understood, felt and believed, as well as the history of the working group, and the groups' norm's social rules and social structures" (p. 536). This collaborative information seeking context was dynamic and changing, based on the group interactions over time.

Design Teams

Perhaps the most comprehensive attempt to examine information seeking in groups was the work of the Washington Group (Bruce et al, 2003; Poltrock et al, 2003; Fidel et al, 2004), who set out to examine the manifestations of collaborative information retrieval in design teams. Their goals were: to analyze the structure of collaboration in information intensive work; to explore the nature and occurrence of collaboration as it emerged from work situations; and to propose both technological and organization change to better support information based collaboration. As evident from their definition of collaborative information retrieval (Table 2, definition 11), the authors were only concerned with information seeking outside the groups' resources. Therefore, they did not examine information sharing.

The context of their work was a comparison of three design teams in two different organizations, Microsoft (1 team) and Boeing (2 teams). Findings from their work included the recognition of the inherent difficulty in examining collaborative information retrieval. The authors stated "the concept of CIR became increasingly elusive as the researchers gained more knowledge about it" (Bruce et al., 2003, p. 152). This difficulty was attributed in part to the challenges of unravelling information retrieval from the context and task.

Within their studies the authors found that the nature of the task directly affected the process of CIR, as well as the organizational setting. They found evidence of collaboration during the following information activities: identifying, analyzing and defining their information problems, and determining strategies for information retrieval.

The act of retrieval itself was found to be completed most commonly by an individual group member. Their work indicates that further study of participation during information tasks and activities is necessary, and that focusing on information related tasks in complex situations is challenging.

Engineers

The collaborative information seeking of engineers has been examined in several contexts. Work done by engineers (Fidel et al, 2004; Hertzum & Pejterson, 2000; Hertzum, 2002) frequently necessitates informal discussion, rather than formal information retrieval related activities. This may partially be due to the preference for human sources, and to the ease of accessing people. It has also been attributed to the lack of contextual information in project files or design specifications, and for the need for other people (experts) to identify the "best" or most relevant documents.

Hertzum (2002) also noted that engineers frequently discuss potential sources collectively, evaluating the "trustworthiness" of sources in meetings. The data from his field study of the meetings of a software design project showed that significantly more time was devoted to discussions related to quality (62%), than to cost (time or money), or other factors related to information. In many cases the need for collaboration during this part of seeking (selecting sources) was related directly to the concept of "trust"; trust for the opinion and knowledge of a specific individual, or a need for collective wisdom or acceptance. This highlights the complex collaborative aspects of information needs, and the links between seeking and use. To examine group information process this "human" aspect needs to be considered.

Health Domain

Within the research on collaborative information seeking there is not yet a model that provides a clear identification of the components or stages of information needs, seeking and use. Blake & Pratt (2006a; 2006b) in their examination of two groups of scientists working on systematic reviews are perhaps the closest. They identified the following four collaborative activities during the synthesis task: Retrieval, Extraction, Verification and Analysis. They also found two process level information behaviours, Collaboration and Iteration, which spanned across all the activities needed for the synthesis task. Their

findings are specific to the synthesis task, and were generated from only two groups, but the collaborative activities and behaviours they found may be present in other collaborative seeking tasks. This provides a foundation which can be used in this current research.

Also in health setting Reddy and colleagues (Reddy & Dourish, 2002; Reddy & Jansen, 2008; Reddy & Spence, 2006; Reddy & Spence, 2008; Spence & Reddy 2007; Spence, 2012) have examined several aspects of collaborative information seeking. For example, Reddy & Dourish (2002) focused on the temporal aspects of work in their ethnographic study of collaborative information behaviour in a surgical intensive care unit. They found that time delays in medical life (waiting for results, timing of rounds) meant that needs might emerge, but information would not be sought until later. This suggests that the relationship between the need and find tasks in groups may be complicated, and affected by time.

The concept of a trigger, which initiates collaborative information behaviour, was developed through this body of work. Reddy & Spence (2008) in their study of a multidisciplinary patient team over time, classified three triggers: lack of expertise; lack of immediately accessible information; and the complexity of information need; which moved a group from individual to collaborative information seeking. Building on this work, Reddy & Jansen (2008) created a model, included below (Figure 13), illustrating the shifts between individual and collaborative information seeking.

Figure 13 describes individual information behaviour as characterized by simple problems (fact finding, homepage finding, question and answer), with little need for communication, and involving only simple interactions with a single person or systems. By contrast, collaborative information behaviour is needed when there is a relatively complex problem (exploratory search), and it involves direct interactions with a number of people and systems, complex interactions and a "conversational" style.
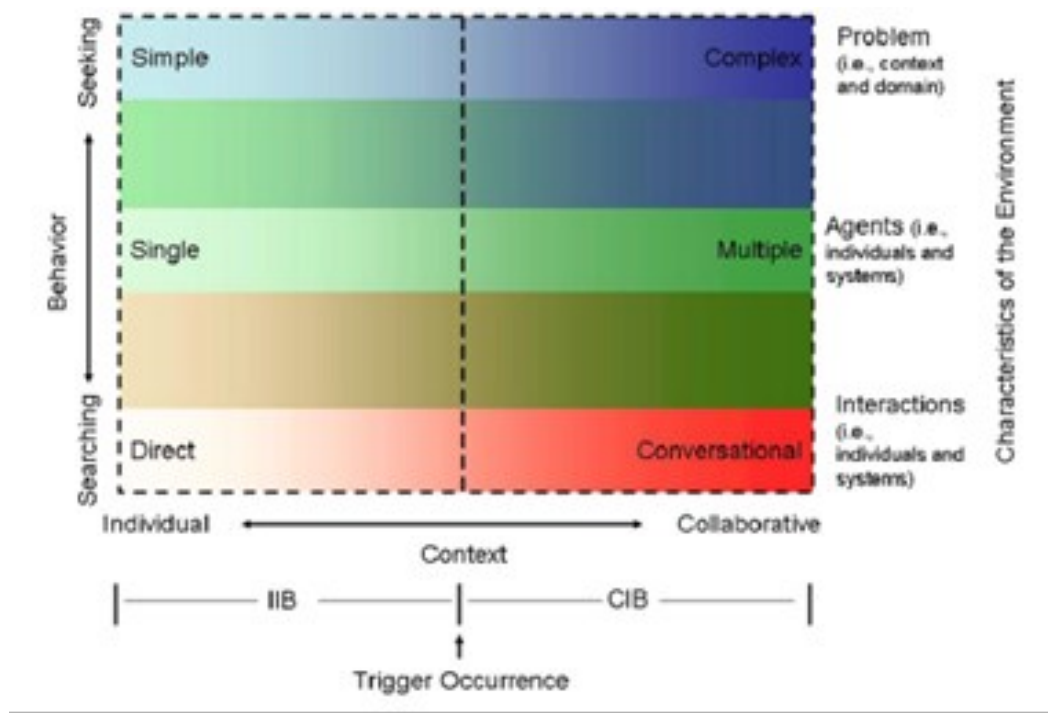
Figure 13   Individual versus Collaborative Information Behaviour, Reddy & Jansen, 2008, p. 11

Similarly Fidel et al. (2004) also discussed how three factors: 1) the complexity of the information need; 2) the amount of domain knowledge and prior experience; and 3) the degree to which the information needed was already documented influenced if information seeking would be completed by an individual or a group. They also described these factors as "triggers" which initiated collaborate searching. The underlying assumption in both studies is that individual seeking is the "norm". Only if particular characteristics of the task, information need, and users' knowledge combine does the group seek information collectively. This also suggests that the participation in information tasks may vary, and that participation is a key element of group information process which should be examined.

Tools to Support Group Seeking

While tools were not tested, strong indications of the type of features and tools required to support GIP have emerged from these studies. The Washington Group (e.g., Poltrock et al., 2003) made a series of recommendations. First, they suggested that the common information space which exists in most collaborative systems could be enhanced to better

support collaboration on information tasks. The information need, for example, could be explicitly recognized in the common space, discussed, and even assigned to particular group members. Members could seek (either individually or collaboratively) information to resolve the need, and then post the results back to the common space. Notification features could be used to ensure all members were aware of the updates and changes. Further, current designs for common information spaces could be enhanced to make searching external resources (i.e. databases) more seamless and integrated. This should include searching for documents and people (i.e. expert directories). These suggestions were made in 2003, yet no robust collaborate information space that includes all their suggestions yet exists.

Reddy & Jansen (2007) from their examination of healthcare teams found there was a need to support the following: 1) awareness; 2) chat; 3) conferencing; and 4) visualization; to aid collaborative information seeking. Sarcevic, Marsic, Lesk & Burd (2008), in their examination of information seeking and sharing in an emergency room, identified that technology could be used to provide a better display of information for teams, and to facilitate the flow of information between providers and seekers. As information was frequently distributed across paper, white boards, and computers, the need for a common integrated display was considered crucial.

Looking specifically at synthesis, Blake & Pratt (2006b) made the following recommendations: 1) integrate the retrieval, extraction verification and analysis tasks; 2) improve document management capabilities; 3) provide support for collaboration and information sharing; 4) improve precision & recall of retrieval and extraction systems; and 5) provide visual interfaces to verify and explore findings.

Artefacts

Artefacts also emerged as a key element of group seeking, particularly related to the information use task. Artefacts are "objects around which groups and individual collaborate" (Goggins, Mascaro & Valetto, 2013). More specifically, artefacts are multi-authored documents, diagrams, charts or illustrations that were created by the group, and contain information integrated from multiple sources. Alternatively called information compounds (Paepcke, 1996), information artisans (O'Day & Jeffries, 1993) or bundles (Gorman, 2002) these artefacts have been found to be essential to the act of "seeing" as a

group. The artefact is used as a prop, perhaps projected on a wall, and those members present add their "information pieces" and negotiate contested information. The creation of temporary and permanent artefacts allows a group to bring the relevant facts together, so they can assess, evaluate and discuss collectively. The creation of artefacts is critical to developing shared understanding and awareness in groups (e.g. Stahl, 2006). They allow groups to think together.

For example, in their examination of expert clinicians, Gorman et al (2002) described how "bundles" ("organized, highly selected collections of information") were collectively created. As expert clinicians selected and organized the specific information necessary for solving a particular patient problem, they created an artefact that linked disperse but essential information. Examining these bundles, the authors found they were multi-authored and that they were shared by multiple individuals across a variety of disciplines. This behaviour was also found by Hirsh & Dinkelacker (2004) in their survey of information behaviour in a corporate research laboratory, and by Hertzum (2002) in his examination of engineers.

Gorman and colleagues (2002) suggest the benefits of creating and sharing bundles include their low fidelity, the ease of their creation and use. They allow individuals or groups to make and assess tentative connections, without the cognitive overhead of categorizing them in formal information systems such as databases. To support this real time interaction (either face to face or virtual), O'Day and Jeffries (1993) suggest that multiuser meeting spaces are needed, as well as support for shared views and communication. This would allow group members to collectively examine these information based artefacts, allow both individuals and groups to make changes, and to respond quickly to verbal and non-verbal communication.

Some tasks lend themselves to the creation of tangible information composites as a temporary tool, while in other tasks information is not so easily combined. Paul, Reddy & deFlitch (2008) examined information use in the process of sensemaking in an Emergency Department. From their field study they noted that the information needed for team members to collectively make sense of a situation was in various forms, distributed among people, and was dynamic rather than static. The information was partially found in white boards, computer systems, and on paper. Generally information

would be compiled from these tools to give an accurate representation of the patient situation. But the authors found multiple cases where information was not put in the right place, misinformation was added, or where there were delays which affected information processing. Some of these issues were due to the inflexibility of the tools to allow for information to be presented at a fine grained level. The authors suggest that collaborative tools need to be modified to better support the need for groups to view and use information, to alert others to critical information, as well as to accommodate particular individual needs. Regardless, artefacts appear to be a critical part of group information process.

Summary of Group Seeking

As noted above, the research on group seeking is difficult to synthesize. Studies have had different goals, defined concepts differently, and examined different levels, tasks and domains. The following elements were found in multiple studies, and appear to be important to group seeking: sources (particularly human), tools, arefacts, roles, and shifts in participation. There is not yet an accepted set of information activities associated with group seeking, while Prekop (2002) described three information seeking patterns, and Blake and Pratt (2006a) modelled the synthesis task. Seeking is embedded in particular tasks and contexts, making it challenging to examine (e.g. Fidel et al, 2004).

2.6.2 Group Search

Research on collaborative search grew from the work in individual information retrieval, which traditionally focused on the mechanisms through which needs are translated into specific actions involving search systems. Acknowledging that search might not always be a solitary endeavor, researchers in CSCW and Information Retrieval have recently begun creating tools to support collaborative finding. This is alternatively referred to as information retrieval, information search, search, or information seeking and retrieval. Starting in 2006 the level of interest in the topic increased, for example Morris and colleagues (e.g., Morris, Paepcke & Winograd, 2006; Paul & Morris, 2009 & 2011) began both examining users and creating tools at an increasing rate. Conceptual articles have emerged (Pickens & Golovchinsky, 2007; Shaw, Marchionini & Kelly, 2009; Shah 2012), as well as special journal issues (Information Management and Processing

November, 2010), conference workshops (e.g., CIS workshops at ACM Group 2010, ASIST 2011, CSCW 2013) and books (e.g., Foster 2010; Morris, Teevan, 2009; Shah 2012).

The research on collaborative search has been motivated by the goal of supporting various levels and types of collaboration (e.g. Shah, 2012), not only the collaboration found in groups or teams. From the perspective of the group, another limitation of this emerging research is that the tools created have often been tested on pairs. Pairs may have different features than small groups (e.g., Hare, 1981), and findings based on pairs may not scale to groups. There are, however, valuable research discoveries and tools emerging from this area. The emphasis in this section is on how this research can add to our understanding of GIP.

Observation of Collaboration on Search

Perhaps the earliest work on collaboration during search was initiated by Twidale and colleagues (Twidale Nichols & Paice, 1997; Twidale & Nichols, 1998). They observed users in the library and noted that individuals working on their own search task frequently enlisted the help of others. Users were observed asking their neighbours' for assistance with a search strategy, how to use a database, or sometimes, noting what others were doing, asking them "how did you do that?" Small groups of individuals were seen to "watch over the shoulder" providing advice, as one person searched on a computer. Collaboration during search was observed to involve the sharing of the search process, as well as results. Based on their observations the authors designed the first real collaborative searching tool, Ariadne.

Similarly, Romano et al. (1999) noted that their interest in collaborative information retrieval (CIR) was prompted by watching people collaborate during search while studying work practices. They remain unique in their attempt to integrate information retrieval with group support systems with their creation of their prototype CIRE (Collaborative Information Retrieval Environment). CIRE provided the following advancements over single search tools: 1) the automatic creation of an *information retrieval memory* which kept track of all pages visited, search queries, comments and rankings; 2) the ability for group members to share queries and results; 3) searching together over time and distance; and 4) the potential to reduce redundancy through

increasing awareness of search strategies and results. Remarkably, there has been no follow up to this interesting work in the intervening years. Evaluation of this prototype revealed that the collaborative features were not often used, generally because members forgot, or were not sure how to use the tool.

Surveys on Collaborative Search

The broadest understanding of collaborative search has been gained through a series of surveys. To gain a baseline of knowledge regarding collaborative behaviours during search for example, Morris (2007) had 204 employees of a high tech company complete a survey. Just over half (53.4%) of the respondents agreed that they had collaborated during search. However, of the 46.6% of users who said they did not cooperate on search, 10.5% said they needed or wanted to do so in the past, but had been unable to effectively do so.

The survey identified specific collaborative activities: watching over the shoulder while someone searched suggesting query terms (87.7%); emailing links to share the results of search (86.3%); and showing a personal display to another to share search results (85.3%). Relating specifically to group behaviours, almost a quarter (23.5%) of the respondents identified that they had performed a web search on a large display during a group meeting. The survey also provided evidence that search tasks were sometimes distributed within a group; 18.1% of respondents agreed that they had divided responsibilities for the search task among several people, then shared results. Collaboration while determining search query terms was frequently noted. Respondents described using "divide-and-conquer" strategies, where different search engines were assigned to specific members, as well as "brute-force" where all parties searched independently, and then merged results. Perhaps showing the "uniqueness" of this respondent pool, some respondents talked about having "Google-races". Collaborative search activities were daily for only .9%, weekly for 25.7% and monthly for 48.6%, with the rest indicating they were yearly activities.

The survey also probed the 109 "search collaborators" for details of their activities including location, and tools used. Of this group, 22% said they were always collocated when searching together; 11.9% were never in the same room, and 66.1% indicated they were sometimes collocated and sometimes remote. In an open ended

question, respondents described their activities including sharing both process information (queries) and results by email, IM and phone, similar to what Twidale and Nichols (1998) observed.

The respondents reported cooperating on a range of different tasks including shopping, travel, real estate, medical information and social planning, as well as job related tasks such as literature searches, fact finding or locating technical information. Morris grouped the obstacles identified by respondents into four themes: 1) problems related to trying to work together on complicated search tasks such as literature reviews without duplicating work; 2) the difficulties when working remotely to navigate together to ensure a shared content and focus; 3) the realization you want to share the search results with others only after you finish; and 4) the inadequacy of search interfaces for teaching searching skills, or supporting novice searchers. These findings match Twidale and Nichols (1998) observations, including the focus on education as a motive for collaboration.

Spence, Reddy & Hall (2005) also used a survey approach in a small technology focused research university, collecting data from 70 respondents. The goal of their survey was to understand more about three aspects of collaboration during search: 1) the trigger(s) that most frequently lead to collaborative information seeking; 2) the media or channel was used for such activities; and 3) the success of such activities. They found that collaborative information retrieval was most frequently triggered when the academics required another expertise, rather than complex information needs, or when the information was not easily accessible. Respondents commented on the greatest need for collaboration to help them "understand" or "make sense". One participant, for example, commented that finding or accessing information was easy but understanding the information required collaboration. The preferred mode for collaborating was "traditional", which included face to face, telephone and email, rather than web (instant messenger, web conferencing, and web sites), electronic forum or fax.

Regarding their third goal, the perceived "success" of collaborative information retrieval, the authors collected data on four elements: 1) the amount of information found; 2) the ease of searching; 3) the relevancy of information found; and 4) the speed. The majority (64 of the respondents) agreed that they usually found more information through

collaborative search, compared to 2 who disagreed. 50 respondents agreed collaborative searching was easier compared to 16 who didn't. 55 respondents reported they found more relevant information while 11 did not, and 48 found collaborative searching quicker, compared to 10. The survey was based on self-reported perceptions of past behaviours by individuals. This survey adds to the evidence that people collaborate on search under specific conditions, specifically when they need expertise. It confirms that interpretation (information use) requires collaboration more than finding, and that people perceive that collaborative search is more successful.

To better understand social search (a similar concept to collaborative search) Evans and Chi (2008) utilized Amazon's Mechanical Turk for a survey, obtaining 150 participants. The results of this survey highlight that social interactions were important before, during and after searching, but not necessarily for all types of tasks. Specifically, collaboration was noted more frequently in informational search (exploratory search), compared to transactional (locate a source to complete a transaction like shopping), or navigational (identifying content from a known site) indicating the goal of searching is likely a factor affecting collaboration.

Morris (2013) conducted a second survey, to see how collaborative behaviours during search had changed since her first survey (2007). 167 responses were collected from the public in general. In this survey 109 participants (65.3%) agreed that they had collaborated with other people to search the web, which represented an increase from the earlier survey. There was also an increase of frequency of collaboration during search. Interestingly, the tools most frequently used to collaborate were not collaboration based search tools. Instead respondents described how they appropriated existing technologies. Email and text were used coordinate search activities. This indicates that while people may be collaborating more on search, current technologies still do not really support the way they want to search together. This survey focused on collaborate interactions during search, but did not focus on groups. It is included here as it indicates levels of awareness and interest in tools to support collaboration during search.

Collaborative Search Features

Through surveys and prototyping tools, core design elements have emerged that are considered important to collaborate searching (e.g., Golovchinsky, Adcock, Pickens,

Qvarfordt & Back, 2008; Golovchinsky, Morris, & Pickens, 2010; Hansen & Klas, 2008; Morris & Horvitz, 2007). For synchronous, explicit searching to support collocated groups the key features identified include: 1) awareness, 2) division of labour 3) persistence (to provide trace information of the group's past searches) 4) communication 5) ranking or recommendations 6) private and shared space and 7) data synchronization.

There has been little discussion of the impact of the particular tasks in the research on search beyond acknowledging that a different task might have different results (Joho, Hannah and Jose, 2008), yet at the individual level task plays a critical role in understanding search (i.e. Ingwersen & Järvelin, 2004). Aspects related to the group such as size, structure, development or leaderships have not been explored. Similarly individual differences and their effect on search have not been experimentally tested. González- Ibáñez, Shah & Córdova-Rubio (2011) looked at happiness as a synergic factor in collaborative information seeking, indicating an emerging area of research.

Group Search Tools

Perhaps the best example of how group searching might be enhanced is SearchTogether (Morris & Horvitz, 2007). SearchTogether is a prototype which allows remote users to both synchronously and asynchronously collaborate during web searching. Designed to support awareness, each user has a screen name and picture, which indicates when they are on the system. The system provides query history by user, automatic updating of activities, page specific metadata including visitation information, ratings and comments. Division-of-labour features were incorporated; including instant messaging, a recommendation mechanism (thumbs up/down), split search and multi-engine search options. In addition, the authors built in persistence; shared search sessions, including chat, query histories, recommendation queues, and page specific metadata were stored.

SearchTogether was evaluated in a study involving 14 users working in pairs, where all the pairs had pre-existing relationships. The pairs could choose their own topic, and were given 20 minutes to search. The participants agreed that the tool helped them achieve their joint goal (3.9 out of 5), and that it was more effective than their habitual methods (4.1 out of 5). This was a self-reported measure of effectiveness. The authors also provided information related to the effectiveness of individual features. Four subjects asked for a copy of SearchTogether summary, illustrating the success of this

feature. Awareness was considered one of the most valuable features, although users also wanted to know what page their pair was on, in real time. Support for division of labour was noted, but the feature was not heavily used. Users really liked the automatically generated summary, and wanted the ability to edit them.

SearchTogether could be helpful for groups when search activities were distributed. Morris, Lombardo and Widgor (2010) created and tested WeSearch, a collaborative Web search system on a tabletop display to support collocated search. WeSearch was designed to support awareness, division of labour, persistence beyond a single session, and sensemaking in the search process. It included facilities to reduce time spent typing on the virtual keyboard text entry (a feature of tabletops), reduce clutter on the tabletop, and address orientation challenges. The tool was tested in an observational study of 11 groups with four members. Group members had prior relationships and brought a shared information need (task) with them. They were asked to describe how they would usually search together, and then invited to use WeSearch. Findings included that the participants found the tool both easy to use (medium score of 6 on a 7 point Likert scale), and helpful (5). In particular the participants liked the awareness features (6) which allowed them to see the queries of all members in a moving stream, and commented on the ease with which they could glance and see pages other members were examining. The awareness features contributed to more discussion about search queries. Participants also liked the ability to record webpages for future sessions, or to view away from the tabletop. To help with sensemaking, WeSearch allowed for clipping, saving and tagging of the clips and the ability to organize them into containers. These were used more by individuals than at the group level. Overall the tool was found to support natural shifts between individual and group work. The main obstacles were hardware based.

Coagmento is another collaborative tool that has been tested in a series of experiments. Originally developed in 2007 by Chirag Shah as a research project for his dissertation (Shah, 2010) the tool has been used to test aspects of collaborative search including user behaviour (Shah, 2008); awareness (Shah & Marchionini, 2010); the synergistic effect of collaboration (Shah, González-Ibáñez, 2011) and communication and performance (González-Ibáñez, Haseki, & Shah, 2013). The original prototype allowed for two people to work together on a search task. The pair could work

synchronously or asynchronously, and be collocated or remote. It provided features to support awareness between the partners, to facilitate communication, to allow the sharing and commenting on specific results, and provided a record of all search activities. In addition users could 'snip' and share specific sections of documents. Shah and Marchionini (2010) and Shah (2013) tested Coagmento with 42 pairs of participants. Their findings indicate that providing awareness of personal actions and history was not as important as support for pair awareness. Being aware of what your partner was doing allowed searchers to be more effective and engaged, and did so without increasing the cognitive load. This was tested with pairs; it would need to be confirmed with small groups.

Summary of Group Search

To date research on collaboration on search has progressed largely in isolation from the research on groups. Tools have been created that provide potentially useful features to support groups (awareness, persistence, division of labour, communication). With few exceptions (e.g. WeSearch), these tools have been tested in experiments with artificial groups (most frequently pairs), who are assigned experimental tasks in test situations. This may or may not reflect the process of "real" groups. The tools generated support only the search task, and have not been integrated with other groupware or office tools. This isolates the information search task in group work from other work and other information tasks (e.g., use), which may be an artificial separation.

Additionally, as also noted by Hearst (2014), while the data from surveys, interviews and observations seems to indicate that individuals and groups want to collaborate during searching, to date there has been little uptake with collaborative search tools. Instead collaborative search is being facilitated through use of general communication tools including email, texting, phone calls and social media communication. This suggests there is a need for a better understanding of the collaborative behaviours that need supporting. Capra, Chen, McArthur & Davis (2013) reflect that while there has been much activity, it is still not clear how the dimensions of individual search map to the collaborative search processes, and what new elements need to be considered.

2.6.3 Group Sharing

In comparison to group search, research on how groups share information has focused mainly on the human side; examining motivations, barriers and patterns of information sharing in groups. Research on group sharing has largely emerged from organizational behaviour, social psychology, and communications studies. Information sharing also intersects with topics such as knowledge management. As this is a potentially huge field, the review here focuses on the mechanisms for sharing within small collocated groups, excluding virtual teams.

Unlike group seeking, the focus of sharing research involves understanding how groups share, access, and pool information rather than how or when a group decides to actively look for information in response to a perceived need. As both seeking and sharing are essential processes in groups, both need to be examined to understand how groups use their resources effectively to achieve maximum results. As noted by Hackman and Katz (2010), the ability of a group to reach its potential "all depends on the degree to which the group has, and uses well, the full complement of resources that are required for exceptional performance" (p. 10). In knowledge based groups, information is frequently the most critical resource.

The conceptualization behind this research involves examining groups as information processors (Hinsz et al., 1997). Hinsz and colleagues applied a generic information processing model of individual information processing to the group level, suggesting that groups could also be examined as information processors. The model includes the following stages: attention, encoding, storage and retrieval. Storage and retrieval are cognitive processes; retrieval means accessing information from memory, rather than searching electronic resources, as it is used in information science. Two threads from this perspective are potentially relevant to this research: the hidden profile or information bias approach; and the transactive memory approach.

Hidden Profile

The "hidden profile" approach originated from the work of Stasser & Titus (1985). The authors found that there was a bias in decision making tasks. Group members were more likely to share information that was held in common versus unique information, and to share information that confirmed members' existing preferences. Their experimental

design, which involved distributing information unequally among members (the hidden profile) has been used by researchers in a range of experiments (see Stasser & Titus, 2003), which have supported their original finding. However, Wittenbaum et al. (2004) have questioned aspects of this research. They suggest that information sharing is more political; group members intentionally select particular members with whom to share information, determine what information to share, and how to share it, to achieve particular outcomes (task completion, group relations, individual goal). Further they note that the work on hidden profiles is based on a decisions made in one meeting, and does not consider or reflect changes due to group dynamics over time.

Mesmer-Magnus and DeChurch (2009) used a meta-analysis to synthesize 72 independent studies on information sharing, focusing on two aspects, uniqueness and openness. Uniqueness refers to the degree to which groups utilize the distinctive knowledge of their members, while openness relates to the degree of deliberate attempts within a group to exchange information about the task, group goals, and all activities related to the task. They found that information sharing did positively predict team performance. Their findings also confirmed Stasser and Titus's (1987) contention of biased sharing. This meta-analysis identified that teams share more information under the following conditions: 1) the information is held in common, 2) members are capable of independently making accurate decisions and 3) members are highly similar. Information sharing was enhanced by the following conditions: when there were structured team discussions; the team task was considered intellective; and there was a cooperative team environment.

Within the information bias perspective the effect of different member roles related to information has examined, as in the group seeking literature. For example, Thomas-Hunt, Ogden and Neale (2003) investigated the effect of social status and perceived expertise on sharing common and unique information. Particular roles were assigned to individual group members, which did make a difference to information processes. Experts, for example, took on an information management role, ensuring all perspectives were considered; alternately socially isolated members were found to emphasize unique knowledge.

De Drue (2007) examined the effect of team outcome interdependence (members assume they will sink or swim together and that they benefit from each other) and task reflexivity on information sharing, learning, and team effectiveness in 46 semi-autonomous "real" teams (size from 4 to 13 members). When both task reflexivity and cooperative outcome interdependence were high, more information was shared, members learned more, and team effectiveness was higher. Strategies such as categorization (Hilmer & Dennis, 2000) have also been employed to encourage group members to pay more attention to information, and increase decision quality. This research overlaps with topics of interest from the group seeking perspective, yet the two perspectives have not been integrated. For example having a group focus on understanding the information need task may also have the effect of increasing the unique information shared and considered. Similarly tools to better support the group information use task might also increase the use of unique information.

Transactive Memory Systems

The second approach from the "groups as information processors" perspective is Wegner's (1987) conceptualization of transactive memory systems. Transactive memory systems are a group level construct that involves two parts: the recognition of the specialized knowledge of individual members and the awareness of "who knows what". To illustrate, as group members get to know each other, individual members recognize the particular knowledge of other members. Over time, instead of remembering, or learning all aspects of the task themselves, individuals just remember "who knows what". Based on this awareness the group can appropriately allocate tasks and responsibilities. Further, members can prompt others for input in situations where their expertise would be helpful. Wegner (1987) described the system in terms of three processes. The first process, called directory updating, is when members learn what other members know. The second, information allocation, represents the process of determining which member will hold the new piece of information, while the third, retrieval coordination, involves deciding who to ask to retrieve specific information. Wegner speculated that through the use of transactive memory systems group performance could be enhanced; groups could become more efficient and effective.

There is limited empirical research on the effects of transactive memory systems, and much of it has examined pairs, as noted by Moreland (2006). An example of how this conceptualization has been applied from the group seeking perspective is the work of Sarcevic, Marsic, Lesk & Burd (2008). In their examination of communication and information sharing in a trauma unit, the authors found that most decisions were not made collaboratively, but were channeled through the team leader. Information seeking, acquiring, sharing and use were organized through specialization and delegation. Leaders would specifically delegate tasks including memorizing critical information (information allocation), and remembering to update this information, to the relevant specialist. Repetition was avoided as all members knew who was responsible for which type of information. The authors suggested that this information behaviour was an example of a transactive memory system (Wegner, 1987).

Group Sharing Research within Information Science

Group sharing has also been examined within information science. Perhaps the most substantive and significant investigation of information sharing and use is the work of Allen (1977), who examined information flow in 33 project teams over ten years in a research and development organization. A critical concept from this study was the identification of gatekeepers, as people who were responsible for much of the information sharing, or flow in R&D teams. The gatekeeper was described as an individual who generally reads widely, is well connected, attends many conferences, is chosen for task forces, and agrees to share information with others as needed. Gatekeepers are generally easily identifiable; they are the first choice of most employees who need to know something. The idea of a "supersharer" or "gatekeeper" is pervasive through studies of information in other context including groups (for example Spence & Reddy, 2007).

The sharing of the results by information searchers was examined by O'Day and Jeffries (1993). Although they examined individuals, the results are interesting to this study of groups. The fifteen users studied were found to frequently share their search results with others proactively and by request. They shared the results with other members of their team, sometimes forwarding search result information unchanged, while at other times forwarding only a refined document, such as a high level summary.

Some individuals broadcast specific parts of the information to a range of people across the firm; this was done in both an ad hoc and regular manner. Several of the individuals studied also archived the most relevant information into a group repository. This sharing of information has the potential to change the information resources within a group, so is of interest in this study.

Specific barriers to information sharing, in addition to being identified in the hidden profile perspective outlined above, have also been examined in ethnographic studies in information science. In their study of information behaviours in the IMF for example, Harper & Sellen (1995) found specific reasons why individuals may not share. As many of the reports rely on professional judgment to clarify and confirm statistics, their production represents a social process. Numbers were shared during the creation of the reports, but only to those who have the same level of technical knowledge, and would be able to "interpret" the numbers. Other, more objective information, including confirmed statistical data, were readily shared with other individuals and groups.

Paepcke, (1996) identified organizational, group and individual level barriers to information sharing. Knowledge workers sometimes feel they need approval to share (organizational level), and the structure of groups at times affected how easily sharing could be accomplished (group level). At the individual level a lack of common understanding or terminology may impede the sharing of some information, which mirrors the findings of Harper & Sellen (1995). Paepcke (1996) also noted the fact that much information is "hidden". Groups share specific process documents and details, while important facts that may be 'obvious' or known to all are missed. This affects the use of the shared information. It is 'useless' without talking to an expert. This barrier to sharing has been found across many studies including Ackerman & Halverson (2004) and Hertzum (2002).

Information sharing has also been examined in terms of a cost benefit analysis (e.g., Widén-Wulff and Davenport, 2005). In their analysis of information sharing in two organizations (an insurance company and a biotechnology firm) the authors found very different patterns. Within the biotechnology company, a more unstructured and smaller organization, information sharing was related to compliance, triggered by the demands of the project, and seen as mandatory. Pragmatic sharing, sharing based on a judgment of

time and consequences of not sharing, was observed, as well as formative, where the individual would weigh the cost versus benefit of sharing overall awareness type information. Sharing in the insurance company was found to be responsive. Someone asks a question or needs information and another member supplies it, in contrast to the biotechnology company where sharing was motivated by a perceived opportunity, or an advantage. Within the biotechnology company information was shared when it might bring an advantage to the individual or group, or when not sharing would have major consequences. Their research suggests that organizational culture affects sharing within groups, as well as the particular industry. While Choo and colleagues (2008) did not investigate the group level, they also found that organizational culture affects information sharing. Widen and Hansen (2012) have worked to bridge the divide between research on information sharing and collaborative seeking, suggesting culture affects both seeking and sharing behaviours.

Motivations for information sharing have also been examined. For example Twidale and colleagues (1997) used the term "serendipitous altruism" to describe how people provided information to others with the understanding they will do the same for you in the future. Talja (2002) examined the sharing practices of scholars identifying four types of motivations: 1) Strategic sharing - conscious sharing to enhance group efficiency, 2) Paradigmatic sharing - sharing to establish a "novel" and distinguishable research approach either within or between disciplines 3) Directive sharing - as between teachers and students and 4) social sharing - sharing to build relationships or community.

Summary of Group Sharing

The research on group sharing identifies that groups will tend to focus on information held in common, and on information that confirms their existing preferences. Tactics to increase information sharing include increasing reflexivity, and structuring team discussions. Group sharing is complex; there are many social, cultural and political aspects to sharing. In addition specific qualities of the information itself may make it difficult to share. Groups create cultures of sharing, which are greatly influenced by the organizational context. Groups may also create transactive memory systems as a technique to increase their efficiency and effectiveness. There are areas of overlap

between the sharing and seeking research, but the two perspectives are not always considered together.

2.6.4 Information Studies of Student Groups

Student groups can be considered as work groups in that they are collectives organized to accomplish tasks, who share goals, work through interaction, are interdependent, need to maintain and manage boundaries, and are embedded within a class, and an institution which sets their boundaries and determines their resources. In a university setting, students are assigned tasks within a particular class, with the expectations set by the instructor. The tools and resources the group has to use are largely determined by the institution, while the Faculty and University instill the culture. While there is significant research on student groups and collaborative learning (see Cohen, 1994; Johnson et al., 2007 for reviews) there is little research directly on student groups and their information process, as noted by Tanni & Sormunen (2008).

Individual students have been examined in the information behaviour literature. The most comprehensive look at how students work with information is Kuhlthau's (1999) examination of how students write term papers. Her information seeking process model, which identified six core stages with associated actions, cognitions and feelings has been validated through multiple longitudinal studies. Kuhlthau collected data on students' behaviours through the entire task, from determining the topic through to the finished product. Extending this work, Vakkari (2001) observed students writing proposals, noting the close mapping of the search process with the "work" task. He consolidated Kuhlthau's stages into three distinct phases, pre-focus, formulation, and post-focus. During pre-focus students go through stages including initiation, selection and exploration (as defined by Kulhthau), followed by formulation, when the student gained a strong sense of the topic, which was followed by more specific information seeking processes including collection and presentation associated with post-focus.

To date there is not similar depth of understanding of student groups. Hyldegård (2009), as discussed earlier (Section 2.4.1) used Kuhlthau and Vakarri's models to understand the experience of individual students as group members. Limberg (1999) also examined student groups, following five groups of five students as they worked collaboratively on a paper over four months. Similarly, her focus was on individual

learning and not on the group. As part of her analysis of individual members however, Limberg (1999) found that the way groups worked affected the information seeking and use and learning processes of individuals. She found differences between individuals who were in groups which had an atomistic approach to group work and those where the group worked more holistically or collaboratively. This factor, combined with interest in the topic, was found to affect individual information behavior. Her research indicates that the both the process of being in a group, and the processes of specific groups, do change individual behaviour, suggesting further research is necessary.

Both of these studies indicate that being part of a group changes the information seeking behaviour, and suggest an examination of the group itself is essential. The focus of the above studies is students working on reports – a question to explore is how things change when student groups are working on other cognitive learning tasks.

For example the information behaviour of virtual student math groups has been explored. In their work on information as social achievement, Zhou, Zemel & Stahl (2007) began with Wilson's (1999) definition of information behaviour and used chat logs of student math groups to identify how information needs are negotiated and constructed by the group. Through the analysis of conversation, the authors identified structured actions around information needs. They were able to identify the points where an individual identifies a need for information. This need was then noted by other members, who made suggestions, and asked for feedback on their suggestions. Through this collective action the group created new information that was relevant for them. This research highlights how new knowledge is actively and collaboratively constructed through group interactions in a particular context.

Perhaps the broadest examination of student groups comes from O'Farrell and Bates (2009) survey of 50 students (58.5% undergraduate; 41.5% graduate students) in the University College Dublin School of Information and Library Studies. The authors asked students about their information seeking and information sharing behaviours while engaged in group projects. The online survey contained 25 questions which asked about both group and information behaviours including: group membership, group meetings, group communications, use and sharing of information sources, perceived usefulness of information sources, problems during the group project, feelings about the group project,

as well as demographic information. They found that undergraduate students held an average of 4.7 group meetings for a project, while graduate students had 6.6 meetings. Students used text messaging as the most frequent way of communicating with other group members (97.8%) followed closely by email (95.6%) and in person (86.7%). Cell phones were used the least for this purpose (55.6%). Students shared relevant websites (95.1%) and journal articles (51.2%) with group members, and ranked sharing information resources as one of the top reasons they liked working in groups.

Motivation, difficulty controlling the group, poor division of labour, communication problems, and a difficult personality were identified as the aspects of group work students least liked. The students identified the top five problems encountered during a group project were: 1) time management problems (65%), 2) difficulties communicating outside meeting times (45%), 3) poor division of labour among members (42.5%) 4) general lack of resources in library on the topic (42.5%) and 5) difficulty deciding on relevance of information found (37.5%). This was an exploratory survey with just 50 respondents from a single faculty. The findings confirm the importance of communication and information to successful group work, and suggest further research is needed.

There has been some examination of tools to support student groups. For example Adamczyk and Twidale (2007) provided vignettes from their students in a graduate level design course. The student groups for this course were multidisciplinary, with members coming from computer science, art history, dance, human factors, narrative media, psychology and sculpture. The design project required that the expertise from the multiple disciplines to be shared. The students, particularly at the onset of the project, were eager for collaborative computer tools, but found the existing tools did not easily match the demands of their work practice. Even though the teams were provided with a Wiki environment to post material, the students frequently chose more freeform ways to share and document materials. For example some groups took photographs and shared them through Flickr.com; created video's and put them on YouTube.com, and shared internet resources using del.icio.us, a tagging system. In addition, the students chose to communicate face to face, as online was not seen as subtle or specific enough for the meaning they wanted to convey. Notably, the wiki was used to share ideas that might

help them write a report or paper, suggesting this technology is helpful for fairly straightforward information sharing, but not for more subtle design discussions and decisions. The testing of Coagmento (e.g. Shah, 2013) was completed using students as participants, but in pairs, and with experimental tasks.

While this current research was being conducted, two dissertations were completed that also examined collaborative information practices of student groups. Saleh (2012), as mentioned earlier in this Chapter (Section 2.4.1) examined the collaborative information behaviour of senior undergraduate engineering students, working on design projects. His focus was on the relationship between learning tasks and collaborative information behaviour, and both the individual level and the group were analyzed, though not at the level of group interactions. Lee (2013), looked at graduate student's collaborative information seeking in a group based learning setting, focusing on the factors that affected students' perceptions of collaborative work, and the difficulties in the collaborative process. As these dissertations were published after this study had been framed, they could not influence the design or understanding of the topic area.

2.6.5 Integration of Information Threads

What is known about the process through which groups identify their information needs, find and use information? Looking across the three perspectives, no holistic model was found that describes group information process in terms of the three information tasks, including information sharing. What has emerged is a list of elements that are common across the threads namely: information tasks, information activities, sources, tools, arefacts, roles and shifts in participation. Each will be summarized briefly below.

Information Tasks

There has been little examination of how a group identifies its need for information, despite this being a critical aspect of individual information seeking (e.g. Taylor, 1991). Fidel et al (2004) for example did identify that information needs emerged from individuals working alone, as well as from groups, specifically in meetings. Particularly for the Boeing design team (Bruce et al, 2003), the needs were formally noted in meetings as agenda items, and tracked over time. However some needs emerged from a less formal process, from the team members just "surfing around". Additionally,

information needs were also introduced by individuals outside the group, and then accepted by the group. Blake & Pratt (2006) found that the contextual information needed to refine and understand the information need was identified through discussion, frequently in meetings, and occasionally through email. The barriers to information sharing have been assessed in multiple studies. Having groups focus directly on the information need, to see if this would increase information sharing has not been explored.

There has been much research on the social factors affecting the process of finding information from other group members. There is little known about the process through which a *group*, rather than an individual searches for information as there is little research that has examined search within knowledge based groups. A set of features to facilitate collaboration during search have been established including: awareness, division of labour, persistence, communication, public and private space, and ranking or tagging. For the most part tools with these features have not been tested using "authentic" groups, working on "authentic" tasks.

Groups are challenged using information collectively, and create arefacts to enable them to collect disparate pieces of information. There is some indication groups could use better visualization tools (Reddy & Jansen (2007). The actual use of information in groups has not been examined as much as information sharing, which has focused primarily on the social influences on sharing.

Information Activities

Similarly, there has been limited research that has investigated the information activities of groups, although this has been well examined at the individual level (e.g., Ellis, 1989). Blake & Pratt (2006a; 2006b) have modelled a particular task, synthesis, while Prekop (2002) found three different information seeking patterns. Talja and Hanson (2006) in their conceptual article on the social practice of CIB suggested the following information practices: analyzing/interpreting/extracting; synthesizing; archiving and indexing; seeking; retrieving and filtering could be applied to information objects. It is not known if the information activities of groups are the same as those of individual, or if different activities are required.

Information Sources

A key theme across the three perspectives is the need to use other humans, both those within the group, and those outside, as information sources. Depending on the task groups use a range of sources. A key challenge is in collectively determining relevance (e.g., Hertzum, 2002; O'Farrell & Bates, 2009).

Tools

Within the *group seeking* research types and features of tools that could enhance group information process were discussed. Interestingly the research on *group search* generated tools, which did not seem to be informed by the *group seeking* research. Surveys have also been used to understand collaborative information behaviours in groups that appear to need support. There has been a great deal of effort to better understand collaboration in the find (search) task, yet from the group seeking research there is evidence that the need and use tasks may need more support. Currently no collaborative search tools are commonly used, while there are several available for download (e.g., Coagmento; SearchTogether). Instead, collaboration on search is more frequently supported through the appropriate of individual tools (i.e. texting, email).

Artefacts

Within all three threads of research the importance of artefacts to group information process was highlighted. In the Group Seeking and Sharing articles groups described the creation and use of arefacts, while in Group Search the persistence feature allowed for a group search artefact to be created. Interestingly while artefacts are critical to group information use in particular, there may be difficulty using tools to create, share and use artefacts, as noted by Adamczyk and Twidale (2007) and Paul and colleagues (2008).

Shifts in participation

Within group work, the group does not do all activities. It is not clear if groups actually search together, or if they only sometimes search. Shifts between the individual and group level was noted in the research on group seeking, search and sharing.

Roles

A benefit of groups is the diversity and range of information that can potentially be used to help create a novel solution. For this to happen group members need to manage their diversity, which often means the creation of roles and responsibilities for members. Individuals in groups have been noted to play specific roles, related to information tasks. Prekop (2002) provides the strongest descriptions of information roles, while Wegner (1987) provides a model of how distributed memory may work.

2.7 Summary

In this chapter the concept of GIP was examined, as well the related constructs of group processes, work tasks, and information tasks and activities. GIP is an emerging construct, and no definition currently exists. Group processes and work tasks are fuzzy constructs where there is little consensus on common language and taxonomies. Similarly, group information tasks and activities are not well conceptualized or understood. The information behaviour lens used in this research to help unravel the levels was described. Research from three separate streams (Group Seeking, Group Search, Group Sharing) pertaining to GIP were examined and integrated.

How groups work with information is considered critical to group effectiveness (e.g., Hackman & Katz, 2010. To date we do not have a holistic understanding of how a group identifies its need for information, finds information from a range of channels, and then works with or manipulates this information. We do not know how this process is integrated across multiple tasks and time. Relevant pieces of this puzzle have been examined from different perspectives. There has been limited examination of information needs, seeking and use as it emerges in "real" groups over time, or how these tasks can be traced within group interactions. This research seeks to examine the problem from an information centred framework, and uses an information behaviour lens integrated with a model of group processes (e.g., Marks et al., 2001) to better understand how work with information.

As with individual information use, GIP involves three key information tasks, identifying needs, finding and using information. How these are negotiated during group work is not clear. For example needs have been found to be established collectively in

meetings, but also emerge from individual work (Poltrock et al, 2004). However they have most often been established collectively (Orr, 1986, Blake & Pratt, 2006). Needs in group settings are not always immediately acted on; timing could be a factor (Reddy & Dourish, 2002).

During finding groups have been found to collaborate during all activities (i.e. constructing a query, examining results) however there is some debate (i.e., Fidel et al, 2004). For groups to use information together they frequently create temporary artefacts, which help them to actually see the information pieces, and debate them in a shared way (Gorman et al, 2000, Hertzum, 2002; Hirsch & Dinkelacker, 2004; Paepcke, 1996). To manage information related interactions as a group, there is evidence that groups shift from individual to group modes, throughout the task process (i.e. Fidel et al, 2003; Prekop, 2002; Reddy & Spence, 2006) and individuals in the group may take on different information related roles (Bruce et al, 2003; Erhlich & Cash, 1994; Prekop, 2002; Spence & Reddy, 2007).

A picture of GIP is emerging which needs to be confirmed. Groups at times work collectively to define needs, determine the channels to solve their needs, searching for people and for documents using tools, and then creating information artefacts to assist in the process of thinking through the information together. Participation shifts, the group is not always involved, and particular members take on specific roles. The key elements involved in group information process appear to be information task goals, a set of information activities to accomplish these goals, sources, tools, the creation of artefacts and changing levels of participation and roles.

What is known about GIP comes from a relatively small body of research, with different methods, units of analysis and criteria. The relationships that are emerging can be at best considered tentative. Starting with group processes and work tasks, a more robust understanding of the relationships group level is needed. Group information activities need to be identified and described, as well as the sources, and tools groups work with, and use to create artefacts. The transitions between individual and group work need to be examined, as well as the ways in which group members take on information related roles. Given that groups adapt, develop and change, these elements need to be

examined over time. Further, these elements need to be confirmed through multiple

samples, using a common methodology.

3.0 Introduction

This chapter begins with a discussion of the research objective and research questions. The methods that have been commonly used to collect group data were compared, to determine the best approach to answer the research questions. The particular design of this research, based on the research objective and the need to examine the essential elements of groups is explained, including the development of the Naturalistic Lab Group Study Protocol.

3.1 Research Objective

Given the background and context discussed in Chapter 2, the main objective of this research was to deconstruct knowledge intensive group work at the level of group interaction, using an information behaviour lens, to understand the process through which student groups identify information needs, find and integrate information to create something new. This research addressed an acknowledged gap. Effective use of information resources is considered critical to group effectiveness (Gardner et al., 2012; Hackman & Katz, 2012; Stasser & Titus, 2003). To date we do not have a holistic conceptualization of the process through which a group, rather than an individual or an organization works with information to accomplish their tasks effectively.

3.2 Research Questions

To accomplish this objective the following research questions were asked.

3.2.1 Research Question 1
Which phases of group and task activities prompt students to identify information needs, find and use information, and how can these phases be characterized?

Groups consume information to accomplish their tasks and manage their processes. The information tasks and activities of groups are not ends in themselves. They emerge from

the interactions of groups as they work together on tasks. The challenge is to understand how to untangle the group, the work task, and the information tasks.

To respond to this challenge, the first priority of this research was to examine the procedural level of groups. Knowledge based student groups have assignments which have a start pointing and ending point. But what really happens in between? Which types of group activities require information tasks? The framework of Marks and colleagues (2001) discussed in Section 2.2 was used as a starting point for identifying, classifying and describing the student group activities. This model was chosen as it reflected groups as complex organisms, and highlighted the need to accomplish multiple tasks over time. The phases of activities of each group were examined and the model adapted to reflect practice. The work tasks of the groups were also identified, classified and described, to provide a holistic understanding of group task and process activities. Answering this research question added to the understanding of group processes and tasks, and provided empirical evidence in support of a three dimensional model of group processes.

3.2.2 Research Question 2

How are the key information tasks (need, find, and use) negotiated within each of the phases of student group and task activities?

This second research question involved filtering group work through an information behaviour lens, as described in Section 2.4, to deconstruct group processes and identify how information tasks are negotiated by a group. Based on the evidence from previous research summarized in Chapter 2, eight specific elements of group information process were examined: information tasks; information task goals; information activities; sources and tool use; artefact creation; and shifts in participation and roles. Each of these elements is described below.

Information Tasks and Information Task Goals

To accomplish their tasks and work together, groups need to complete a process which includes three information related tasks: need, find and use. To better understand this process, the information task goals were identified within each phase of group activity. Prior work on information task goals was used as a base (see Table 3). Understanding

information tasks in this context extends the knowledge of information task taxonomies to student groups.

Information Activities

To accomplish their information task goals, groups require a range of information activities, as discussed in Section 2.4.4. The information activities used by the groups were identified as they emerged from the research. Previous categories of group information activities were used as a starting point (see Table 4). Identifying group information activities helps us understand the mechanics of how groups actually work with information.

Sources

As noted by Wilson (2000) in his definition of human information behaviour, it is important to consider the range of sources, including humans that are considered potential sources of information for groups. A source in this research is defined as a person, thing, or digital object that is used to provide information. Research on groups suggests that they do seek information from a range of sources from project files through to electronic resources (Poltrock et al, 2003; Saleh, 2012). The importance of human sources has been identified in the research on groups (i.e. Hertzum, 2002); primarily because many documents created within companies to accomplish one task do not contain enough contextual information to be "reused" for another without human mediation. A goal of this research was to identify the key sources used by student groups, to better understand the type of tools required to integrate information seeking and group work. Sources were identified as they emerged from the research.

Tools

The access to information sources often is mediated through the use of tools. The concept of a tool was interpreted broadly in this research. It was used to refer to any electronic or physical objects used to assist in the manipulation of information including laptops, cell phones, databases, word processing packages, flip charts, white boards or pen and paper. A range of collaborative and group based tools are available, however groups frequently use single user tools to accomplish group tasks (Morris, 2013; Whatley, 2009). This

research question focused on how student groups actually used tools, and included examining times when the need for specific tools or features was identified by the students. Tools used and needed were identified as they emerged from the research. Examining the tools used and needs expressed provided critical information about how groups work, to help design more effective tools.

Artefacts

Groups create and use information composites, in the form of artefacts which help them integrate information, and complete their task, as noted by researchers including Gorman et al, (2002); Hertzum (2002); Hirsh & Dinkelacker (2004); O'Day & Jeffries (1993) as well as Paepcke (1996). These artefacts of integrated information are essential to the process of groups "seeing" together and actually working with information. This research examined the creation and use of artefacts of student groups, to better understand how group information process can be supported. Artefacts were identified as they emerged from the research.

Participation

Group work involves shifts between individual and collaborative work, as identified by Hyldegård (2009). To better understand these shifts, and how they can best be supported, the participation of student groups across the stages of group processes and tasks were identified. Participation was defined as the number of group members who were actively engaged in the group activity. Active engagement was identified by the involvement of members with each other, with an information object or a computer, as observable through their verbal communication, and physical gestures. Participation was classified as one of three levels: Individual (student was working independently with no observable interaction with others); Sub-group (some members of the group working together, but not all); Group (the majority of members all observed to be involved in the same activity).

Roles

Not all group members play an equal role in group information process, as identified by Prekop (2002). Information related roles have been identified in studies of group

information seeking; however there has not been a consistent classification of roles within group information process. "Role" in this research is used to describe the particular responsibilities group members took on to accomplish information tasks and activities. A goal of this research was to identify and classify the roles individual students assumed, while working together on their group projects. Roles were identified as they emerged from this research.

3.2.3 Research Question 3

How can the information process of student groups be defined and modelled?

Based on the findings of Questions 1 and 2, it is hoped that this research can provide a robust definition and model of Group Information Process. This question will be answered through the integrative analysis of the data from all the student groups in both studies.

3.3 Studying Groups

3.3.0 Overview

These questions seek to shed light on a dynamic and complex phenomenon; the processes, tasks, tools and structures through which groups work with information to create something new. Progress in group research has been affected by particular methodological issues. Even within group research for example, researchers have tended to focus on the cognition and behaviour of individual members rather than the group (Forsyth & Burnette, 2005; Hyldegård, 2009; Hoyle, 2005; Levine & Moreland, 1998; Worchel, 1994). Additionally, as noted by McGrath and colleagues (2000), when *groups* were studied, they were examined as a simple system, with one directional cause effect relations. Groups were frequently studied in isolation (in a lab for example), removed from a particular context, and as if they were static entities that do not change or develop over time. Yet current theories of groups (e.g., Kozlowski & Bell, 2003) emphasize groups as systems. This current understanding of groups suggests that groups should be examined over time and in context to allow the changes in group interactions over time to be examined. Methods need to be created to permit researchers to examine how groups negotiate their interdependence, maintain awareness and build shared understanding over

the course of task completion. As described in Chapter 1, these four elements represent the essential factors that are necessary for understanding a group, rather than an individual, or an organization.

Consequently, as pointed out by McGrath et al (2000) and Hackman & Katz (2010), viewing groups as complex interactive systems, with multiple goals, suggests not only is a different kind of analysis necessary, but that methods themselves should be examined. To accomplish this, the common data collection methods used to examine small groups were compiled through examining research across disciplines including organizational behaviour (e.g., McGrath, 1884), psychology (e.g., Wheelan 2005), computer supported cooperative work (CSCW) (Olsen & Olsen, 1997; Sharp et al, 2007), information science (Case, 2007; Pickard, 2007) and sociology (Babbie, 200; Hare, 1976). These data collection methods were evaluated to see how well they would support the following requirements of this research:

1) Examine group work in context and as naturally as possible;
2) Provide rich detailed data of group interactions;
3) Capture all group activities including use of sources and tools;
4) Trace the essential group elements (interactions, interdependence, awareness, shared understanding over time);
5) Ability to replicate the process for multiple groups.

3.3.1 Comparison of the Common Data Collection Methods Used to Examine Small Groups

Based on a review of group research, the following methods were found to be most commonly used to collect data on groups: 1) experiments; 2) quasi experiments; 3) surveys; 4) observation; 5) interviews; 6) diaries. These methods are briefly explained, examples given, and assessed in terms of the criteria above.

Experiments

In "classic" group research (i.e. Cohen & Bailey, 1997; Hare, 1976; Hoyle, 2005; McGrath, 1984; and Zander, 1979) the common procedure was to recruit and organize individuals into groups. The groups would be randomly assigned to be control or experimental groups, and would be given a task to complete. All conditions except for the

experimental variable would be the controlled. Experimental research tests hypotheses about variables and can confirm causal relationships.

An example of experimental group research that has examined information constructs is Miranda & Saunders (2002) research on information sharing. They recruited 32 six person groups in 2 conditions; the experimental group was given an electronic support tool to assist in the decision making task. All the participants were recruited from the same undergraduate class, and randomly assigned to groups. All were given equivalent instructions, tasks and time to complete the task. The aim was to confirm the following hypotheses (among others): that the breadth of information sharing will have a direct positive impact on decision quality; and that the depth of information sharing will have a direct positive impact on decision quality. Quantitative measures were made of the performance of different groups, and statistical analysis was used to determine if the effect was statistically valid. The results supported the hypothesis regarding breadth, while depth in fact had a sizable negative effect.

How well does the experimental design, as demonstrated in this example, fit with the criteria of group level research? They authors were trying to understand a group level phenomenon, the effect of aspects of information sharing (breadth and depth) on decision making. These concepts were measured by coding the number of task related comments shared during a discussion sequence (information depth), and the number of distinct discussion sequences (breadth). In their discussion the authors suggest that a limitation of their work is that there may not be a simple, linear relationship between depth and decision quality. This highlights a key issue with some experimental research on groups, as noted by McGrath, et al. (2000). Group level constructs are often not simple and one-directional, yet they are examined as if they were so.

The experimental method provides the advantage of being easy to replicate for multiple groups. However the context is not "real" in the sense that these groups were created and their task did not have any "real" world implication. For this reason the complexity, and dynamics of group interactions in experiments may be limited, and the members may not have the same commitment or motivation to successfully complete the task as they might in "real" life (Carroll, et al, 2006; Hoyle, 2005). To compensate for

this, in some experiments there is an attempt to use simulated tasks, or to use contests or games to enhance the motivation of members.

The interaction of groups in experiments might not reflect the dynamic elements of groups over time. Convertino et al, (2004) identified that to examine collaboration, there is frequently the need to collect rich interactions through field studies and ethnographic methods, as experiments do not allow for the understanding of authentic practices, including context. Further, group members in experiments may be interdependent, but they only need to coordinate their actions for a short time, and generally in one location. In reality groups, even rapid task forces, need to coordinate over multiple sessions, and within and between meetings. "Real" group members would need to remain aware of what others are doing, and would build shared understanding and trust through time. These aspects of group work are not well represented in experimental designs.

Quasi-Experiments

The quasi-experimental method is frequently used in place of a traditional experiment when it is difficult to control the variables. Quasi-experiments retain some of the advantages of a controlled experiment, while allowing for more natural behaviour by groups. They are often conducted in the field instead of the lab. The design of quasi-experiments includes a range of different forms, some might involve manipulation, but they tend not to allow for randomization, nor is there usually a control condition (Hoyle, 2005). With the quasi-experiment the aim is to show a correlation between observable variables, rather than cause-effect.

Quasi-experiments can involve experiments in the lab which do not involve a control group, or randomization. Convertino et al, (2004), for example used a quasi-experimental design to test activity awareness in the laboratory, instead of in the field. The authors used authentic but simulated tasks and collaborative situations taken from their field studies, but examined students working on learning tasks in multiple collaborative sessions over time. Students thought they were working with another student; they were actually working with a confederate, which allowed aspects of the process to be controlled and manipulated. By comparing their results in the lab to the

results in the field, they were able to confirm the "authenticity" of their laboratory method.

Within the research on small groups, or more specifically work groups; the quasi-experimental method has been used in the field to examine the effect of interventions or intentional changes. This process allows researchers to take advantage of naturally occurring differences in the "real" world (Olsen & Olsen, 1997). For example in CSCW researchers have examined similar groups that use different groupware technologies, to try and understand differences. Within organizational behaviour quasi-experiments have been used to evaluate the effect of training, technology, or structural changes. Cohen & Ledford (1994) for example, worked with a large telecommunications company to evaluate the effectiveness of self-directed teams. Using a quasi-experimental approach they identified newly created self-directed teams in specific areas (customer service, technical support, administrative groups, and managerial groups) and found groups in matching functions which were not self-directed. They compared the groups in terms of effectiveness by collecting data through observation, surveys, and company performance data. These examples highlight how mixed methods and multi methods are frequently used in quasi experiments, to provide a broader perspective on the phenomenon being studied. The data generated from quasi-experiments, and the data analysis can vary greatly. Statistical analysis can be used, as well as more qualitative thematic coding.

Depending on the design, the quasi-experiment method can score well in terms of examining group work in context and as naturally as possible. It generally provides thick, rich, descriptive data, of group interactions over time. This method can allow for all group activities, including their use of tools and choice of sources to be noted. Especially in field based studies, this method has higher authenticity in terms of the key group criteria. Groups could be examined in their "real" setting as they develop over time, interactions could be observed, as well as how the groups manage their interdependence. How awareness and shared understanding are built and maintained could be traced.

Given the range of groups and "natural" settings however, it would be difficult to assess how representative one group is of others. Would the particular group behaviour be attributable to the task, the environment, or individual differences (Case, 200; Olsen & Olsen, 1997; Pickard, 2007)? A suggestion is that there is the need for multiple quasi-

experiments, across different tasks and domains, to provide a broader base of data (McGrath et al, 2000). Costs associated with quasi-experiments as a method to study groups can also be high, especially in terms of time. With quasi-experiments in the field, data is collected over time, and there is a need for interest and support from the host organization. It can take time to build the connections with organizations to allow researchers access, especially for longitudinal studies.

Surveys

Surveys allow researchers to administer a set of open or closed questions in person, on paper, by phone, or digitally, to a representative sample. Surveys can be used to: describe particular phenomena; to explain, answering the question why; or to try and establish a relationship between different variables (Babbie, 2001; Pickard, 2007). Surveys generally require quantitative analysis, although, open-ended questions provide rich data for content analysis. To be generalizable, surveys need rigorous sampling methods. Creating good surveys is a multi-step iterative process. Unlike experiments and quasi-experiments, participants may not require much time commitment to complete a survey, depending on the design. In the past, particularly as a cost effective way of acquiring a large amount of data, surveys have been used to understand aspects of small groups (Riva & Wachtel, 2005).

How have surveys been used to explore group level questions? Surveys are usually administered once and often at the end of a group session. The results may represent the groups only at the adjourning stage, or what is fresh in terms of an individual group member's perception of the group experience. This may not be an accurate picture of the changes or development of the group over time. In some cases surveys are administered at the mid-point and at the end, to counteract this issue.

Often group data is acquired by aggregating the results of individual respondents, which may not necessarily be a true reflection of the group level. Not all team members may respond to the survey (Riva & Wachtel, 2005). Who is given the survey, as well as who responds, are also potentially critical factors with group surveys. The survey may not be given to all members, as in the work of Van der Vegt & Bunderson (2005), who asked the supervisor and four of the team members to complete the survey.

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Deeter-Schmelz & Ramsey (2003) used a survey to investigate information processing in service teams, to explore the links between teams and customers. They administered the surveys in person to all team members, and returned in several hours to collect them. They used teams that had stable membership over the six months of the study, and data from teams with less than a 50% response rate were discarded. The unit of response was the *individual*, while the unit of analysis was the *team* level. Team scores were calculated by using the unweighted mean of the team member responses, and tests were used to confirm within-group inter-rater agreement.

In this example, the survey was administered at only one point in time, yet evidence confirms (see for example, McGrath et al, 2000) that group interactions are not static but develop through stages over time. Further there was some variability in the number of members of the teams who responded. The authors acknowledge in the limitations of their work that they are examining a "snapshot" of intra-team processes. They suggest that a longitudinal study would be necessary to examine the development and maintenance of team information processing over time.

Surveys do not allow for the group level to be examined in context and naturally, but most frequently rely on individual perceptions of group constructs. They do not provide rich details of group interactions, but a summary assessment. Depending on the design they could be used to prompt for reflection on group processes including the use of sources and tools, but from an individual perspective. Surveys can provide feedback on how the group worked together and maintained awareness or shared understanding over time, but from an individual's self- reflective point of view. Surveys are very useful in terms of being able to be re-used for multiple groups.

Observation

Observation is a core tool for collecting data on groups, especially in their natural setting. Observation can be direct, the researcher physically watching a phenomenon, or facilitated through the use of technology by video or audio recording an event, or by using software to track computer activities. The researcher may be a participant, a semi-participant, or a non-participant in the process. The goal of observation is deceptively simple; to gather as much information as possible, about how groups respond in a "natural" environment.

Observation is useful to help understand how groups accomplish specific behaviours in situ. Greenberg (2008), for example suggests observation is critical to the process of designing tools for groups. He confirms that observation has a strong exploratory dimension, and can reveal critical aspects of the task and the group process. He also suggests specific follow up observation is helpful to provide greater details of specific processes.

The work of Fidel et al (2004) provides a typical example of how observation is used to examine group work. As one of the key methods used in their field study, the researchers observed interactions between team members at meetings, at work, and examined documents related to the project. This data, along with interview data was analyzed using a cognitive work analysis framework, to understand the multi-dimensional aspects of collaborative information behaviour. The importance of observation to this study and this method was the ability to collect rich and detailed data, which allowed for a multi-dimensional analysis.

Observation is very useful for providing data related to the group level criteria. It allows the researcher(s) to consider group actions in their context, and as they naturally occur. Observation, particularly repeated observation of video recorded events, allows for rich and detailed data of group interactions to be collected and analyzed. By looking at group interactions as they occur, the use of sources and tools can be collected. As observation takes place over time and multiple sessions, group data can be collected that allows emergent phenomenon such as shared understanding to be traced over time. It is possible to replicate observation techniques for multiple groups, but the issue is time. There is some indication that people, and groups, change their behaviour when they know they are being watched (e.g. Riva & Wachtel, 2005) a factor that needs to be considered with this method.

Interviews

Interviewing as a method can be used in both qualitative and quantitative modes to help examine groups. An interview can take the form of a highly structured survey, which is administered face to face to encourage participation, and where all participants are asked the same questions in the same order. Alternatively semi-structured interviews allow for the unexpected, and provide opportunities for the researcher to be unscripted, and to

probe emerging ideas (Babbie, 2001). Case (2005) also separates brief interviews, which might include "door to door" strategies, from more in-depth interviews, such as the work of Chatman (1996). How questions are asked in an interview can depend on the methodology, whether for example you ask someone to describe their feelings toward a phenomenon, or invite them to reflect (Wimpenny & Gass, 2000).

It is possible to conduct a group interview, although most interviews in group research have involved interviewing individuals, to discover individual perceptions, beliefs or feelings about a particular aspect of group processes. For example, Bruce et al. (2003) in their case studies of collaborative information retrieval interviewed the team leaders, and all team members. If groups are interviewed, the researcher would have to consider the potential moderating effect of other members on responses of individuals.

Comparing interviews as methods to gain group level data, some challenges are apparent. Unless interviews are repeated over time, the perception of group development might be missed. Questions regarding group processes would have to be well designed, to ensure they probe for the experience of group interaction, as perceived by the individual member. Individual interviews would be helpful in terms of understanding individual outcomes, and the individual perception of the group and the task. In the same way individual cognitive changes could be self-reported, and the individual sense of any group innovation, or unexpected result. Interviews from various members would need to be analyzed in a similar fashion to reveal common themes, and where there were disconnects. Pickard (2007) warns of the rich and detailed data that interviews yield, and the need for clarity when designing the interview to ensure you have the evidence you need.

Interviews provide an excellent way of gaining an in-depth understanding of individual group members, but not directly the group. They do not allow for group work to be examined in context, as it occurs. Interviews would not easily allow for detailed data to be collected on group interactions, and unless interviews are repeated at various points during the group process, they may not provide a perspective of group awareness and shared understanding. They may be used to understand individual perceptions of group processes and effectiveness. The same interview protocol can easily be replicated for multiple participants.

Diaries

Diaries aim to gain direct insight from individuals about their thought processes, feelings and behaviours, and how these change over time (Olsen & Olsen, 1997; Pickard, 2007). In contrast to interviews, the aim is to capture the details without the presence of the researcher. There is no potential for "interference" from the researcher, but there is less incentive for participants to answer, or to provide much detail. However, diaries have been used in information science and in CSCW to provide details of how individuals solve information related problems, or interact with new technology (Case, 2007; Olsen & Olsen, 1997). There are a variety of forms diaries can take. They can be written, or can be recorded by the participant at a predetermined time point. They can be unstructured, or structured, providing prompts for the participant to consider. The more complicated the form and process, the less likely participants will remain committed to the process. Pickard (2007) suggests researchers need to be clear about the purpose and value of the diaries to encourage adequate response.

Diaries have not been used as frequently in group research, but there are some examples. Hyldegård (2009), used diaries as one of the methods to capture the information related activities and the affective experiences of individual group member over four weeks, as they were working on a group project. Combining methods, Hyldegård used the diaries as a tool in the interviews with the group members, to follow up specific comments, or ask for elaboration on the activities and attitudes that the members had been expressed in the diaries.

As a tool for collecting group level data, diaries are only partially appropriate. Diaries do not provide a window through which groups can be examined in context and naturally. They do not allow for rich detailed descriptions of group interactions to be collected, while they may provide clues about the individual's feelings and thoughts of group interactions. Examining the diaries of all group members may reveal patterns or conflicts, or highlight differences in perceptions among group members. In this way, diaries may provide clues to changes or developments in groups over time, which may reveal evidence of stages of group development. The diary may be structured to encourage group members to consider group concepts, and provide individual assessment of group effectiveness.

3.3.2 Comparing Methods

McGrath (1994) suggests that there is no perfect method, all methods involve trade-offs and present dilemmas. The table below provides a summary of the relative strengths and weaknesses of the methods in terms of meeting the key requirements of the research problem.

Table 5   Comparison of Methods of Data Collection in Group Research

Method	In Context and naturally	Capture Rich detail	Capture all Group level Activities (Including use of Sources and Tools)	Trace interactions, interdependence, awareness, and shared understanding over time.	Replicate the same process for multiple groups
Experiment	No	Partial	Partial	Not easily	Yes
Quasi experiment	Yes	Yes	Yes	Yes	Not easily
Survey	No	Limited	Limited	Limited	Yes
Observation	Yes	Yes	Yes	Yes	Time consuming
Interview	No	No	Partial	Limited	Yes
Diary	No	No	No	Limited	Yes

The methods that best allow for the essential elements of the group to be examined are observation and quasi experiments. Ideally, as there is no perfect method, and group phenomena are complex, the preferred way of studying groups is through using a mixture of data collection methods (a multi-method approach). This approach allows for a balance between the need to capture the essence of the group, with the need for rigorous, valid, and reliable data.

3.4 Developing the Naturalistic Lab Group Study Protocol

Based on the comparison of methods above (Section 3.3.1), the "Naturalistic Lab Group Study" design was created to answer the research questions posed in this research. The goal of this quasi-experimental method was to preserve the benefits of the natural world but move them to the lab, where data could be more easily captured. The key elements of the "Naturalistic Lab Group Study" design were as follows:

1. Participants should be "real" groups that have a mandate outside the study;
2. Groups bring their own group project – which have goals and objectives outside the study;
3. Groups are allowed to set their own meeting schedules;
4. Groups agree to hold all meetings in a controlled setting (i.e., a Focus Group room), where all activities and actions can be observed and recorded;
5. Groups agree to use computers with tracking software installed (either by installing software on their own computers, or agree to use research computers during their meetings);
6. Groups agree to allow the researcher to become a "silent" group member, included in all group communication;
7. Groups agree to complete diaries summarizing their individual work on the group project between meetings, if required;
8. And groups agree to individual surveys and a group interview after the group project is completed, if required.

In this protocol groups are allowed to work on their own projects, according to their own schedules, and determine their own processes. They act as they would "naturally", so the context is real. As they work their behaviours, communications and actions are captured through multiple methods, both within and between meetings. Built into the design is the ability to incorporate multiple types of data collection methods (observation, survey, diaries, artefacts), to enable detailed analysis of the group level.

The rich data that can be collected using this method allows for the observation and examination of the four key elements of group work: interaction, interdependence, awareness and shared understanding, over time. Through the repeated viewing of the video for example, group interactions can be observed, including how they emerge and develop over time. All behaviours including how members alert each other work is done, if they need help, or if they discovered information of interest to the whole group could also be examined. The negotiation of shared understanding could potentially be assessed through examination of the groups' communication and the changes in artefacts. Activities between meetings could be analyzed through diaries. By surveying individuals and groups at the end of their project, individual and group perceptions can be compared.

In addition, an added element of using real groups (i.e. they were not created for this research) working on authentic tasks increases the likelihood that participants are motivated, and that their processes are "natural". Finally, another important aspect of the design is the ability to compare multiple cases. The Natural Lab Study protocol can be used to examine multiple groups in replicated studies.

This research design also provides multiple ways of insuring validity and reliability, as recommended by Cresswell (2007). The Naturalistic Lab design allows for rich, detailed data to be collected from motivated participants, helping to ensure external validity. Data can be collected from multiple sources and sessions, and analyzed in phases to allow for triangulation. The analysis and coding can evaluated through peer review and debriefing. The specific strategies used in this research are discussed in Section 3.6.7.

The Naturalistic Lab design thus directly addresses the concerns regarding group methods raised by McGrath et al. (2000). It involves examining real groups, working on authentic tasks and interacting over time, in a controlled setting to monitor and capture the group and its activities. The design allowed for the monitoring of key variables over time, and for comparisons to be made within and between groups.

3.5 Research Design

The Naturalistic Lab Study protocol was used to examine multiple groups in replicated studies. The first set of groups were required to complete their task in a single session, while the second set required multiple sessions to complete their task. A reflective and integrative chapter study provided the synthesis of findings from the first two studies, and the creation of a model.

Table 6   Research Design

Phase	Goals	Data Collected and Assessed
Chapter 4 Single Session Groups	To deconstruct the processes of student groups working on a class assigned task in a single session to identify how they work with information. Respond to Research Questions 1 and 2.	• Demographic and Prior Experience Survey • Video of group meetings • Morae log files of computer activities

Phase	Goals	Data Collected and Assessed
Chapter 5 Multi Session Groups	To deconstruct the processes of student groups who worked on a class assignment over multiple sessions to identify how they work with information. Respond to Research Questions 1 and 2.	Demographic and Prior Experience Survey • Video of group meetings • Morae log files of computer activities • Emails • Post Study Individual Surveys • Post Study Group Interview
Chapter 6	Analysis and discussion of a taxonomy and model of Group information process. Responds to Research Questions 1, 2 and 3.	Synthesis and integrative analysis of data from Single and Multi Session Groups

3.6 Application of the Naturalistic Lab Group Study Protocol for this Research

3.6.0 Overview

This research was designed to examine group processes in situ. It balanced two different approaches of studying groups: to be able to observe group processes as naturally as possible as they occur over time, and to be able to capture rich data of all group behaviours and actions. The protocol received ethics approval from Dalhousie's Social Sciences and Humanities Human Research Ethics Board in 2007, and was continued through to 2014.

"Real" student project groups were recruited from a Faculty that has professional undergraduate and graduate degrees, and from specifically targeted classes where there was a group assignment worth a significant (20% or more) part of the final grade. The recruited groups were invited to work on their instructor designed group projects in the Group Work Lab, a room specifically designed to allow for the unobtrusive capture of all activities through multiple camera and microphones. The students were supplied with Toshiba tablet personal computers which had logging software (Morae) installed, so all activities on the computer could be tracked (see Section 3.6.3 for more details).

The protocol was designed to capture all activities including use of information both within and between group meetings where relevant. All participating student groups

agreed that their activities could be audio and video taped and that their computer activities could be tracked. For Study Two, which involved groups meeting over multiple sessions the groups also agreed to the following: they would add the researcher to their email discussions; they would individually fill out weekly diaries; and after the completion of the assignment they would both complete a post study individual survey and be interviewed as a group. These steps were not utilized for the groups in Study One, as data was collected as part of the actual class, and it was not possible to extend beyond the established time.

3.6.1 Recruitment

The participating groups were recruited from selected classes at Dalhousie University. No formal sampling was done, but particular types of groups were sought, and groups had to meet specific criteria. Since the aim was to examine knowledge based work, the targeted classes were in professional schools. The students in these schools have group work as a core learning outcome, and all students have practicums, internships or coop terms, ensuring all potential participants had prior work experience. Typical assignments in these schools were complex and reflected professional tasks. In addition, to ensure groups were motivated, all the targeted classes had group projects which represented a significant part (i.e. more than 20% of the final grade) of the course work.

Recruitment strategies included posting flyers in the building, and attending the targeted classes directly to make an announcement and call for volunteers (see recruitment flyer, Appendix 2 and Recruitment Announcement Appendix 3). In addition to this active recruiting process, the researcher was approached by a Professor who volunteered his class to participate. The single session groups presented in Chapter 4 were recruited by this method, with the usual proviso that the students receive informed consent and volunteer. These students were also given an option after the study to "opt out". Table 7 below provides a summary of the participating groups.

Table 7   Summary of Participating Groups

Group	Group Size	Number of Sessions	Hours	Timeframe
Study 1 (all graduate)				
Group A	5	1	5	I Day
Group B	4	1	5	I Day
Group C	2	1	4.5	I Day
Group D	3	1	4.5	1 Day
Study 2				
Group E (undergraduate)	5	5	7.2	2 Months
Group F (Graduate)	4	6	14.3	3 Months
Group G (Graduate)	6	10	18.4	3 Months
TOTAL	7 Groups	25 Sessions	58.9 Hours	

3.6.2 The Tasks - The Assigned Class Projects

The researcher did not participate in the creation of the assignments, or in how the assignments were carried out. Each of the groups brought their class assigned course projects with them, to work on them in the Group Work Lab. Groups set their own agendas, and the multi-session group set their meeting times. Their class projects formed the experimental task(s) for each group. Details of the projects have been provided in Chapters 4 and 5.

3.6.3 Observation Protocol

The same protocol was used for all seven groups, with only minor changes, which are noted below.

Space Description

The studies took place in a research space which contained a suite of labs designed to support observational studies, including studying small group interaction. The research space included a Group Work Lab, an Observation Lab and a Usability Lab. The Observation Lab was located between the two other labs, and contained a one way mirror

on both sides. Activities in both rooms could be observed, and data collected and managed from the Observation Lab.

The Group Work Lab contained a series of configurable tables, allowing the researcher to re-arrange the meeting space to accommodate various group sizes. Built into the corners of the Group Work Lab were four pan/tilt cameras and three ceiling microphones. They were designed to recede into the corners, and be largely unobtrusive. Three portable microphones were used to enhance sound recordings. The cameras and microphones allowed all activities in the room to be recorded. As well, the room included a suite of ten tablet computers, which had tracking software (MORAE) installed. The computers were Toshiba tablet PC's, which could be used as a standard laptop, or could be swiveled to become a tablet. A stylus was included that could be used to write on the tablet, as well as draw. The MORAE software installed captured all on-screen activity, all keyboard and mouse input, as well as audio and video. Essentially all activity by a user on the computer was recorded, and could be viewed and analyzed.

For the groups in Study 1, there was a need to capture data from two groups simultaneously, while ensuring each group could work privately. For this study both the GroupWork and the Usability lab were used. The Usability Lab was set up as an individual office but could also accommodate a small group. This room was furnished with a large desk, a computer, a white board and a flip chart. The desk was quite large, and could accommodate multiple people. Two pan/tilt video cameras were installed in this room, as well as two microphones. The laptops in the Group Work Lab were made available in this room as well.

The Observation Lab included a set of tools to help record, monitor, and archive the audio and video data from both rooms, and work with the Morae Log files (See Figure 14 below). The room included an intercom system, controls for the speakers and cameras, a bank of nine DVD recorders, external hard drives, and a large monitor. The cameras and sound from both rooms could be could be mixed and directed through a Sony Anycast station. This device included a video switcher, audio mixer, and camera control functions, and allowed the researcher to control the multiple cameras and microphones, and send the recorded data to the appropriate hard drives. As the video files, especially of long meetings were quite large, three external hard drives were

connected to the Anycast, to record the feeds from the cameras and microphones. The equipment in the Observation lab was designed so that the researcher could adjust the camera angles during the group meetings, observe the meetings directly through the glass, as well as see what the cameras in both rooms were capturing through a split screen on the large monitor.

View from the Control Room into the Group Work Lab. The large monitor shows the view of all four cameras, and the AnyCast is on the desk.

Figure 14   View from the Control Room into the Group Work Lab

Pre-Session Set Up

Prior to all group meetings, the Group Work Lab was prepared in the following ways. Tables were put together in the centre of the room, and all four cameras were turned on to capture group activities from multiple angles. Desktop and ceiling microphones were used to ensure all conversations were recorded. A tablet computer was set up for each student, giving them access to the internet, Microsoft Office suite of products, as well as any special software the group might request. The same tablet computer was assigned to the same student for each meeting. The tablets had tracking software installed (Morae), so that all computer activities could be examined. Morae was launched and set to start recording when the keyboard was used, on each of the computers. To simulate a typical meeting space, the room also included a flip chart, markers, pens and paper.   Additional equipment (e.g. a projector) could be supplied as needed. Groups D and G also had the use of a large monitor which had been added to the room.

After the Group Work Lab (and the Usability lab when required) was set up, the researcher entered the Observation Lab to turn on all the equipment necessary for viewing, recording and saving data. The cameras and sound were mixed through an Anycast station, which was switched on first, and configured for the group. The cameras and speakers controls were turned on, and the Anycast was set to record. The large monitor was switched on, and used to help ensure the cameras were focused on the relevant activities of the group.

In addition to storing data on the hard drives, the Observation Lab had a bank of nine DVD recorders, six of which were used for this study. Building in redundancy, each DVD was set to record sound and image from a single camera and microphone, as well as from the combined Quad screen image. When the group entered the room the Anycast was switched on online and the DVDs set to record, to ensure all activities were captured from multiple angles.

A sign was posted on the door after all equipment was activated to indicate research was in progress. A researcher was present for all group meetings, monitoring from within the control room, which is separated from the group work lab by one way glass. The researcher did not intervene in the meetings, but allowed the group to work as they normally would. Each group was informed that they could ask for the researcher for assistance, or any additional equipment as they worked.

Post-Session Procedure

After each meeting, the researcher stopped the AnyCast which triggered all the data to be stored to the hard drive. The DVD recorders were stopped and the data was copied from the recorders to DVD's. Each meeting generated five DVD's from each camera separately, as well as a Quad view with all four cameras. All the data was also captured and stored on the hard drives. After the Group left the Group Work Lab (and the Usability Lab when used) the researcher stopped the Morae recorder, and saved the files, transferring them to the controlled access computers locked in the Observation Lab. Any documents, files or folders created during the Group meeting were also saved and stored on computers in the Observation Lab. The researcher also noted any issues or problems with any of the computers or equipment. Any issues the group had experienced using the room or the technologies were also recorded.

3.6.4 Data Collection Instruments

The following instrument was used with all 7 Groups:

Demographic and Prior Experience Questionnaire (see Appendix 4).

This survey was designed to collect information about the comfort and familiarity of participants with technology and the internet, their prior experience with groups, as well as basic demographic information.

Multi-Session Groups (Chapter 5)

For the Multi-Session Groups, the following instruments were used to capture data between meetings, and to gain individual and group feedback after the completion of the class assignment:

1. **Digital Diary** *(See Appendix 5):*

Prior to each meeting (subsequent to the first one), all group members in Groups E to G (Multi-Session Groups) were asked to individually complete a digital diary. The diary asked each member to identify their activities on the group assignment according to the following categories: (A) planning; B) gathering materials; C) writing; D) assessing; and E) revising/editing/proofreading; and to assess the percentage of time spend on each. It also included open ended questions to probe for challenges, use of technology, and collaboration with members outside group meetings.

2. **Post Study Individual Survey** *(Appendix 6)*

At the final meeting, which was set for a convenient time after the groups submitted class project, each member was asked to fill out a survey modified from the work of Deeter-Schmelz & Ramsey (2003) regarding their group experience. This survey included 18 questions that probed for information use and group dynamics and used a five point Likert scale from strongly disagree through to strongly agree. In addition open ended questions were included to probe for their individual assessment of the project, their success, barriers experienced, and their overall assessment of working with the group.

3. **Semi-Structured Group Interview** *(Appendix 7)*

After each member completed their individual survey, they were asked to participate in a semi-structured group interview. Each group was prompted to reflect on the following things: what they had been trying to accomplish; if their plan changed; how they worked

together; how they would rate their motivation; their trust of each other; whether a leader emerged; how they searched and shared information; their technology use; what they might do differently if they had a similar assignment; and if they would work with the same group again. The researcher started with the questions listed in Appendix 7, but adapted the interview based on responses from the group.

3.6.5 General Procedure

The same procedure was followed for all groups with only minor changes. The Group Work Lab and the Observation Lab were set up, as noted in the pre-session set up. During the initial meeting the group members were oriented to the Group Work Lab, shown the tablet laptops, and were given a few minutes to "play" with them. Each group was also shown the Observation Lab; the equipment and controls in the room were explained to make the procedures as transparent as possible. The research study was introduced to them, and any questions were answered. These steps were taken during each orientation to ensure each Group felt as comfortable as possible with the space, and to reassure all group members that the goal of the research was to examine group process, not the particulars of their progress towards their class assignment.

After the orientation and time for questions, each individual member was asked to read and sign the Description of Procedures and Consent Form (see Appendix 9), and to fill out the Demographics and Prior Experience Questionnaire. Before the Researcher left the room, the groups were also given an open invitation to ask for any tools or materials they might need, over the course of the study, to complete their assignment. The Researcher specifically invited them to view the space as "their own", encouraging them to even move the tables, and equipment to suit their needs.

At the end of every group meeting, as noted in the post session procedure, the video was copied to multiple DVD's and to an external hard drive, the Morae files were copied to the hard drive, and all paper was stored in the Group folder. All files and folders were kept locked in the controlled access Observation Lab.

3.6.6 Data Analysis

To answer the research questions the group activities were deconstructed in the following manner, informed by a task analysis approach modified from (Bystrom & Hanson, 2005

and Toms, 2011). As identified above several different types of data were collected from the groups, depending if they were a multiple or single session group.

Developing a process for Video Analysis

The initial and primary data source for the analysis of data in both studies was the video and audio recording of all the group meetings. As noted by Heath, Hindmarsh and Luff (2010), video tapes provide an exceptionally rich source of data that allows for fine-grained analysis of social organization. The questions addressed in this research focus on understanding group behaviours and processes as they occur over time. Using video as a data source allowed for the examination and re-examination of all group communication (verbal and non-verbal), including all actions, gestures and looks, as well as the evolving process of making decisions and creating artefacts.

This richness of the data was both strength and challenge. The process of analyzing audio-visual material has been described as "particularly difficult" (Heath, Hindmarsh & Luff, 2010, p 1), as even a second or two of film contains incredible detail. In total 60 hours of audio-visual material was collected from the groups in this study. This video captured all group activities, and included complex, and overlapping conversations. Such was the complexity, creating a transcript from the videos proved impossible. Files were sent to a transcription agency, but they were unable to accurately reproduce the conversations. Given this the challenge was to create a data analysis plan that would enable the research questions to be addressed, which required analysis of changes over time, but one that did not require fine grained analysis of all 60 hours, which would be almost impossible.

Within the literature on qualitative data, there is only a small amount written about the process of collecting and working with video data, despite the clear advantages of the medium (Heath, Hindmarch & Luff, 2010). Key techniques used for the analysis of video include conversation analysis (e.g., Mondada, 2006; Peräkylä, 2005), discourse analysis (e.g., Foster, 2009; McNaughton, 2009), and qualitative comparative analysis (e.g., Leech & Onwuegbuzie, 2008). A main component of both conversation and discourse analysis involves the selection of significant micro-episodes for close analysis (Foster, 2006; Peräkylä, 2005). To identify these significant episodes it is necessary to get close to the data through the process of watching and re-watching, and writing descriptive

notes, and creating a log of contents (McNaughton, 2009; Spiers, 2004). After significant episodes had been selected, they would be analyzed using the specific techniques mentioned above. Discourse and conversation analysis have been used to provide a deep understanding of, for example, how a group might achieve shared understanding, however they accomplish this through the microanalysis of seconds in time. The aim of this research in contrast, relates to patterns and changes over the entire process of task work.

As a result, the analysis of the audio-visual data followed a hybrid plan. The first stage of video analysis described above (getting close to the data through descriptive notes and creating a log of contents) was followed by process of thematic coding of group processes and information task and activities, as described in detail below. This particular analysis procedure emerged as a response to the particular research questions, and the main objective of the research, which was to understand how groups worked with information to accomplish multiple tasks and manage processes over time.

Preparing the Video

The video was common in both Studies, and the analysis of the video, as noted below was accomplished first, and was the primary source. The following steps were followed for the preparation, coding and analysis of the video of all seven groups.

1. Due to the large size of the video files, prior to using the videos the files had to be compressed, and the format changed to a standard movie file format.

2. Each meeting for each group generated multiple videos; one for each camera, then a combined video that provided the quad view of all for cameras. The best video was selected for analysis. In most cases the first choice was the Quad view, so the actions captured by all the cameras could be viewed together, giving a multi-angle view of the group. In some cases, due to an issue with the recording procedures, the Quad video was not available. For these meetings all the DVD's were scanned, to see which one provided the best overall view. In the end a single DVD was analyzed for each meeting as the primary source. The additional DVD's were used as necessary to supplement, or to provide more details.

3. The chosen audio-video file of each session for each group was loaded into a HyperResearch, a Qualitative Data Analysis software for coding. HyperResearch

was able to accommodate the large video files, so the sessions of each group were viewed as a single file. At the time this research began, HyperResearch handled large video better than NVivo, and provided similar capabilities. HyperResearch is designed to allow the video to be coded directly, and controlled from within the program. Sections of video could be selected by the researcher, and then codes applied directly. The software allowed for the building of code dictionaries, to code and retrieve, build theories, and conduct analyses of data.

Coding the Video

Each session of each group was coded through the following steps. During this coding process the videos were viewed as many times as necessary to ensure all the activities of interest had been fully examined. In addition, when it was necessary to examine specific details of computer use the log files were used in tandem with the video.

Step 1: *Identifying Stages of Group Activities- Descriptive Coding*

As identified above, the first stage of analysis involved becoming familiar (*close*) with the data. The video of each session was viewed, and notes were added in HyperResearch to describe all activities relevant to GIP. To ensure all activities were described systematically, each video was viewed multiple times and sections were repeated as necessary.

During this stage, the researcher identified the key stages or phases within each session. A stage was the term used to represent a block of time when the group engaged in one particular activity. Group activities are fluid, but there was almost always a core activity or theme that could be identified and marked in terms of a start and stop time. For example at the beginning of a session members often took a few moments to greet each other and socialize before beginning their task. This would be marked in terms of a stop and start time. The groups might then begin updating each other on task activities completed between meetings, so this would be marked with a start and stop time and labelled as a separate stage. Whenever a group changed activities, a new stage would be marked. Some stages for some groups clearly mirrored a particular task or subtask (e.g., create a survey), but not always. Times when the group appeared to not have a clear focus were given a label to indicate this (i.e. off task or social). The labels of each stage were created to summarize what the group actually did during that stage. The process of

identifying stages helped provide a critical log of group activities. It also helped make the hours of data more manageable. For each group, Step 1 was completed first for all the sessions, involving multiple viewing of the videos.

Step 2: *Thematic Coding of the Video*

After the descriptive analysis phase and classification of the stages, each stage of each session was coded using the structured process outlined below, corresponding to Research Question 2. Through this structured process the information behaviour lens was applied to the group level.

a) Information tasks (Need, Find, Use) and activities (See Table 4). The information tasks were classified by goal, according to a code dictionary that incorporated previous taxonomies presented in the table earlier this chapter (Table 2).

b) Similarly, the information activities were coded using Table 4. New codes were generated as required. (See also Coding Manual Appendix 10)

c) The sources, tools and artefacts used during each stage were identified and coded. Sources used included both human and document based sources (e.g. prior knowledge, articles, books, notes, humans, specific web sites, Wikipedia). Sources were coded as they emerged, directly from the data. Tools used or requested were coded. These were also coded as they emerged directly from the data and included a mix of technologies and tools (e.g., flipchart, computer, pen & paper). The artefacts the group created were also coded. Examples included outlines, flow charts, and presentations.

d) Participation and Roles evident during each stage. Changes in participation level from individual through subunits within the group, to the entire group were noted for each stage. The patterns were noted for the stage, and then linked to the information tasks and activities. The roles of individual members in relation to information tasks and activities were also classified. Roles emerged to describe points in time when individual group members took on a specific role, for example; Analyst; Director; Scribe; Searcher; Writer. The scribe for example would be used to label an individual who volunteers to write things down, on a paper, a computer, a flip chart, or a white board. They may or may not be generating the content, the role indicates specifically that they were making

information explicit in form. These roles emerged from the data. (See Coding

Manual, Appendix 10 for details)

e) Additionally in response to the data, a set of codes also emerged related to

interpersonal processes and affective aspects of the group (Social). For example

frustration emerged as a code in response to group members specifically

commenting on a high degree of frustration with the task or process. These codes

did not relate to a specific research question, but helped to illuminate aspects of

the context. They are not analyzed in detail in this research, as they are outside the

scope of the study.

A sample of how this coding was accomplished using HyperResearch is

illustrated in Figure 15 below. Figure 15 presents a screen capture of the HyperResearch

interface which illustrates the coding process. This shows a snapshot of the video,

representing a second of the group process. The video show the quad view, so the group

can be examined from multiple angles. The highlighted part on the bar shows the stage

that was currently being coded. The right hand side of the interface allowed for the codes

to be inserted and the coding dictionary to be searched.
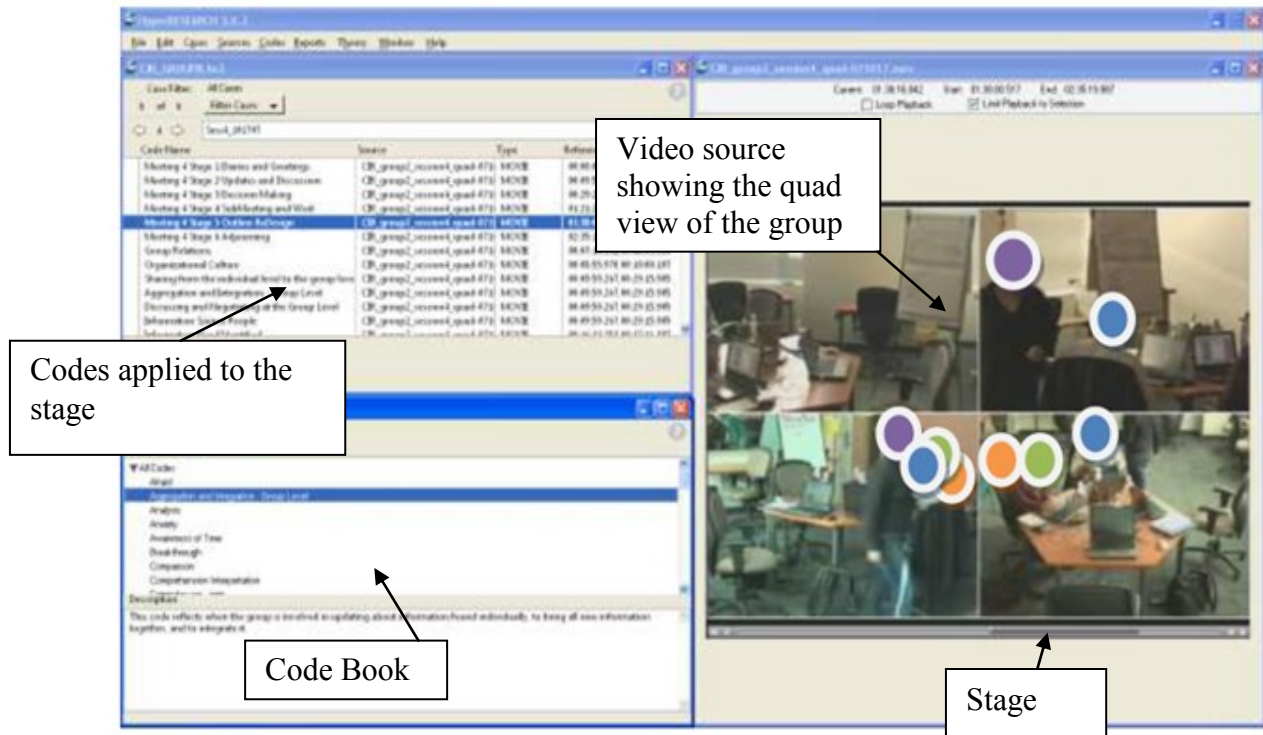
Figure 15   Screen Capture of HyperResearch including Coding of the Video

Coding the video directly, rather than a transcript allows the layers of the group interactions to be noted. For each stage the key group activity would be coded. Within each phase of activity the information tasks and activities were then coded. How the groups were using tools, if they were looking at each other or at the flip chart or white board, or at a source – all these details that could only be observed in the video were coded. This allowed for elements such as the changes in participation to be noted, which may not have been evident from the transcript alone. Figure 16 (below) shows the narrative transcript and the coding that was generated.

As they began the process of Identifying Challenges and Risks (subtask 1), the group decided to divide the labour. Participant 1 volunteered to be the scribe - to write things down. The group determined they would go through the case study and identify the information

00:08:21.860,00:16:02.203	Information Task - Sharing
00:08:21.860,00:16:02.203	Information Task - Using
00:08:21.860,00:16:02.203	Information Goal - Decision Support
00:08:21.860,00:16:02.203	Information Activity - Synthesize
00:08:21.860,00:16:02.203	Information Source - Map
00:08:21.860,00:16:02.203	Information Tool - Pen and Paper
00:08:21.860,00:16:02.203	Information Tool - Word
00:08:21.860,00:16:02.203	Participation - Group
00:08:21.860,00:16:02.203	Participation - Individual
00:08:21.860,00:16:02.203	Shared Understanding

The group actively worked to achieve a shared understanding and consensus by discussing the facts and visualizing things on the map..

Figure 16   Working with the Data

Analysis of the Data

As the coding proceeded through the above steps for each stage, then session, for each group, the Coding Manual (Appendix 10) changed and evolved. After all the sessions had been coded, the codes were reassessed to ensure consistency.

The descriptions of each group were examined to make sure all the tasks, activities, sources, tools, artefacts had been noted, and the patterns of participation and roles identified. For each session there was a thick description of group processes, as well as the layers of coding outlined above.

This data was analyzed using the following steps.

1. The data for each group was examined over all their sessions, and their activities were compared to the framework of Marks et al., (2001). The goal initially was to see if the phase and process dimensions could be directly mapped. These definitions changed over the course of this research. The final classification is shown in Table 8 below.

Table 8   Classification of Group Activities

Phase	Definition	Example	Origin
Planning	Periods of time when the core activity of the group was related to discussing plans or strategizing how they would accomplish their overall project or a specific task.	The group could be observed to be reading the project guidelines and discussing their overall goals, and how they might achieve them. The group might also be observed to be discussing different strategies or ways of achieving their goals, or challenges with their goals.	Marks et al., (2001) Transition phase which was defined as "periods of time when teams focus primarily on evaluation or planning activities to guide their accomplishment of a team goal or objective" (p. 360)
Monitoring	Periods of time when the group stopped their task activities to check their progress against their plans and goals, and made adjustments	The group could be observed to be coordinating their activities – for example a member might say "have we addressed all the factors"? Another example would be the group checking their progress against time, and adjusting the roles of different members to work more efficiently.	Adapted from Marks et al., (2001) Action phase which included the following dimensions: 1) Monitoring Progress; 2) Systems Monitoring; 3) Team Monitoring/Back up Behaviour; and 4) Coordination.
Doing	Periods of time when the group was working directly on their course project	The group could be observed to be working on tasks that were part of their group project. These varied by group but included working on the matrix, surveys, creating a flow chart, or creating a presentation.	Generated from the research
Social	Periods of time when the groups were socializing, increasing their knowledge of each other, or talking about events, hobbies or activities.	During these times the group might be talking about other courses, social events, or other things outside the scope of their work together.	Generated from the research. This classification included the Interpersonal processes identified by Marks, et. al., 2001.

2. The periods of time when the groups were working directly on their task were classified by work task type. Table 9 identifies the list of group work tasks that was used as a base for the analysis. The final group work task classification emerged from the data, and is discussed in Chapters 4 and 5, and presented in the Coding Manual (Appendix 10).

Table 9   Group Work Tasks

Hackman (1969)	McGrath (1984)	Campbell (1988)	Algon (1999)
Production	Generate	Decision	Interacting with People
Discussion	Execute	Judgement	Interacting with Ideas
Problem Solving	Negotiate	Problem	Interacting with Things
	Choose	Fuzzy	

3. Within each of the phases of group activity identified above (Planning, Monitoring, Doing) the information behaviour lens was applied, involving identifying the key elements outlined below. These elements were coded as they emerged from the data, and are discussed in the Chapter 4 and 5. See also the Coding Manual (Appendix 10).
   a. Information Tasks and Activities
   b. Sources, Tools & Arefacts – these were coded as they emerged.
   c. Participation & Roles

4. The final stage of analysis was a process of negative case analysis (Cresswell, 2007), to analyze the themes and codes across all groups. The researcher reviewed all the codes and themes above, across all groups in the study to identify negative or disconfirming evidence. Evidence that did not fit was considered and incorporated or resolved. Figure 17 (below) illustrates the levels of analysis.

Steps 1 and 2 involved classifying the phases of group processes, to answer Research Question 1. Within each of the phases, the information tasks and activities were identified. Tools, sources and artefacts were noted, and the changes in participation and roles were traced, related to Research Question 2. This allowed group work to be decomposed into key elements, providing a rich understanding of how the groups actually worked with information. The final step allowed for the examination across all seven cases and the development of a robust definition and model of GIP.
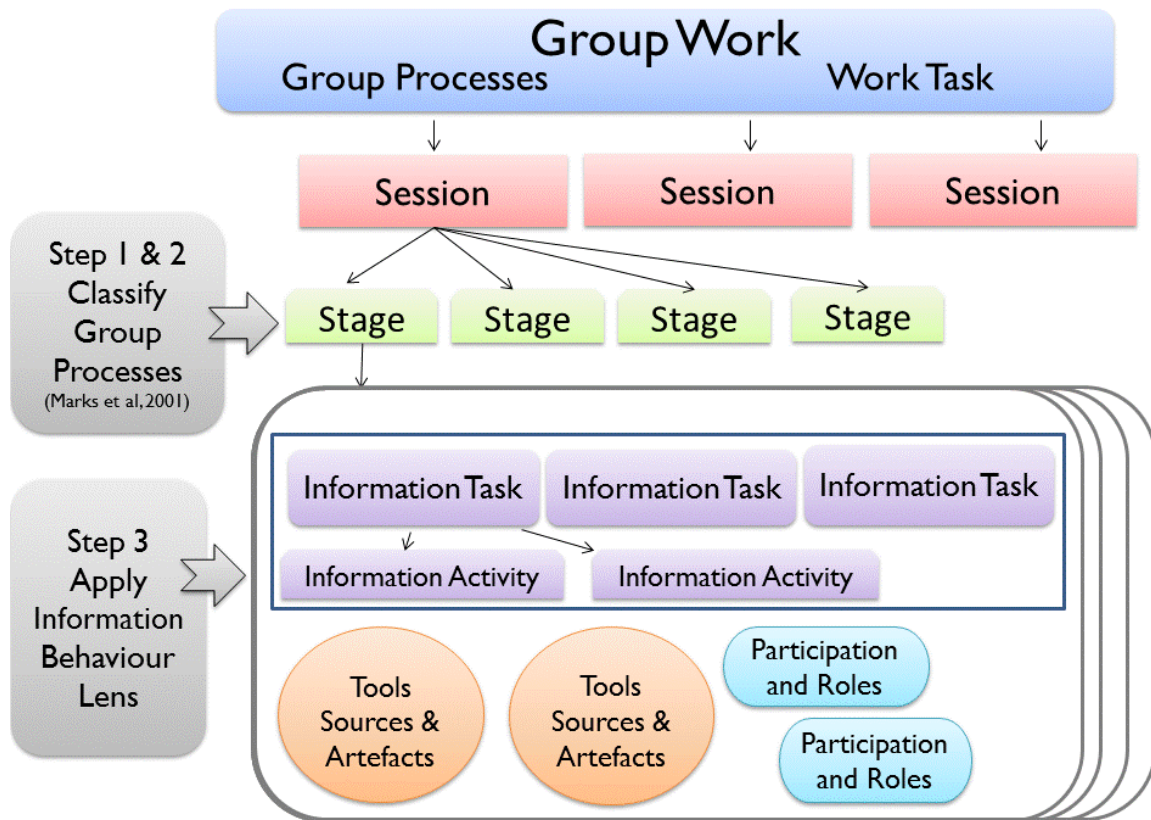
Figure 17   Stages of Analysis

Analysis of Other Data

All Groups

Demographics forms

In addition to the analysis of the video, demographic and prior experience data was collected for each group. This survey was administered electronically. The scalar data was imported to excel, to allow for analysis. The analyzed data from the demographic forms was added to the participant descriptions, so that the range of age, education, and experience of each of the groups could be reported, creating a basic demographic profile of each group.

Analysis of the Group Projects

The assigned group projects for all groups were analyzed using Li & Belkin's (2008) faceted taxonomy of conceptualizing tasks. The process used is described in Chapters 4 (Section 4.2) and Chapter 5 (Section 5.2).

Multi-Session Groups

Log files of all Computer keystrokes recorded with Morae

Morae recorder is a tool that can be loaded on computers to record all activities. The recorded files are then loaded into the Morae Observer for analysis. The Observer allows for the files to be viewed as a video. These log files were used to specifically provide enhanced details of what members were doing on the computers, particularly their search activities. When a section of the video did not provide rich enough details, the Morae file for that session was identified, and used in tandem with the video to provide richer data. The Morae log files were used in tandem with the video – particularly in Step 3 of the video analysis outlined above, and they were summarized in the description created in HyperResearch.

Individual Questionnaires

The individual questionnaires probed for the individual assessment of the groups' information sharing processes, and allowed for open ended comments. The surveys were administered electronically, and the data was imported into excel for analysis. The data for each group was averaged, and compared to illustrate where there were differences at the group level. There were not sufficient numbers to test for significance, but the patterns between groups were used to triangulate with the analysis of the video and Morae files. The open ended questions were imported into a word document and thematically coded. This analysis was integrated with Step 4 of the video analysis for the Multi-Session Groups (Chapter 5, Section 5.4.4).

Email Communication

The multisession groups added the researcher to all group correspondence during the time of the study. These emails were collected and analyzed through the process of thematic coding, using the taxonomy emerging from the video coding. Excel was used to create a list of all correspondence, and allow for the coding.

Data Collected but not Used for this Research

The following data was collected and assessed, but was not included in the findings reported here.

Group Interview Data

The group interviews were also loaded into HyperResearch and examined. Given the research questions for this study, the analysis of the interviews did not add to the findings in any significant way.

Diaries

The aim of the diaries was to capture the activities of individual members between sessions. As the diaries were done at the start of each group meeting, the video captured some thoughts and comments on this process. It became clear that individuals did not always understand what they should be filling out, and members interpreted questions in different ways. As the categories in the diaries had been determined before the analysis of group activities, they were not as helpful as expected. Further, the key aim of the research was to examine group behaviour in situ. For these reasons the analysis of the diaries has not been included in the findings.

3.6.7 Summarizing the Analysis Procedure

The analysis and coding of all the data described above included both inductive and deductive processes. As noted, some of the codes were created directly from the data, but more frequently they were created through comparing the data to previously identified taxonomies. The two methods were used to reflect the research questions. In particular, rather than create new terms for the information tasks and activities, the goal was to see how previous taxonomies could be used or adapted, extending the knowledge of task based information behaviour. Further the coding process was iterative. The coding dictionary grew and changed as each successive meeting of each group was analyzed.

The researcher coded all of the data, and the coding was confirmed through peer review and debriefing. The coding framework and dictionary and were explained to other researchers, including at two different PhD symposiums, to provide a range of opinions and discussion of the codes and the process. A final peer analysis was conducted using the final coding dictionary and segments of three groups. The dictionary, and segments selected to ensure coverage of all the codes were present were given to a recent PhD graduate. The graduate was able to code the segments using the definitions, and met with the researcher to resolve any differences in coding. As a result of this process final adjustments to the dictionary were made.

In addition the multiple types of data were used to confirm the findings. As the research involved multiple cases, each group was compared to each other, to ensure that all similarities and differences between the groups had been assessed.

3.6.8 Reliability and Validity

This research uses a qualitative methodology, and is motivated to provide deep understanding of a phenomenon. The quality of qualitative research can be measured in terms of validity and reliability (e.g., Cresswell, 2007). A critical part of the methodology was the ability to allow multiple strategies to ensure the quality of the research.

Reliability

Reliability relates to the consistency and accuracy of the methods used (Case, 2007). Reliability can be demonstrated when the same measures are repeated over time, and yield the same results. The design of the research with multiple case studies allowed for the replication of methods over time, and for each case to provide a "check" for the one before. The use of recordings and log files as primary data sources also meant the researcher could view the phenomenon multiple times. The research procedures, including the coding and analysis processes, have been clearly articulated, and the coding instruments have been included (Appendix 10). The analysis was conducted iteratively, with multiple checks back to the video, the codes, and narrative descriptions. The concepts and themes generated in this research were discussed with peers throughout the analysis process, for example during two PhD research colloquiums, and a final check was completed at the end of the analysis process.

Validity

Cresswell (2007) in his examination of validity in qualitative research concludes that validity relates to the assessment of accuracy, and suggests that researchers use at least two accepted strategies in their research. This research incorporated the following strategies suggested by Cresswell (2007, p. 209):

1. Rich, thick description. In relating the findings in the two studies, the researcher has attempted to provide enough detailed description to allow the reader to

determine if the findings are transferable to other settings. This increased the external validity of this work.

2. Triangulation. In the Multi Session Groups (Chapter 5) the various types of data collected were compared to confirm findings. Specifically the findings from the individual surveys and group interview were used to confirm the data from the video and log files.

3. Negative Case Analysis. While this research did not involve hypothesis, it involved multiple cases. The findings from each case were iteratively examined to ensure all outliers and exceptions had been considered.

4. Peer review and debriefing. As noted above during the analysis phase the researcher attended two PhD workshops, where the themes and codes were presented and discussed. The researcher also collaborated on a separate research project, which also used this data (Toze et al, 2011). This research involved coding specific information seeking episodes, but intersected with some of the codes and themes from this work. Finally, after all the phases of analysis, a recent PhD graduate was given the Coding Manual (Appendix 10) and selections from videos of four of the groups (2 from Study 1 and 2 from Study 2) to code. The sections of the videos were selected to ensure a variety of activities were represented, and that all the codes could be examined. The PhD Graduate and the researcher met several times to confirm the coding process, and the codes, and to ensure agreement, as noted above. This led to the refining of definitions to ensure clarity.

CHAPTER 4   SINGLE SESSION GROUPS

4.0 Introduction

This chapter contains the description, results, and the discussion from a study that involved four student groups who completed their assignments in a single session. The naturalistic lab study protocol outlined in Chapter 3 (Section 3.6) was used to collect data from the four groups of students. The groups met in the GroupWork or the Usability lab for a single session to work on a simulated task. The objective of this study was to deconstruct knowledge intensive group work to understand the process of information needs, seeking, and use, within groups.

The groups in this study were from two consecutive years of the same course. Any change in the application of this protocol is explained in the procedure. The findings are presented for each research question as outlined Table 10, and then summarized.

Table 10   Map of Research Questions by Section

Research Question	Data Analysis	Data Used	Section
Which phases of group and task activities prompt students to seek, find and use information, and how can these phases be characterized?	Steps 1 & 2	Video	4.4.2
How are the key information tasks (need, find, and use) negotiated within each of the phases of student group and task activities?	Step 3	Video	4.4.3
Analysis of the differences across the groups	Step 4	Video	4.4.4

4.1 The Groups

4.1.1 Recruitment

Groups in the Single Session Study were recruited from two different years of the same course. Their participation was initiated by their class instructor, as identified in Chapter 3. The instructor approached the researcher about the class participating, eager to give his students the experience of participating in group research.

For all four groups the protocol was the same. The researcher met with the class prior to the study, during their class time, to explain the research, and to answer questions. In essence the study became a part of their assignment. For this reason, these students were not given the honorarium. They were not required to complete the Post Study Individual Survey, or the group interview.

To ensure that there was no coercion regarding their participation in the study, a "Post Participation Briefing Email" (see Appendix 8) was sent out after the experiment, to each student participant. This email restated the goal of the research, and highlighted the procedures regarding confidentiality and security of the data. The students were given an option to "opt out" by responding to the email by a specific date. None of the students followed up with questions, or requested that their data be removed.

4.1.2 Group Descriptions

Data from two groups (A & B) was collected on November 29th, 2008; and data from the other two (C & D) was collected November 21st, 2009. The groups did not form themselves; the Professor organized the students into groups. The researcher attended the planning meeting before the assignment date, and explained the study and answered any questions. The students were given a tour of the facilities, including the control room, and the ways of capturing data were demonstrated. After the students had been fully briefed, they signed the consent form, and filled out the demographic form. The description of the groups below includes data from the Demographics and Prior Experience Questionnaire (Appendix 4).

Table 11   Summary Study 2 Group Characteristics and Data

Group	Group Size	Number of Sessions	Number of Stages	Hours	Time Frame
A	5	1	18	5	1 Day
B	4	1	15	5	1 Day
C	2	1	7	4.5	1 Day
D	3	1	9	4.5	1 Day

Group A

Group A included 5 members, one male and four females, who varied in age. Three fell into the age category 24 to 27; while two were between 40 and 49. The group was quite

diversified in terms of their undergraduate degrees which included Psychology, German, Biology, and Recreation and Sport. Four of the five students were enrolled the same Master's program, while one was in a combined degree. Two members already had a Master's level degree.

Comparing their technology experience two members stated they only used the web 1-5 hours a week, one member used it 6-10 times, and two used it more than 10 hours. The majority (four members) used email and web search daily, and three members had never used chat rooms. Three members used Facebook daily. One member did not use Facebook at all.

The majority of Group A (four members) indicated they worked in groups "quite frequently" but their stated preference was for individual work, or to be neutral about group work. On a scale of 1-5 where 1 is individual and 5 is group, two members indicated a preference of 2, two remained neutral (3) and 1 member slightly preferred group work (4). In terms of the number of people they would like to work with 2 members would prefer to work alone, two would choose a group of 3-4 people, and one would prefer to work with only one other person.

Group B

Group B was composed of 4 members including one male and three females, with ages ranging from 21 through to 39. Each member fell into a different age category (21 to 23; 24 to 27; 28 to 30; 37 to 39). There was more similarity in backgrounds in this group. Three members had a Biology undergraduate degree; the fourth had History and Political Science.

All group members used email and searched the web daily, and two used Facebook frequently. One member in this group had never used Facebook, and three members had never used chat rooms. All the group members identified that they had experience working in groups. Their preference for group versus individual work was centred; two members slightly preferred group (score of 4 on the Likert scale), one was neutral, and one slightly preferred working individually (2). The preference of three of the group members would be for a group of 3-4 people. One said they would prefer to work alone.

Group C

Group C was a pair; a male and a female, both between 24 and 27 years old. One member had an undergraduate degree in international relations. The other had a dual major, biology and chemistry. Both were in the same Master's program. Both members were quite comfortable with technology using email, web searching, Facebook, instant messaging and online journals daily or weekly. Neither member used chat rooms. Both members had worked in groups frequently. One member preferred to work in a group of three to four people; the other member indicated a preference for groups of five or more people.

Group D

Group D was a group of three; two males and one female. Two members of this group had history and economics undergraduate degrees, the third had a biology/marine biology degree. All were in the same Master's program. Their ages ranged from 21 through to 30. All members used the web at least six to ten hours a week. All used email, web searching and instant messaging frequently. Two were frequent Facebook users. One was a non-user. All members had significant experience working in groups, but had different preferences. One member preferred to work in a group of 3-4, 1 preferred one other person, while one didn't care.

Summary of the Groups

All the groups included some diversity in terms of age, background and gender. In terms of comfort and use of technologies all the groups had a similar spread. All the groups included some members who were frequent users of social media such as Facebook, and other members who avoided such sites. All the groups had a range of attitudes towards group work, with no group skewed to individual or group based work. All the groups were given the same instructions, and worked under the same conditions.

4.2 The Task: The Course Project

The course project, which formed the task for all four groups, was a policy simulation exercise that included structured tools (i.e. a matrix) that have been used in real situations in practice. In the class prior to the simulation, students were introduced to these tools

and the case study and were given the following documents: a case study, a handbook, and the lesson plan. On the day of the simulation, the groups were asked to complete the following assignment, which included several parts. The assignment included the following parts:

Part One: The Analysis

    a) Identify the maritime vital interests and principal threats, risks, and challenges facing the Republic of Colombolo in your assigned area(s) of marine activity.

    b) Complete the Integrated Maritime Enforcement Matrices for requirements and capabilities in the assigned area(s) of marine activity.

    c) Summarize the surveillance, monitoring, and control requirements and capabilities, identify and quantify the shortfalls, and state the enhanced capabilities needed to meet the requirements of enforcement in the assigned area(s) of marine activity.

Part Two: Policy Objectives

    a) Provide a general statement of over-arching maritime enforcement and compliance policy objectives for the Republic of Colombolo (i.e., across all areas of marine activity).

    b) Based on your analysis, provide the over-riding policy objectives for an integrated maritime enforcement regime in your assigned area(s) of marine activity.

    c) In support of this, state the specific operational, legal, political, and non-state/user objectives in your assigned area(s) of marine activity for the integrated maritime enforcement regime.

Outcomes

- Each Group gave a 10 minute presentation (4 to 5 slides) to explain their analysis and policy recommendations. The presentation addressed the following:
    - A brief summary of the principal threats and challenges
    - A matrix presentation of requirements and capabilities completed for your assigned area(s)
    - A summary and justification of the figures in the matrices

o   A brief statement of the over-riding policy objectives on an integrated enforcement regime

o   A statement of the over-riding policy objectives and the supporting operational, legal, political and non-state/user recommendations deemed necessary

This assignment was designed and administered by the course Instructor, and included tools that might be used in a real situation. The researcher was not involved in the discussion of the assignment, or in providing any assistance. The case study and the assigned task were the same in both years, with the following exception. For the second set of groups (C & D) an intervention was included. The day of the exercise an extra memo was given to the groups, providing updated information, and an identifying an urgent need for a decision regarding a course of action.

To better understand the characteristics of the assignment, Li & Belkin's (2008) faceted classification of task was applied at the course project level. The facets related to the user's perception of the task were not included, as the groups were not invited to assess their tasks. The results of this task analysis are presented in Table 12.

Table 12   Characteristics of the Task for Group A-D

Groups A, B, C & D		Policy Simulation Exercise
Description		Case Study
	Source	Externally Generated
	Task Doer	Assigned as Group
	Time	Unique, Short Time
	Product	Decision/Solution
	Process	Single time task
	Goal	Quality – Mixed Quantity – Multi
	Task Characteristics	High objective task complexity Assigned as a task with high interdependence
Subtasks		SWOT analysis (1a) Decision Support Matrix (1b) Summary (1c) Policy Objectives and Recommendations (Part 2) Presentation (Outcome)
Course Weighting		2o% Course Grade

4.3 Procedure

The procedure outlined in Chapter Three (Section 3.6) was used for all groups, with the following exceptions. To accommodate the fact that the class was divided into two groups who needed to work simultaneously on their assignments, both the Group Work Lab and the Usability Lab were used. All activities in both rooms were captured using the technology available in the Control Room. Groups were assigned to rooms based on size. In both years the smaller of the two groups worked in the Usability Lab. Also, in 2009, for Groups C & D, the large monitor and white board had been installed in the Group Work lab. However Group D, the group working in this room, did not make use of this monitor during their session.

The length of time given to the groups to complete their simulated exercise was determined cooperatively between the Instructors and the students; the researcher was not part of this discussion. The researcher and a technical assistant were available at all times to answer questions or requests and to handle technical problems, but they did not interfere during the process. There were some technical issues with the Morae log files from these sessions. As the working sessions lasted four hours, the Morae recorder froze, and data was not consistently captured. For this reasons the videos were the main source for this analysis.

4.4 Results

4.4.0 Overview

Data was analyzed iteratively in stages, as outlined in Chapter 3 (Section 3.6.6). The same process was used to analyze the data for each group. The results have been organized into sections, following the research questions and data analysis plan (Section 3.6.6). The first section (**4.4.1**) provides a descriptive summary of what the groups did, and identifies the key elements (stages, information tasks and activities, tools and sources, roles and participation) which will be analyzed in further sections. The second section (**4.4.2**) relates to Research Question 1. The stages of each group were examined to try and identify common patterns, based on the taxonomy of Marks et al., (2001). The key phases for each group were described and summarized.

Within each of these phases, the information tasks and activities of the groups were identified and described **(4.4.3)** using the information behaviour lens, to address research question 2. In addition the tools and sources used to complete the information tasks were identified and discussed and the artefacts created**.** Shifts between individual, sub-group and group work during these tasks were identified. Any patterns that emerged in how the information processes were accomplished were also noted; for example did one participant always do the searching. The final section **(4.4.4)** speculates on the factors affecting the differences between the groups.

4.4.1 What the Groups Did

Group A

Group A went through 21 stages of activities to complete their course project. They shifted between working on the course project, determining what they should be doing, and assessing their progress. The group used the project materials as their main source, and created artefacts as they went through the stages of their project. They used the map to help orient their thoughts and "see" together. Table 13 highlights their activities at each stage. The more detailed notes created during the analysis process are included in Appendix 11.

Table 13   Workflow of Group A by Session

Stage	Description	Time	
		Start	Stop
1	**Beginning**: The group took stock. Members checked with each other, questioning and clarifying, asking questions like "*do you know what is going on*?" The goal was to assess who knew what, and which resources they needed. Particular expertise was noted. Participant 2 was identified as – "*you are the lawyer - law type*" (Role). Members shared information, and assessed information held in common. No artefacts were created. There was no information seeking from external sources. They worked as a group.	0	00:05

Stage	Description	Time	
2	**Identify Challenges/Risks – Beginning** The group began project work without any real discussion of overall strategy. As they worked the following pattern emerged: • Participant 1 volunteered to write things down. (Role-scribe) • The group alternated between working individually and collectively. o One person would mention a key point or factor (information sharing), and then other members would question or clarify. • Once information had been shared they would work as a group. • To help the group "see" together –they used the map provided • The group worked to achieve shared understanding and consensus by discussing the facts and visualizing things on the map. • An artefact was created by Participant 1 using a pen and paper to record group decisions. • Information seeking to support decisions and to solve problems. • Tools used included multiple computers and pen and paper.	00:05	00:15
3	**Checking Resources** Members commented that their progress seemed slow. They questioned how they were using their resources. To overcome information overload members asked – "What information did they need for this part of the project, and what they should save for later?" They worked as a group. Their information tasks related to "how to". Members shared and synthesized information. No artefacts were created, or tools used.	00:16	00:17
4	**Division of Labour** Stage 3 triggered a review of their strategy. Participant 4 voiced concern that the group was off track, becoming unfocused. The group made a decision that it would be more efficient to divide the task (Participant 1 would look for challenges; Participant 2 would keep track of risks). Sources used included the case study, the project guidelines and prior knowledge. Information seeking to learn "how to". Members extracted information from their assignment guidelines and analyzed this information collectively. Tools used included pen and paper, and the computer.	00:17	00:19
5	**Identify Challenges/Risks – Revised Process** The group worked directly on task, sharing information from the case. Participant 1 took on the role of *Reader*, sharing information, which was discussed and analyzed by the group. The group worked to actively create consensus, through questioning, clarifying and agreeing. The information sources used were the case study, and prior knowledge. There were problems related to the group being able to collectively see the artefact that was being created. Multiple copies of the artefact were created (paper and computer).The group was continuously identifying the need for information – which was answered through conversation (information sharing). Members identified facts from the case study and prior knowledge, rather than searching for answers through electronic resources. Participant 4 moved to the iLab computer searched for something – she mentioned Google. She shared some information from her searching - referring to what another country was doing. This information was discussed briefly, but not really picked up or included in any of the artefacts.	00:19	00:30

Stage	Description	Time	
6	**How are we Doing?** Interspersed with working on their project there were mini-stages (less than a minute) where the group would assess their progress. Participant 1 commented at about 30 minutes; "*great list- good progress, slow though, but good thorough job*". Members briefly examined what they had done, and what they still had to do, and then went back to task work	00:30	00:31
7	**Back to Challenges and Risks** Same process as Stage 5 above.	00:31	00:56
8	**Almost there?** Members checked themselves again at 56 minutes, using this time check as a prompt to set goals: "Check again at …it is 10:30 now, by 11:00 we should have started the matrix" (Participant 1). Members speculated about the other group, and how they were progressing. During this stage the group members shared information to confirm decisions, and to keep track of important facts and decisions.	00:56	00:56
9	**Finishing Challenges and Risks**- Between Stages 5, 7 and 9 the pattern of group worked shifted. At the beginning of this part of the assignment all members were looking at their own papers/computers - and took turns suggesting things. By stage 9 they had moved to a more collective or collaborative model. Participant 1 would read things out, and they would all discuss. The group continued to use the map to "see" together.	00:56	01:28
10	**Examining the Matrix** The group started a new subtask. The first few minutes were spent figuring out what they were supposed to be doing. The group was uncertain about which matrix to use. They needed to confirm information from an external source (the other group).	01:28	01:35
11	**Beginning the Matrix** The matrix was a tool to support decision making. Each box on the matrix, which needed to be given a score, represented a complex group decision about the level of requirements that were needed. To determine the score the group assessed the information found in the case study, and debated - extracting, synthesizing and evaluating the information being shared. The main sources were the case study and prior knowledge. The group used pens and paper, computers, and needed to jointly use a computer. Information was found to confirm, to support a particular decision, and to locate a particular fact. The matrix was a group artefact which recorded a group decision, and was then used in the next stages of their course project.	01:35	01:44
12	**Wait…is this Right?** The group made comments about their progress, and passing time. Members discussed the fact the other group was half through their matrix. "*But this is not a competition*" (Participant 2). The group confirmed information to assure themselves they were filling out the matrix correctly (information goal – how to). They worked at the group level, and needed to consult an "expert" (the instructor).	01:44	01:49

Stage	Description	Time	
13	**Working on the Matrix** Participant 3 continued the role of official "scribe". Participant 2 also filled out the matrix on her computer, and Participant 5 filled out another on his paper copy. The group experienced problems with a lack of shared view. They needed to keep asking others/confirming their decisions (is that a 0, 1 or 2?) as they couldn't all see the same matrix. They shared information to confirm and to make decisions. For most of this stage they worked as a group, but with individuals recording things separately. They used the case study, their notes, and prior knowledge.	01:49	02:02
14	**More advice** The external guest entered the room. He advised the group not to overthink – just to make a quick decision. The group decided they needed to set a firm goal. They would finish the matrix in twenty minutes.	02:02	02:03
15	**Finish the Matrix** This stage was quite animated. All members were involved. There were differing opinions which they had to talk through. They were sharing and analyzing information from the case study and individual notes, to support their decision making. Even with the differences of opinion, the group commented that they felt they were productive – they were getting things done. They used a mix of pen and paper and computers - generating multiple copies of the matrix. The group finished the matrix at 2:20. See Figure 18.	02:00	02:20
Lunch Break			
16	**What Next?** The group identified the tasks left and jumped into a stage of assessment. They spent a few minutes struggling to understand what they should be doing. There was an information seeking episode to determine how to accomplish the next part of their course project, and to make a decision.	02:45	02:48
17	**Requirements & Capabilities** The group worked together as a group. The main sources were the case, prior knowledge, individual notes and the group artefacts created, especially the matrix. To work together they used computers, pen and paper. Participant 1 played the role of scribe – writing things down for the group, and asking questions for the group to discuss and comment. Participant 2 was using material she collected earlier to confirm recommendations with Participant 1 and the group. The group was very aware of time, and the need to make decisions.	02:48	03:00
18	**Assessing** The group paused to assess their next step. Members reread the instructions, to counteract the feeling of being overwhelmed with information. They looked for information to determine how to do their task, and to confirm facts. Their project guidelines were the source.	03:00	03:04

Stage	Description	Time	
19	**Policy Recommendations** All group members were involved. Conversation was animated; there was conflict, disagreement, frustration but also laughter. Participant 4 suggested they create a flow chart (group artefact). Participant 1 tried to create one. Others looked on, and provided comments and suggestions. This artefact was on paper, so it was not easy for all to see or manipulate. Participant 2 acted as the time keeper - "*we only have one hour left*". The group laughed about their problems all getting on the same page. Participant 2 commented "*I will be having nightmares about this tonight*"… *and "maybe this is why they have us do this exercise to realize how frustrating it is*".	03:04	03:32
20	**Creating Slides** Participant 1 steered the group to the slides (outcome) and - "volunteered" Participant 3 - who had a computer and was great with charts, to be the slide creator (writer). The key players during this stage were Participant 1 who read a group artefact created earlier and Participant 3 who created the slides. Participant 2 jumped in and out - helping when needed. Participants 4 and 5 were not that engaged in the process. It was not clear in the end that what went on the slides was a "group" view, or Participant 1's interpretation of the "group view". There was one information-seeking episode during this stage, Participant 2 searched for an appropriate background for the slides - then emailed this to Participant 3. Tools used included computers, email, the internet, pen and paper.	03:32	03:57
21	**Finishing** The group rushed to finish as the other group entered the room and set up to present. The group finished their project without a clear plan for presenting, or time to confirm they were ready.	03:57	04:00

Stage 15 - Participants 1 and 2 are jointly using a computer. P 3 is using her computer. P5 is marking decisions on the Matrix. P4 is using the case study and her notes

Figure 18   Screenshot of Group A

Group B

Group B moved through 17 stages to complete their tasks. Overall the group was observed to work in a structured manner, with a concern for efficiency. Table 14 provides a summary of how they spent their time. The more detailed notes created during the analysis process are included in Appendix 11.
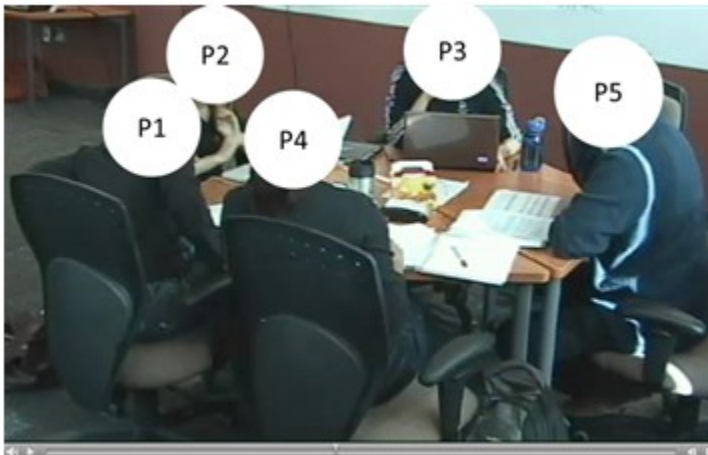
Table 14   Workflow of Group B by Session

Stage	Description	Time	
		Start	Stop
1	**Taking Stock** The group began discussing the fact that they were not certain about their project. All members took out materials. Participant 4 brought pens, pencils, erasers, and highlighters. All members had blank paper. Participant 4 had journal articles, and notes. Members started trying to summarize the main parts of the case, to ensure they were all on the same page.	00:00	00:03
2	**Individual Re-read** This stage involved individual work. Participant 1 suggested that they should all take a few minutes and reread the case. There was limited communication. Members individually highlighted, made notes, but did share some documents.	00:03	00:17
3	**Let's get started… Challenges & Risks** Participant 3 suggested "*I think we should just start going through this*" (the assignment). Participants 1 and 4 agreed, and traded some papers back and forth. The group started working but had some challenges. They needed to keep re-confirming what they should be doing. For example Participant 3 commented, "*But we can't look at it in terms of capacity - just need to look at vital interests.*" To be able to "see" the information together, the group used the map as a common artefact to orient themselves. There was a mix of individual and group level work. There was some group and individual generation of ideas.	00:17	00:36
4	**Monitoring our work** Initially Participant 1 and 2 made notes on their own copies of the assignment. Participant 3 noticed this and decided it would be more efficient record decisions on the computer. Participant 3 took on the role of scribe. Additionally she often typed without consulting, or without telling others what she was writing, taking on the role of writer.	00:19	00:21
5	**Vital Interests** During this stage there was animated discussion, and task based conflict. Humour was used to diffuse tension. Participants 1 and 3 didn't seem to agree on the vital interests. They shared information to increase their understanding of the problem. The group continued to use the map to confirm things, and to think through the problem together. By the end all were happy with what they had written. Participant 3 prompted "*are we happy with these vital interests?*" and added one more point. Members referred to the case study, their own notes, and referenced other articles. There was no external searching. The computer was used to type notes. They worked mainly as a group.	00:36	00:47

Stage	Description	Time	
6	**Confirm what we have done** The group spent ten minutes discussing and debating to ensure agreement and shared understanding. They had some challenges separating what should be considered a "risk" vs. what was a "challenge". Participant 2 took notes on a notepad. Participant 3, again commenting on efficiency, took the pad and typed the notes into the computer. There were some issues with the tablet computer, and the lack of familiarity with it. Individual members were flipping through their individual copies of the case, and their notes, and sharing information. All were participating, but Participant 3 had "control", as she was writing, and was the only one who could see the computer screen. She recorded what was said, but also determined how the ideas were formalized into the official record. It was a group artefact, but created by one member.	00:47	00:57
7	**Which Matrix? And how do we score?** The group struggled to determine which of the matrices they needed to complete and how to use this tool. Participant 3 read the instructions and definitions out loud, and the other members confirmed understanding; "*So 2 means....no capacity*"? Information Sharing to determine "how to".	00:57	00:59
8	**Starting the Matrix** Before they could complete the matrix – they needed to agree on a strategy. Members discussed exactly how they should complete it – for example should they go down the columns or across the rows. They made a decision to go across.	00:59	01:03
9	**But wait?** The group began filling in the matrix according to this plan, but did not get far. The group was unsure that they were using the tool correctly, and questioned themselves. Participant 1 for example asked "*We are doing requirements*?" Participant 3 was obviously frustrated, and decided they needed to confirm what they were doing with the instructor (expert source). Participant 3 brought the Instructor into the room and commented "Ok, so we are very confused…" The discussion with the Instructor clarified how to. The group was able to work through the matrix with a clearer focus. They worked as a group to resolve their problem.	01:03	01:10
10	**Back to the Matrix** The group shifted some of the numbers they had previously recorded, based on their new understanding. As they worked through the matrix, one member read from the manual, to share definitions. The group systematically worked through each box in the matrix. They needed to agree on a number, forcing the group to come to a consensus. They were aware of time, and the need to work quickly. Comments such as "*Let's leave that as a 2 - Don't think about it too much otherwise we will be here all day*" were made. All members seemed focused - working closely together looking at the paper copy of the matrix. The group needed to reuse material they already created. For example Participant 1 asked "*what did we say*" – prompting Participant 3 to go to the computer and refer to the Risks/Challenges they had identified. There was no searching for external information. Information was shared from the case, the project manual, their notes, and prior knowledge. They worked collectively as a group. Participant 2 recorded their decisions on the paper matrix.	01:10	01:44

Stage	Description	Time	
11	**So how are we doing?** Their work was interrupted at times, to allow the group to assess their progress and decisions. For example after filling out a box members would comment: "*Ok so we are good*"; and "*cool - we are getting there*". When a member from the other group entered to ask about the right matrix they realized they were ahead, and were happy.	01:33	01:33
12	**Completing the Matrix** After these mini breaks they resumed work. Participant 1 took on the role of "reader" - looking for definitions in the manual. Participant 2 made notes on the Matrix. Participant 3 volunteered to retype this on the computer when they finished. At 1:45 they finished the matrix and Participant 3 commented "*I think we are doing well...got a roll going*". They decided they could take a coffee break.	01:33	01:44
Break		01:44	01:59
13	**Determining next steps** When they returned from their break, the group started working on identifying the overcapacities and shortfalls. They were unsure how to start. One member suggested using another matrix – it was not required but might help. No one responded; all were working individually flipping through their own notes. Participant 3 decided she would start filling out the matrix electronically – she had an electronic copy (searches email for this). The others began working together on the next task.	01:59	02:03
14	**Parallel work Over Capacity/Recopy Matrix** The group was not as focused or efficient during this phase. There was much more off topic conversations, frequent comments about tiredness, and talk of social plans and their other courses. Participant 3 mainly worked individually, typing the matrix into the computer. The other members shared information from their notes, the case study, and the matrix (group artefact). Individuals were flipping through the pages, and evaluating the information that was being shared, and synthesizing information to make decisions. Tools used included the computer, email (to retrieve the matrix), a USB stick to share information, as well as pen and paper. They needed to keep track of earlier decisions, referring back to the matrix or their notes.	02:03	02:36
15	**Policy Objectives & Slides** During the next stage the group also worked in parallel; simultaneously working on the policy objectives and their slides. The group continued to lack focus, spending much time off task. Participant 3 was at the computer, creating the slides. At the same time Participant 4 was reading the policy requirements aloud to all. They jumped from discussing the slides and the presentation, back and forth to the policy recommendations. There was some discussion of different views, and they commented on their different backgrounds (3 Science, 1 Political Science). During this stage Participant 4 referred to the extra articles she had brought with her. She was reading those as well as the case study, and occasionally shared some facts and ideas.	02:36	03:50

Stage	Description	Time	
16	**Finalizing Content** Participant 3 finished the electronic copy of the matrix, and added their policy objectives to the slides, changing some wording. She read them out loud to confirm the final text. The others listened and asked some questions. There were some issues related to the group not being able to easily see the computer screen. Participant 4 kept moving to see. The instructor entered and they shared what they had done, which helped give them the sense they were on the right track.	03:50	03:53
17	**Quick Practice** During the final stage the group organized themselves for the presentation. The members all gathered around the computer – jointly looking at the screen. Members claimed the slides they wanted to present. Members worked individually, looking at their slides and making notes. Participant 2 voiced some concern; "*I hate presentations like this...on the fly...don't know what I am talking about.*" Participant 4 read through her slides carefully and asked several times "*what did you mean by...*" indicating that she did not immediately identify with the words chosen. The group ended by commenting they wanted to get through this quickly, as they wanted to get home. See figure 19 below.	03:55	04:00
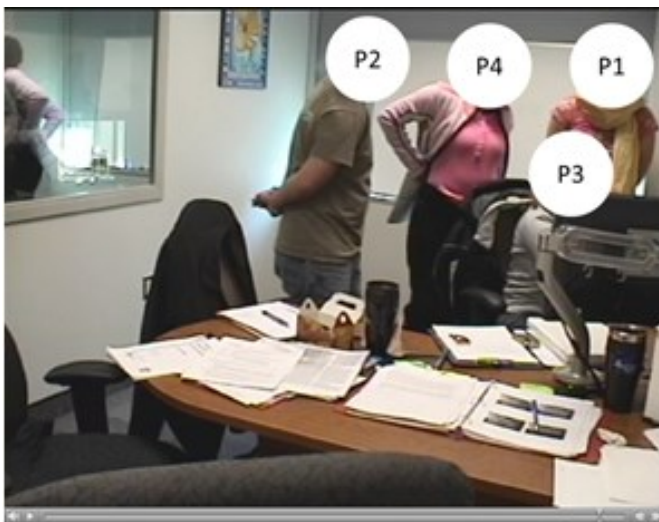
All are looking at the presentation on the laptop (Stage 17). You can see the notes, case study, articles, pens, papers and notes they have been using.

Figure 19   Screenshot Group B

Group C

Group C was the only pair. They worked together to complete their project in a different fashion, collapsing their activities into fewer stages, and doing some parts of the assignment simultaneously. There was more individual work, and Participant 1 completed several information seeking episodes actively looking for external information to support their decisions (Role – Searcher). Participant 2 was the editor. Table 15 summarizes their activities and processes. The full descriptive notes of Group C are included in Appendix 11.

Table 15   Workflow of Group C by Session

Stage	Description	Time	
		Start	Stop
1	**Getting Situated** The pair went through a process of trying to organize and orient themselves and the project. Both members organized their papers, and started reading independently. They were determining which information they needed to consider.	0	00:04
2	**Discussing the Problem** The pair started discussion of the overall objective of the assignment. Both were flipping through papers, looking at the map, asking questions and sharing information. They were working mainly independently, each looking at their own materials. They would share some information, reading sections they thought were important aloud to each other. Participant 1 had signed on to the computer, but did not use it.	00:04	00:15
3	**Ok let's start** The pair started working through the matrix. Participant 2 started recording scores on her copy of the matrix, as they discussed the information from the case and came to decisions. Neither felt confident they were approaching things in the right way.	00:15	00:22
4	**But wait** Feeling frustrated, Participant 2 went to find their instructor to ask for some advice (expert source). They confirmed which version of the scenario to use.	00:23	00:27
5	**Drawing it out** Based on this conversation the pair realized they did need to summarize their resources before they could fill out the matrix. Participant 2 decided to use the space around them to list the key information. She moved to one white board and started listing all the assets so they both could "see". She asked some questions of Participant 1, but worked largely independently. Participant 1 had a military background (specialized knowledge). Participant 2 asked questions that drew on his expertise. The pair used the map to help orient themselves, and to understand the problem.	00:27	00:42
6	**Matrix** The pair began work on the matrix by saying ""*Yeah well you have to really see if they are as overtaxed as they say they are*..."(Participant 1). To complete the matrix they flipped between the matrix itself, the guideline documents for definitions, and the case study to confirm facts. For example Participant 2 would say "*monitoring*" - then Participant 1 would read the definition, and they would start discussing how they should score. They worked through the matrix systematically confirming their decisions, and going back to earlier boxes to re-evaluate at times. Participant 1 started using the computer during this process, but did not always comment on what he was doing. He used Google to search for UNCTAD, and then clicked on a link to the "Oceans & Law of the Sea" site. This was not used at this time, but the pair came back to it later. They were mainly working together.	00:41	01:01

Stage	Description	Time	
7	**Are we doing this right?** The instructor entered again as they were working through the matrix and confirmed that they were completing the matrix appropriately. They discussed what was meant by "requirements", and confirmed the scores (0, 1 & 2). Participant 2 also asked if they were making good progress.	00:01	01:07
8	**Finishing the Matrix** Participant 2 worked alone for some time. Participant 1 left for coffee. When he returned Participant 1 tried to bring in external information (another class) and information from websites (Intergovernmental organization site). He executed a series of searches for information, only sharing at times to support their decisions; "*This reinforces the 0*". Participant 2 was filling out the matrix. As they worked Participant 2 walked over to the white board, and added notes, keeping track of things they would need to consider for their policy recommendations. They were often negotiating with each other. "*Ok, you win this one*" (Participant 1). Information was integrated from external sources, prior knowledge, the case study provided, as well as the information on the white board. Tools used included the computer, pens and paper They oscillated between working separately and as a pair. The seeking of external information was to clarify points, and aid decision making. See Figure 20 below.	01:07	02:51
9	**What Next?** Participant 1 suggested dividing their work. "*I am just going to run through natural law because I think we have to make sure we know - we can quote (Solace) as he (the instructor) was pretty key on saying we had to know law of the sea*" He continues searching, suggesting Participant 2 start drafting their policy recommendations. As they work the pair starts commenting on how they are feeling... "*Starting to think we have done this - we have talked about it - do we really have to prove to you what we have learned*? (Participant 2). Participant 2 moved between the two white boards, using one to help determine what needed to be changed on the second. Participant 1 joins her at the second white board, bringing their matrix along. They try and simplify their diagram of their solution, which is their overall recommendation. Participant 1 brings the map over to help them. They are actively using the space, whiteboards, their group artefact and the map to help them generate their recommendations.	02:51	02:54
10	**Parallel work- Policy Recommendations and Finding Evidence** After working with the diagram Participant 2 moved to a computer to summarize what they have decided. Participant 1 started utilizing external websites again; clicking through a site and reading he comments - "We have sovereign rights for the purpose of exploring"…so we were right". Participant 2 shows frustration. "This class already assumes you are working at a level? Need more time...this is complicated - doesn't go quickly for me". Participant 2 kept typing up their notes, and discusses what she is writing with Participant 1. At times Participant 1 tells Participant 2 what to type. They go back and forth between writing and clarifying things.	02:54	04:09

Stage	Description	Time	
11	**Confirming last facts** The instructor comes in to check on their process. They confirm the deliverables. Participant 1 decides to recopy the Matrix so their decisions are clearer. Participant 2 finished their recommendations. Participant 2 is not happy at the end and comments "I *need more time to square this away*". Participant 1 tries to reassure her. End is prompted by the time, rather than the successful completion of all the tasks. They do not have any time at the end to reflect or plan their presentation – they just finish the actual project itself.	04:09	04:16
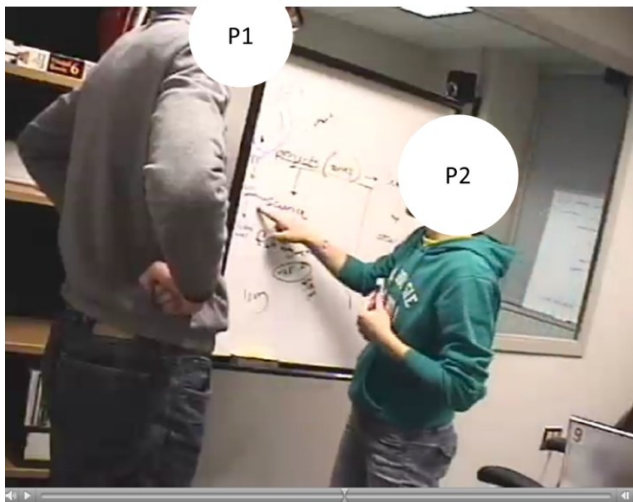
Figure 20   Screenshot of Group C

Group D

Group D worked through their project by moving through sixteen different stages. The group made use of multiple white boards, and created together, so all could see and assess. They did not search for information through the internet, but used the materials provided, as well as their prior knowledge. The specific processes are described by stage in Table 16 below.

Table 16   Workflow of Group D by Session

Stage	Description	Time	
		Start	Stop
1	**Getting Organized** The group tried to use the tablet computers, but had problems. One tablet appeared to keep freezing and crashing. The group decided to rely more on the white boards in the room because of this difficulty. They joke, "*I am thinking that is part of the challenge - how do you deal with ...malfunctioning*".	0	00:02

Stage	Description	Time	
2	**How will we work?** Members moved to the white board and started writing headings (Risks, Challenges etc.). They agreed that they will generate the necessary information through this process.	00:02	00:05
3	**Challenges & Risks** They started working on the actual project. Participant 1 was reading from the case study on the computer as Participant 2 and Participant 3 filled out content in the chart on the white board. Participant 3 had a copy of case study in her hands. They worked through interactive questioning and answering. For example - "*Is that a risk or a threat - and what is the difference?*" (Participant 2) *"It's a threat until it happens."*(Participant 1). They negotiated, and then settled. They did not look at the case study or definitions – they worked from their own knowledge. They worked as a group. Participant 2 used notes (a strategy) he had brought some ideas with him. They finished the first subtask quickly with no real conflict. They used a computer, and the whiteboard, and integrated information from the case study and their discussion. The chart created on the white board became a key group artefact.	00:05	00:26
4	**What next?** Next the group needed to identify the vital interests. They discussed briefly how to do this, and determined that they would add a column to the table they had already created on the white board.	00:26	00:27
5	**Vital Interests** During this stage the group continued to work with the white board along the wall, but also moved over the portable white board to use it as well. There was more debate during this stage. For example participants wrote things down, changed their mind, and wiped things out. It was a very dynamic stage. To help them think, the group decided they needed to create a flow chart to organize the vital interests on the portable white board. Participant 1's role was largely as scribe, with some interjections into the discussion. Participants 2 and 3 were thinking and writing on the board. The group reviewed their progress as they finished, ensuring they were in agreement. They used multiple coloured markers, making links and highlighting things in their chart. It was a very active process of integrating and manipulating information.	00:27	00:38
6	**So now…** Finishing the vital interests, the group wanted to start the matrix, but needed a few minutes to assess how they would do this. They flipped through the documents confirming the right matrix, and referred to the memo they had been given in class. The group commented on feeling overloaded. "*Sorry this is where my brain stops…this is brutal, so much stuff?*" (Participant 3). Participant 2 tried to translate the new information, and focus and simply their task. "*So the big thing right now is protection…and getting rid of pirates and terrorism*". "*We need guns!*" Participant 2 joked. This reminded them that they needed to list their resources.	00:38	00:41
7	**Assessing our resources** Participant 2 started making notes on the legal pad. They worked in sub groups. Participant 1 was working to reproduce the chart from the white board on the computer. Participants 2 & 3 were working on a list of resources. They did this by summarizing key information from the memo onto the legal pad.	00:41	00:48

Stage	Description	Time	
8	**Confirming the Matrix process** As they moved to the matrix itself, they again needed a few minutes to assess. They looked at the requirement matrix, and tried to interpret. *"Is this a wish list? -* Participant 3. They debated this, coming to a shared understanding.	00:48	00:49
9	**Matrix** They decided to work in stages – asking what they (the case study site) needed; what they had; and then mapped the two together. A general pattern emerged: Participant 2 read out the category, and made suggestions, and then the other members commented and debated. They needed to keep confirming what the scores meant. They kept referring back to the definitions, to talk through things and arrive at a shared understanding. Participant 3 joked about the difficulty of working with two economists. They did not use any external databases, but used the white board, as well as the project materials, and their prior knowledge.	00:49	01:45
10	**Transitioning** After finishing the Matrix, the group took a few minutes to refocus. They were still processing, and deciding what they would do next.	01:45	01:47
11	**Off task** The group had a break from the project for a few minutes. They had an off task discussion.	01:47	01:50
12	**Overall Policy Formulation** Participant 2 refocused the group on the task. He provided a recap, *"this whole meeting has been convened because of a ship spill and terrorism events"*, summarizing from memory and providing a common reference for all. In addition to the white boards, the group also used a flip chart to organize their policies. They had some disagreements during this stage regarding their project, but worked through them by discussion. They were very physically active. They moved around the room, referred to the white board, wrote on the flip chart and motioned to things. At one point Participant 1 walked to the board and sketched a map of the island, and the surrounding areas, to help them assess what the priorities should be. They asked questions such as "do you think there are any other countries that have this problem? (Participant 2), identifying a clear need for information, but they did not attempt to search for supporting information. Instead they answered from their own knowledge. They did not look up or seek any agreements or treaties. Instead they used their collective knowledge, and discussed situations they knew. Work was at the group level - all three trying to come to a shared understanding of the problem. It was an iterative process of systematically discussing ideas, evaluating and synthesizing; topics emerged and reemerged during their conversation. Humour was used throughout.	01:50	02:44
13	**Review** The group stopped work to assess. During this stage they referred back to the assignment guidelines, and looked at what they had created, to ensure they were on target.	02:44	02:45

Stage	Description	Time	
14	**Specific Policy Objectives** The group worked to determine their specific policy objectives. They used the matrix, the charts on the white board, the case study and their prior knowledge. Their discussion was animated, and continued to be active. Participant 2 was doing the actual recording in a document on the computer, and the others commented – You will present this, as it is in your words. All members were actively participating. See Figure 21 below.	02:45	02:59
15	**Making sure** Similar to Stage 13, the group needed to stop for minute to assess their progress. They pulled out the assignment guidelines, to confirm if they were doing what they should be doing.	02:59	03:03
16	**Finalizing Policies** –same as Stage 14.	3:03	03:58
17	**Reflection** As they finished the group reflected on their process, commenting, "*We haven't reached that point yet with technology - where everyone is coming to a meeting - flipping out their computer" (Participant 3)*. They double checked what they had done, and worry that they have missed some things. They conclude that they have a "*great plan*" but that it's "*never going to fly though*", indicating this is a theoretical solution but maybe not a realistic one. As the other group had not finished, they took a break for a few minutes.	03:58	04:00

The group is working on their policy recommendations (Stage 14). Members review the artefacts they have created on the board, and organize their thoughts on the flip chart. Members are actively moving around the room to work with information.
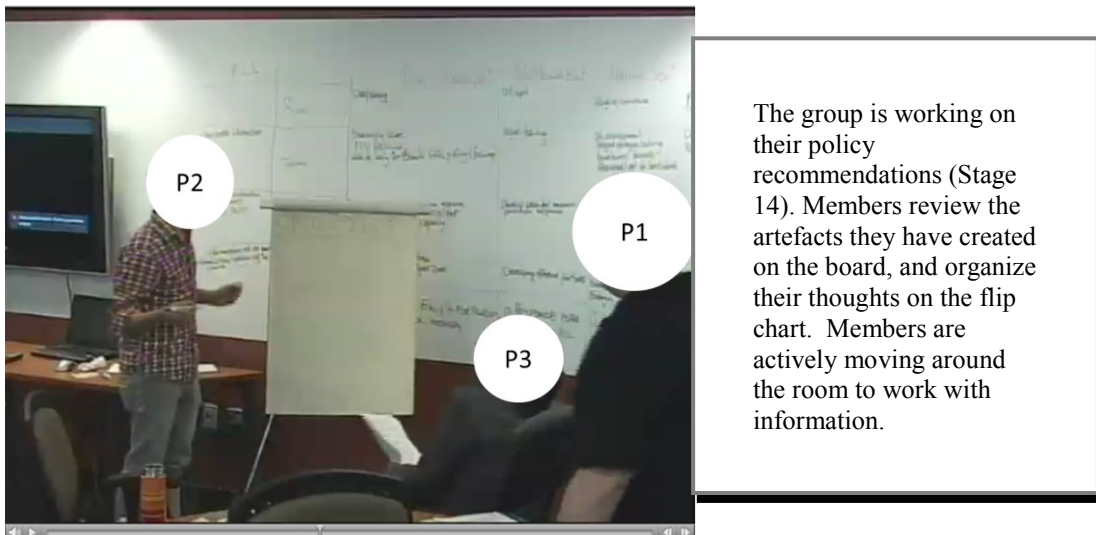
Figure 21   Screenshot of Group D

Summary

All four groups worked on the same project. They all worked through a process of sharing, then debating, analyzing and evaluating, before coming to a decision or generating their recommendations. But the groups spent their time in different ways, and reacted differently to the tools such as the matrix. The pair (Group C), for example had a very different pattern than the other groups, as observed in the description above. They

were the only group that did not directly follow the tasks in sequence, but took a more holistic approach. They were also the group that did the most external information seeking, although not all the information found could be seen to be directly integrated into the final product.

Two of the groups (A and B) spent more time on the analysis and less on the process of determining their recommendations. All the groups spent time figuring out how to use the Matrix, and all required external confirmation (talking to the instructor or the other group) to confirm they were on the right track. For most groups the time spent on the matrix was very interactive, except Group C, where Participant 2 worked alone part of the time.

The groups in Study 1 did not use a great a range of sources, due perhaps to the nature of their assignment. The main information source was the case study, and the workbook that explained the Matrix. Some members had prepared notes in advance (i.e. Participant 2, Group D), or brought articles with them (Participant 4, Group B). Groups used the map that was part of the case study as a key document to help guide discussions and decisions, and all the groups consulted with the course instructors to clarify questions related to the matrix during their session. All the groups took advantage of the unique prior knowledge of their members, for example Group A relied on Participant 2 for legal information and Group C relied on the military background of Participant 1.

Relatively few sources beyond the case study and materials themselves were required; yet all the groups' commented that the amount of information they had to process and work with was a challenge. Some groups dealt with this by dividing the work (Group A in particular). Other groups used the group space to help them organize and process (Groups C & D). The group project was designed to be cumulative, with each part building upon the previous ones, so all groups used the artefacts they were creating to help them work through the next subtasks. Group C and D made extensive use of the group space using multiple white boards. Groups A and B used more paper and computers. All the groups used computers jointly at some point. Groups B and D had some problems with the tablet computers, and members of Group A used their own computers. A member of Group B brought in journal articles, and a member of Group C

spent a great deal of time searching for external websites. All the groups were constantly aware of time, and were also aware of the other group, and compared their progress.

All the groups in this study experienced the following challenges: allowing all members to see the artefacts the group had created; keeping track of previous ideas and decisions; and duplicating processes (e.g., creating things on paper or on the white board, and then needing to recreate them in Word or in PowerPoint).

4.4.2 Classifying Group Processes

The descriptive narratives above help illustrate how each group went about accomplishing their projects. As noted in the summary above, while the groups worked on the same assignment, there were differences in how they worked, time spent on individual subtasks, amount of external searching, and their use of tools. Despite these differences, a goal of this research was to understand if common phases of group and task activities could be identified across all the groups, which triggered information needs, seeking and use (Research Question 1). To answer this question, the researcher compared the description of each stage of each group activity above, and the codes generated, to the taxonomy of Marks and colleagues (2001), as described in the data analysis (Section 3.6.6).

Through this analysis, the names of the phases were changed, to better reflect the core activities observed. For example the Transition phase of Marks et al. (2001) included the following dimensions: Mission Analysis, Goal Specification, Strategy Formulation and Planning. The term *Planning* was used to summarize these dimensions and to reflect the activities of the groups observed. The dimensions of the Action phase included: Monitoring Progress, Systems Monitoring, Team Monitoring and Back up Behaviour and Coordination. *Monitoring* was used to summarize these processes, and reflect what the group actually did. Times when the group was working directly on the task have been coded as *Doing*. Times when the group was doing something other than Planning, Doing or Monitoring were classified as *Social,* as during these times they activities related to talking about social events, or actually socializing. The activities classified as Social have not been analyzed here. As identified in Chapter 1, the focus of this research was to look at the relationship between task and group processes. While

periods of interpersonal or social activities were noted, their analysis was outside the scope of this research.

The mapping of the taxonomy to group activities proceeded for each group, as presented below. This is followed by a section characterizing the common phases across all four groups.

Group A

Re-examining the coding and the descriptive narrative for Group A, three distinct phases of group activity could be identified: 1) Planning, 2) Monitoring, and 3) Doing. There were also times when the group was not working on the task, or planning or monitoring, and these phases have been classified as Social. Group A's workflow could be fit into a pattern; they alternated between short phases of Planning or Monitoring which occurred between longer phases of task work (Doing). As they completed one part of the assignment the group needed to re-assess, and determine a plan for the next stage (Planning), or review their progress (Monitoring). It was also found that mid task the group sometimes needed to stop and re-assess, to make sure they were on the right track. Group A spent a great deal of time on the first part of their project, analyzing the challenges and risks, and did not start the matrix for several hours. They had less time for generating their policy objectives. At the end they were working down to the wire, with no time to reflect before their presentation.

The group began at a high level, trying to understand their overall mission and who "knew" what. Their activities fit with the *mission analysis* phase of planning, members were evaluating their mission and assessing the team's resources. The group did not discuss specific strategies at this point, but moved to doing. The group began identifying the challenges and risks, and members took on specific roles. But the group commented on feeling inefficient, that they were taking a long time to make decisions, and that they had too much information to grapple with. This led the group back to a phase of Monitoring and then Planning. Group A then preceded through a stage of assessing their progress and process (Monitoring), which led to formulating a new strategy for how to work together (Planning). The group then went back to the task (Doing). This iterative process was repeated for some parts of their project. For others the group switched between Doing and Monitoring, with less time spent Planning. Table

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17 below shows how the stages described in Section 4.4.1 have been classified into the four categories of group activities.

Table 17   Classification of Stages of Group A by Session

Stage	Planning	Doing	Monitoring	Social
Stage 1 Beginning	x		x	
Stage 2 Identify Challenges/Risks – Part 1		x		
Stage 3 Checking Resources			x	
Stage 4 Division of Labour	x			
Stage 5 Identify Challenges/Risks – Revised Process		x		
Stage 6 How are we Doing?			x	
Stage 7 Back to Challenges and Risks		x		
Stage 8 Almost there?			x	
Stage 9 Finishing Challenges and Risks		x		
Stage 10 Examining the Matrix	x			
Stage 11 Beginning the Matrix		x		
Stage 12 Wait…is this Right?			x	
Stage 13 Working on the Matrix		x		
Stage 14 More advice			x	
Stage 15 Finish the Matrix		x		
LUNCH				
Stage 16 What Next?	x			
Stage 17 Requirements & Capabilities		x		
Stage 18 Assessing			x	
Stage 19 Policy Recommendations		x		
Stage 20 Creating Slides		x		
Stage 21 Finishing		x		

Group B

Analyzing the stages of Group B the following was found. Members of Group B worked individually at first, and then alternated between phases of Monitoring and Doing. They stopped to Plan as they moved to a new part of their project, or needed to resolve conflict about what they were doing. The group moved quickly through their project in the first part of their session, with one member in particular (Participant 3) keeping them on track and ensuring efficiencies. Similar to Group A, Group B began with a few minutes of Planning. They decided the best way to proceed was for everyone to read the case study individually. During the Doing phases individual members' assumed specific roles, and the shifts to Monitoring phases were prompted by an individual or a group commenting that there was a problem, or that time was passing. During the Planning stages the group

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assessed what they had left to accomplish, and determined a plan of action. The majority of time was spent Doing. The group completed the parts of the assignment in sequence. Table 18 below shows how the stages of Group B map to the different phases of group activity.

Table 18   Classification of Stages of Group B by Session

Stage	Planning	Doing	Monitoring	Social
Stage 1 Taking Stock	x			
Stage 2 Individual Reread		x		
Stage 3 Getting Started…Challenges & Risks		x		
Stage 4 Monitoring our work			x	
Stage 5 Vital Interests		x		
Stage 6 Confirm what we have done			x	
Stage 7 Which Matrix? And how do we score?	x			
Stage 8 Starting the Matrix		x		
Stage 9 But wait?			x	
Stage 10 Back to the Matrix		x		
Stage 11 So how are we doing?			x	
Stage 12 Completing the Matrix		x		
BREAK				
Stage 13 Determining next steps	x			
Stage 14 Parallel work Over Capacity/Recopy Matrix		x		
Stage 15 Policy Objectives & Slides		x		
Stage 16 Finalizing Content		x		
Stage 17 Quick Practice			x	

Group C

Group C did not have as many different stages as the other groups, but did also move through phases of planning, doing and monitoring. They mainly moved between stages of doing and monitoring, with planning at key points where decisions needed to be made.

Table 19   Classification of Stages of Group C by Session

Stage	Planning	Doing	Monitoring	Social
Stage 1 Getting Situated	x			
Stage 2 Discussing the Problem		x		
Stage 3 Ok let's start		x		
Stage 4 But wait			x	
Stage 5 Drawing it out		x		

Stage	Planning	Doing	Monitoring	Social
Stage 6 Matrix		x		
Stage 7 Are we doing this right?			x	
Stage 8 Finishing the Matrix		x		
Stage 9 What Next?	x			
Stage 10 Parallel work- Policy Recommendations and Finding Evidence		x		
Stage 11 Confirming last facts		x		

Group D

Group D progressed through their assignment by Planning then Doing, with breaks to Monitor, and to just give themselves a break (Social). They used their Planning times to determine what they needed to do, and the best way to do it. Their planning was sometimes trial and error – they sometimes started a task one way, then reassessed, and picked another strategy. The worked efficiently, but then did have a break where they were not focused on work. They finished ahead of the other group, and were content to relax and wait. Table 20 shows their pattern of activity by stage.

Table 20   Classification of Stages of Group D by Session

Stage	Planning	Doing	Monitoring	Social
Stage 1 Getting Organized				x
Stage 2 How will we work?	x			
Stage 3 Challenges and Risks		x		
Stage 4 What next?	x			
Stage 5 Vital Interests		x		
Stage 6 So now…			x	
Stage 7 Assessing our resources		x		
Stage 8 Confirming the Matrix process	x			
Stage 9 Matrix		x		
Stage 10 Transitioning	x			
Stage 11 Off task				x
Stage 12 Overall Policy Formulation		x		
Stage 13 Review…			x	
Stage 14 Specific Policy Objectives		x		
Stage 15 Making Sure			x	
Stage 16 Finalizing Policies		x		
Stage 17 Reflection			x	

Characterizing the Phases Across all Groups
Planning

After all the phases of each group had been classified, all the phases of Planning were examined and analyzed to create a robust understanding of this phase. Planning was

found to occur at the start of a new subtask, but also when a group ran into a problem. During the Matrix for example, all the groups needed to go back and forth between Doing, and re-establishing what they were supposed to be doing (Planning). All the groups needed to re-read the case study, and the matrix handbook to reassess their Plans. Within the planning stages, there was a mixture of activities related to the specific sub-activities suggested by Marks et al, (2001): goal specification, strategy formulation and planning and mission analysis. Further these sub-activities were often found inter-mixed, so the analysis remained at the Planning level.

Perhaps because the groups were under a tight timeline, the process of planning was sometimes compressed. The groups often started directly working on their subtasks, and then needed to go back to set goals when they ran into a problem. For example, during the process of identifying the risks and threats, several groups immediately started Doing the task, but ran into problems. They had to stop task work, and go back to their instructions, to determine the difference between a risk and a threat (e.g. Group D). The group needed to ensure they understood the goal, before they could complete the task.

Some groups took a few minutes as they started a subtask to debate options, at other points they started work directly, but then reassessed as time went on. For example Group A started out working collectively on the identification of challenges and risks, but felt they were not making good progress. They stopped, re reassessed, and decided to divide the labour and organize their roles differently. They then went back to working on the subtask itself. The pressure of time affected this process, as groups would re-evaluate based on efficiency and the need to complete things quickly.

Monitoring

Similarly, all the phases classified as monitoring, across all the groups were analyzed, revealing the following pattern. All the groups displayed activities related to monitoring their progress. This included commenting on the time, and how much they had (or had not) accomplished, but it also included judgments about the quality of their work which prompted a change in strategy (Planning) if things were not progressing well. Groups frequently Monitored their progress as they finished a subtask, to confirm they had completed all the necessary sections, as well as mid-task, if they felt progress was slow. At times the groups wanted external confirmation of their progress, and consulted one of

the instructors. In each of the groups there appeared to be one individual who took on the role of Monitoring or coordinating the progress, more so than other members. They prompted the others when things were off track, and helped move the group forward. Between Group A and B, and C and D there was also a sense of competition – the groups monitored there progress against the other group that was completing the task at the same time.

As with Planning, Mark's et al (2001) suggested a range of sub-activities that characterized monitoring including: monitoring progress, systems monitoring, team monitoring/back up and coordination. While evidence of these sub-activities was found, as with Planning, they were often intertwined, and difficult to separate. Consequently, the analysis remained at the higher level.

For example, the activities during monitoring phases included some evidence of systems related monitoring including keeping track of the team's resources and environmental conditions, including people, technology, equipment and information. But perhaps because of the nature and timing of the task, there were not many activities noted that would fit into this category. Groups did consider typing directly into the computer to save time, and did transfer information from the whiteboard and from the matrix to the computer.

Within the Monitoring phases, periods of time when members of the group provided feedback or coaching to each other were observed, and also times when a member helped another carry out their actions, or took over a task. These types of Monitoring activities, related to team monitoring and backup, were observed at various times for all groups. Particularly in Group B, Participant 3 frequently took on the role of team monitoring. She consistently moved the group from making notes to tracking their decisions on the computer, and kept the group coming back to their task work. In Group C, Participant 1 searched to find external information to back up the policies of Participant 2.

Even though the groups worked on many of the tasks as a group, activities related to coordination, or the management of synchronous and simultaneous activities, were still required at times. Marks and colleagues, (2001) specifically identify that information exchange, or sharing as well as mutual adjustment of action is necessary for coordination.

All the groups spent time coordinating, especially as they moved between tasks. Monitoring activities related to coordination included times when the members of the group decided to divide their labour then negotiated how they would put things together again. Each group, including C (the pair) had a member who took on the role of coordinator, and who would often direct the others. All the groups had the greatest challenge in coordination during subtask 2 (the Matrix). All the groups had difficulties creating a common, or shared view, of the matrix. Members needed to keep checking with each other, and moving to see the matrix form or the computer to keep track of what had been decided. Artefacts the group had created helped with this coordination aspect of monitoring. Groups C & D in particular, used the charts created on the white board to help coordinate and Monitor their activities during subtasks 4-6.

Doing

During the "Doing" phase the groups were working directly on their course projects. As with the Planning and Monitoring Phases, the stages when the groups were Doing were analyzed. Phases identified as Doing involved the group working on the different subtasks within their assignment, which represented different types of group work tasks. To fully understand "Doing", the different types of work tasks needed to be considered. This level of work task classification relates to the goal of the activity – what the group was trying to achieve. As noted in Chapter 2, Section 2.5.2, there have been many different task classifications created. Matching the taxonomies with the assignment in this research, it was found that the classifications of Hackman and Vidmer (1970), McGrath (1984), and Li and Belkin (2008) matched best.

As all the groups were working on knowledge based tasks, the categories used for the task analysis were all intellectual task categories. The goal of a task classification system is to have distinct categories that do not overlap. The task classifications below (Problem Solving, Generating and Problem Solving) were identified as distinct and separate activities. However to complete parts of the assignment, a group might need to use a combination of tasks. For example for Part 2 the groups had to generate policies, and then make a decision about which would be the best policy. The "Doing" phase will be analyzed in terms of the following three task goals: Problem Solving, Generating and Decision Making, which are defined below.

Decision Making

Decision making was used to define times when the main activity of the group involved choosing between options, where there was no known or right answer (McGrath, 1984). Completing the Matrix was an example of a task within their project which required decision making. The students had to systematically work through each box in the Matrix and decide if it should be scored as a 0, 1 or 2. The group had to agree on the decision.

All the groups spent a significant amount of time making decisions, particularly to complete the matrix and to generate their policy outcomes. There were differences in how each group approached decision making, but all went through a similar process where one member would suggest a particular decision, then other members would join the discussion to debate, verify or add additional information. A key part of decision making for each group was ensuring they clearly understood the definitions provided in the guidelines (verifying) and to keep track of decisions already made. Some groups were faster at making decisions (Group B for example); others seemed to make slow steady progress (Group A and D).

Generating

The code "generating" was used to identify times when the main activity of the group involved brain-storming, or coming up with a range of ideas. The product of generating is something new. It is similar to Hackman and Vidmar's (1970) category of production ("the production and presentation of ideas, images, or arrangements" p. 40), with an additional emphasis on synthesis, evaluation and creativity. It also corresponds with McGrath's (1984) classification of "generate" that included Planning tasks (Generating plans) and Creativity tasks (Generating ideas).

All the single session groups spent more time generating than any other task, as generating was necessary to solving the assignment subtasks 1a and 1c, as well as all sections of Part 2. Critical to the process of generating was the need to have a large common information space where the group could actually see what they were creating, and manipulate information. Group D provided the best example of this, using the large white board on the wall, as well as a portable white board and flip chart to help them create lists and policies.

Problem Solving

The code problem-solving was used to describe times when the main action of the group was to solve a problem. This corresponds to Hackman and Vidmar's (1970) category of problem solving which they described as a "course of action to be followed to resolve a particular problem". Problem solving involves answering *how* questions. The course project directly involved generating, and making decisions. Aspects also involved problem solving. For example to complete subtask 1c - "state the enhanced capabilities needed to meet the requirements of enforcement in the assigned area" the groups had to determine *how* these requirements could be met. In addition the additional memo given to Groups E and F the day of the exercise added a problem dimension. There were specific issues (i.e. piracy) that needed to be immediately addressed.

To solve a problem the groups often expressed a need for more information. This did not always result in a move to find information by searching through the internet or articles, but more frequently to sharing of information from the case study, and from the prior knowledge of individuals. Problem solving also involved examining all the necessary "pieces" of information to allow members to think together.

4.4.3 Analysis of Group Information Process by Phase

Classifying the phases of group activities provides a way of understanding the different *types* of activities iterate through, during their workflow. The next step is to understand the information related process within each phase. What information tasks, activities, are required to Plan for example, and which tools and sources are used to create what type of artefacts? Do all members participate in the information process? Do some take on specific roles? Are these seven elements (information task goals, activities, tools, sources, artefacts, shifts in participation and roles) sufficient to help understand how groups negotiate information needs, seeking and use tasks? Does the information process within Planning look different than during Monitoring or Doing phases? This section will explore these questions to address Research Question 2.

The data from the four single session groups will be analyzed to investigate GIP within each Phase. The following elements of the group process will be examined for each of the phases: information task goals, information activities; sources; tools, artefacts, participation and roles. These elements were coded as described in Chapter 3

Section 3.6.6. The coding generated for each element is examined first. Each phase (Planning, Monitoring, Doing) will then be deconstructed into the specific elements, to provide an understanding of group information process at the level of interaction (Tables 24 to 28).

Information Tasks

As outlined in Section 2.4, and illustrated in Figure 3, this research used an information behaviour lens to better understand group information process. This lens involves examining how the three key information tasks, identifying a need for information, choosing channels to seek information and then using information are negotiated by groups. During the analysis phase, these tasks were all observed. But the pattern found was more complicated than individual information behaviour.

For example, the need for information within a group was often signaled by through conversation. During the Matrix task for example, groups would often ask a question, and another member might provide the answer from the case study or matrix handbook, or from their prior knowledge. This might lead to a full group discussion. Less often this led to searching an external database.

Not all information needs were observed to trigger information seeking. Sometimes these needs were ignored. At other times group members searched for information, in response to a need, but did not share the information, or the need that prompted the search. Other times individual members searched for information to provide a contrary view (e.g., Group A and Group B), or to confirm a decision (Group C).

The coding of the Need task within the videos revealed that in many cases the identified needs were not fully explored. The groups observed did not spend much time, for example, negotiating the need to better understand it. This may have represented a missed opportunity to extend their resources. For example, during the session with Group D, members asked potentially useful questions such as "what other countries have similar shared border issues?" But instead of focusing on this question, and searching to locate other treaties or policies that might be relevant, the group just relied on knowledge held in common.

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The Finding task, within the single session groups, most frequently involved sharing information between group members. All the groups also specifically sought out an expert (their instructor) to solve an information problem. As highlighted in the descriptive notes, searching through the internet was uncommon. Perhaps because of the task, or the time factor, or perhaps even the technology (Tablet problems) the groups, with the exception of Group C (the pair), did little searching.

The Use task at the group level was also found to be problematic. The groups needed a range of activities (outlined below) to use information. Some groups (C and D) used the physical space (white boards, flip charts) to "see" together. Groups A and B had challenges keeping track of their decisions, and the artefacts being created, as they were created on a single computer. The groups expressed frustration with the amount of information, and the difficulty with integrating and synthesizing information.

Information Task Goals

To better understand how groups negotiate through the needing, finding and using tasks, the information tasks goals were identified. As discussed in Chapter 2 (Section 2.5.2) there has been previous work on information task goals. The information goals identified in this research incorporated previous definitions. New goals were only created when needed to reflect group work. For example the goal of keeping track emerged from the examination of the groups. Table 21 (below) presents the six information task goals that emerged through the analysis of the single session groups. Of note is the goal of "keeping track" which emerged from this research.

Table 21   Information Task Goals Observed in Single Session Groups

Goal	Definition	Origin
Confirm	Information is found and used to verify another piece of information.	Taylor (1991); Choo et al (2007))
Decision Support	Information is found and used by the group to balance information in order to make correct choices	Limberg (1999); Freund, 2008
Fact Finding	Information is found and used to determine the facts of a phenomenon or event, to describe reality.	(Choo (2007); Taylor (1991) Limberg (1999); Freund (2008)
How to	Information is found and used to answer questions such as *How do we?* Or *What do we need to do?*	Freund, 2008; Taylor (1991) – (Instrumental)

Goal	Definition	Origin
Keep Track	The group works with information to ensure information is not lost, but that it is saved somewhere to be used again.	Generated from research
Make Sense	Find or use information to better understand or make sense.	Like problem understanding (Taylor, 1991); Sense-Making, (Devin, Choo, 2006)

Information Activities

The information activities required to complete the information tasks were coded based on observation. Previous lists of individual and group information activities were used as a base, and codes emerged through the data analysis process. Table 22 outlines the 16 information activities that were observed in the single session groups. Activities unique to the group level include "negotiating" the relevance of information between members, and questioning and clarifying, which was related to building shared understanding. The process of signaling a need, which is recognized by another member, or the group, is also unique to groups.

Table 22   Information Activities by Task for Single Session Groups

Task	Activity	Definition	Example	Origin
Need	Need Recognized	When at least one member of the group realizes they need information to complete their task work, or to manage the process of working together. Cannot observe this until the need is signaled.	The moment prior to a member signaling the need for information. Relates to a situation where a need for information emerges. To find this you need to look for the discussion of the need, and then find the situation that prompted it.	Marchionini 1999
	Signal Need	Group member(s) asks a question or prompts the group to for information.	Member asks a question, or highlights that they need to know something.	Emerged from research
	Understand need	The group, or part of the group, has a discussion centred on clarifying the need for information... for example what would help - where they could find it etc.	A member specifically refers to a book, website, article, news story where information could be found. Or a member might ask more questions to help refine the need.	Marchionini, 1995

Task	Activity	Definition	Example	Origin
Find	Formulate Query	Activities related to determining what to type into the search box	A member opens a search box and prepares to enter a query.	Marchionini, 1995
	Execute Query	Execution of a query by clicking on the "search" button, following links within results, webpage, or information object, or clinking back or forth function and following links from within an information object	The member hits search.	Marchionini, 1995
	Examine Results	Examination of results or surrogates.	Member or members can be seen to be actively scanning the results of a search.	Marchionini, 1995
	Reformulate Query	Modification of an existing query or composition of second and subsequent queries	Member goes back to a search box and changes their query.	Toze, McCay-Peet & Toms, 2011
	Request for Assistance	Group needs to consult with Instructor, or a key person external to the Group to move forward with their task	Group is seen emailing, texting, calling or leaving the room to meet with an "expert"	Emerged from this Research
	Reflect and Iterate	Summary evaluation or assessment of information found and not found.	Members are actively discussing or debating the information they have found –either through a search or though sharing. Relates to sufficiency – is the information found enough.	Marchionini, 1995
	Share	Times when a group member voluntarily made information available to others, in response to a need	Times when information was made available within the group, member to member based on their prior experience or knowledge.	Davenport, 1997, p. 87
	Analysis	Group needs to examine information and assess its usefulness to help make a decision, solve a problem etc.	Group is assessing the information not in terms of what is missing, but in terms of its usefulness to complete their task, to plan or to monitor. Relates to relevance.	Blake & Pratt, 2006a

Task	Activity	Definition	Example	Origin
	Extract Information	The process of extracting information by reading, scanning, listening to information found in information object. In a group situation includes discussion. Refers to not only extracting information from found information, but also from shared information.	A member might specifically read out a piece of information – and another might add it to a group artefact.	Marchionini, 1995; Blake and Pratt, 2006
Use	Generate	Group members use different pieces of information to create something new	Group members can be seen to create something new, based on multiple sources of information.	Emerged from this Research
	Negotiation	Activities related to group members discussing and debating the relevance of information	Negotiation involves a difference of opinion. For example a member might say –"I don't agree …" and provide information to support a different point of view.	Emerged from this research
	Questioning or Clarifying	Actions related to group understanding. To make sure all members have the same understanding of the information being discussed individual members asks questions, restate or clarify (Did you mean…?). Different from verification, which was used to code times when the group wanted to confirm an external fact or decision.	Members probe or ask questions to ensure everyone has the same understanding. An example might be that a member asks "what do you mean by x" or asks "so you mean that…"	Emerged from Research
	Synthesize	Process by which a group assesses information (both found and shared) and attempts to fit things together, and assess patterns.	Members can be observed to be working with information from multiple sources, and attempt to synthesize into a common artefact.	Talja & Hanson, 2006

Task	Activity	Definition	Example	Origin
	Verification	Actions related to confirming a fact or decision that the group had made.	Members ask a question related to a decision previously made – to ensure that they still agree.	Blake & Pratt, 2006a

Sources

The sources were coded directly from the data. As noted above, the range of sources used by the groups for this task were finite. The following sources were observed: the case study, assignment guidelines, matrix handbook, prior knowledge of other members, specific web sites, map, journal articles, and experts.

Tools

Across all phases the groups used the following tools: pen and paper, computer (singly and jointly), white board, flip chart, the map, email and a USB stick. Groups needed tools to allow them to "see" together, to manipulate information as a group, and to help keep track of decisions.

Artefacts

The groups jointly created documents, the matrix, a presentation, diagrams, flow charts and charts.

Participation

The groups worked individually, in sub groups and as a group.

Information Roles

Information roles are the roles assumed by particular members related to information. Table 23 provides the description of the information roles that emerged from this study.

Table 23   Information Roles for Single Session Groups

Role	Description
Analyst	Group member(s) were observed to take on a role related to analyzing the information collected. Related to the Information Use task.

Role	Description
Director	A group member was observed to coordinate activities by assigning tasks or activities. Different from the leader as the role was focused on coordination rather than planning or leading.
Leader	A Group member was observed to guide the group in their activities including motivating them, and setting overall goals and plans
Reader	A group member was observed to read definitions out loud to ensure shared understanding within the group.
Scribe	A member was observed to take on the physical act of writing on a flip chart, on the white board, or typing on the computer. They were not necessarily generating the content, but physically recording it.
Searcher	Member was observed to actively search for information through the internet or external databases.
Writer	Member took on the primary role of creating new content.

Elements of Group Information Process by Phase

Planning

The elements involved in Planning are listed in Table 24 below. In the Planning phases, the groups worked with information to identify what they needed to do, and how they should do it. At the information task level the groups worked through needing, sharing and using, with no information seeking and retrieval through external sources. Generally a member would acknowledge uncertainty, and then other members would start to share bits of information to determine, or build, enough shared understanding of what they needed to accomplish to move forward. The group would extract information from their assignment guidelines, and then, through questioning and clarifying work towards a concrete statement of their shared plans. For some tasks the groups would go through a process of strategy formulation, looking at all the ways they could accomplish the task, and deciding the best one, but not for all tasks Groups shared information to: confirm, for decision support, and to determine how to.

As depicted in Tables 17-20 above, the groups moved in and out of Planning phases, for each part of their project. As they worked they need to reassess and come back to their goals, or change and modify them. During the Planning phase the groups used the course assignment, pen and paper, and sometimes the computer. Members made notes, but did not generally create an artefact that contained decisions or ideas related to Planning. Members frequently worked as groups during Planning, with members taking on roles (i.e. Director, Leader). Planning phases were not associated with information

seeking and retrieval episodes, but all the groups did request assistance from the instructor during this phase.

Table 24   Elements of Planning (Summary across Single Session Groups)

Information Task Goals	Confirming, Decision Support, How To, Keep Track, Make Sense
Information Tasks	Need, Find, Use
Information Activities	Signal Need, Recognize Need, Understand Need, Questioning & Clarifying, Extract Information, Negotiation, Request for Assistance, Share
Sources	Case Study, Assignment Guidelines, Matrix Handbook, Expert (course instructor)
Tools	Pen & Paper, Computer
Artefacts	Notes
Participation	Mainly Group
Information Related Roles	Director, Leader

Monitoring Phase

As noted above, the group activities associated with the Monitoring phase related to coordination: to ensure the group was on track; that there were sufficient resources; that members who needed back-up received it; and to coordinate activities. To accomplish group activities during Monitoring phases, the groups needed to be aware of any needs, to share information, and to use information. The goals of the information tasks during monitoring were: to keep track; to discover how to; and for decision support. The related information activities were often verbal, and not captured in any artefact. Groups did use tools to transfer information from one medium to another (from paper or the white board to the computer). They required joint computer use, and a shared view. The groups often had a Director who was responsible for Monitoring phase activities, and in some groups a Leader emerged. Participation during Monitoring phases shifted from individual work through to group work, although it was most frequently involved the entire group. Table 25 below provides a summary of the elements of the group information process during the Monitoring phase.

Table 25   Elements of Monitoring (Summary across Single Session Groups)

Information Tasks	Need, Find, Use
Information Task Goals	Decision Support, How To, Keep Track
Information Activities	Signal Need, Recognize Need, Understand Need, Questioning & Clarifying, Negotiation, Share

Sources	Other members
Tools	Pen & Paper, Computer, Joint Computer Use, USB, Email
Artefacts	Documents
Participation Changes	Most frequently group – shifts from Individual, Pair, Sub Group,
Roles	Director, Leader

Doing Phase

To complete the tasks themselves, the groups required all the information tasks and activities, but not necessarily for all tasks. The Doing phases across the four groups are deconstructed into the information related elements for each task type: Decision Making (Table 26); Generating (Table 27); Problem Solving Table 28).

Decision Making

Each group went through rounds of needing, sharing and using information to make decisions. Less commonly groups actively searched for information through the internet. Groups were looking for information to support their decision, but also to confirm, to find specific facts, and to keep track of what they had decided. Decision making involved analysis, extracting information, questioning and clarifying, re-finding, synthesizing, as well as recognizing and signaling the need, and all the activities associated with information seeking and retrieval. The main source was the case study, but groups did also use the simulation materials, and in some cases external websites and journal articles. To help with this process the groups used pens & paper, computers, white boards, the matrix and flow charts. The participation varied, from individual through to group. All roles were used at various points to help the group make a decision. Decision making during this study was not as active a process as generating, and did not result in as many varied artefacts.

Table 26   Elements of Decision Making (Single Session Groups)

Information Tasks	Need, Find, Use
Information Task Goals	Decision Support, Keep Track, Confirming, Fact finding
Information Activities	Signal Need, Recognize Need, Understand Need All Activities necessary for Information Seeking & Retrieval, Questioning & Clarifying, Analysis, Synthesis, Extract Information, Negotiation, Verification, Generate, Share

Sources	Case Study, Matrix Workbook, Specific Web Sites, Map, Prior Knowledge, Journal Articles, Experts (course instructor)
Tools	Pen & Paper , Computer, Joint Computer Use, White Board
Artefacts	Document, Matrix, Flow Chart
Participation Changes	Individual, Pair, Sub Group, Group
Information Related Roles	Director, Leader, Analyst, Reader, Scribe, Searcher, Writer

Generating

To generate their analysis and recommendations the groups spent a good deal of time actively interacting with information.The groups needed to grapple with the information, and really needed to see the pieces together, so they could move them, change their minds, and synthesize the pieces into something new. Generating involved more action than making a decision; members frequently gestured at things, and used the map to help as an orientation tool. Generating also required group members to keep track of ideas, and to verify facts and definitions from the case study.

There was some finding during the process of generating, but mainly the groups worked through sharing. The groups used a range of tools, and created complex artefacts, sometimes needing to create them on a white board or paper, and then replicate them on the computer. Participation varied; the full group often participated in generating, with members playing a full range of roles.

Table 27 Elements of Generating (Single Session Groups)

Information Tasks	Need, Find, Use
Information Task Goals	Decision Support, Keeping Track, Confirming, Fact Finding
Information Activities	Signal Need, Recognize Need, Understand Need All Activities necessary for Information Seeking & Retrieval, Questioning & Clarifying, Analysis, Synthesis, Extract Information, Negotiation, Verification, Generate, Share
Sources	Case Study, Matrix Workbook, Specific Web Sites, Map, Prior Knowledge, Journal Articles
Tools	Pen & Paper , Computer, Joint Computer Use White Board; Need for Shared View and Tools to manipulate information
Artefacts	Document, Matrix, Flow Chart, White Board
Participation Changes	Individual, Pair, Sub Group, Group.

Information Related Roles	Director, Leader, Analyst, Reader, Scribe, Searcher

Problem Solving

The information process necessary to aid problem solving were more difficult to separate within the video data, as problem solving occurred as part of the decision making or generating tasks. Problem solving appeared to be closer to generating, as it required much manipulation of information to ensure all dimensions were considered. Needing, finding, sharing and using were all required for problem solving, although finding through information seeking and retrieval was not common. The groups needed information to find specific facts, to keep track, and to confirm, and used the full range of information activities. The map, the case study, external articles, and the internet were all utilized in problem solving, and artefacts included charts and tables on the white board, as well as diagram on paper.

Table 28   Elements of Problem Solving (Single Session Groups)

Information Tasks	Need, Find, Use
Information Task Goals	Keep Track, Confirming, Fact finding, Making Sense
Information Activities	Signal Need, Recognize Need, Understand Need All Activities necessary for Information Seeking & Retrieval, Questioning & Clarifying, Analysis, Synthesis, Extract Information, Negotiation, Verification, Generate, Share
Sources	Case Study, Matrix Workbook, Specific Web Sites, Map, Prior Knowledge, Journal articles
Tools	Pen & Paper , Computer, Joint Computer Use White Board
Artefacts	Document, Flow Chart, Diagrams, White Board
Participation Changes	Individual, Pair, Sub Group, Group.
Information Related Roles	Director, Leader, Analyst, Scribe, Searcher

4.4.4 Differences between groups

A final analysis of the data from the single session groups included identifying and trying to understand the differences between the processes of the four groups. Even though all the groups were working on the same task, and cycled through the same phases, some interesting differences were observed between the groups. To fully account for the differences, additional data and analysis would be required. However, the following points of difference are highlighted, which appeared to be important.

One of the striking differences when observing the groups was the different ways they used their space to share and display information. Group C and D, for example, used multiple white boards and attempted to create tables to integrate all the information they needed to assess. Group C also tried to create a diagram to pull all the key points together. In contrast both Groups A and B used pens, paper and the computer to manipulate information. Group B created a flow chart to help organize information. This difference may be due to individual differences. Regardless, it does highlight that groups may need a robust set of information tools to accommodate different styles.

The groups could also be observed to manage their diversity in different ways. Group A managed its diverse resources the most effectively, taking advantage of the legal skills of one member, and the presentation skills of another. Group B had a member who acted as a Leader for most of the task, as did Group A. There was a great diversity in some of the groups (particularly A and B) in terms of prior knowledge, educational program, and nationality, which members highlighted in their conversation, which might have influenced how they worked. Information seeking, particularly within Group A was related to one member wanting to use information to help change people's mind, or support their own position. This might have been related to trust – the degree to the members trusted each other's knowledge and skills. Examination of trust was beyond the scope of this research.

There were moments when specific groups appeared to have issues related to building or maintaining shared understanding. In Group B for example, two members had consistent task related conflict. But the group still managed to work effectively. All the groups had difficulty creating a shared understanding of how to interpret and use the matrix.

4.5 Summary

The objective of this study was to deconstruct knowledge intensive student group work to understand the process of information needs, seeking, and use, within groups. Two specific research questions were addressed. The first question related to the classification of the phases of group activities. To accomplish their assignments, and manage the process of working together, all four groups were found to cycle through three phases of

group level activities. These three phases were: Planning, Monitoring, and Doing. Social Phases were also noted, but not analyzed as they were beyond the scope of this research. This finding confirms and extends the work of Marks et al., (2001). It integrates task work and group processes to provide a holistic look at the phases of activities during student task work.

The second research question involved examining *how* the student groups managed the key information tasks (need, seeking and use) within each of these phases. Each phase was deconstructed to reveal the elements involved in a group information process: information task goals, information activities, source, tools, artefact, roles and shifts in participation. The importance of these elements, which emerged from the prior research on information and groups, was confirmed. Descriptions of 6 information task goals, 16 information activities, and 7 roles identified in the four groups were provided.

Even within small student groups, working on a simulated task in a single session, the complexity of a group level information process was highlighted. The groups were found to face specific challenges related to utilizing their information resources effectively. For example, some groups duplicated processes. They needed to use white boards and flip charts to see and generate together. These artefacts had to be recreated electronically, to be added to their presentation. Some groups needed to jointly use computers to allow members to examine artefacts together. Groups had difficulty keeping track of the facts in the case study, as well as also their decisions and ideas. They needed to confirm and verify information. Members complained of information overload, and of being overwhelmed.

A lack of "Finding", or information retrieval at the group level was identified, as well as the range of activities, sources and tools required to enable group information use. The groups in this study frequently moved from identifying the Need for information, to Sharing, and then working with the shared information (Using) without the need to search through external databases. All the groups did need to seek out "experts" for advice when they ran into problems, taking a direct approach, rather than searching for more information. All the groups spent the greatest amount of their time *Using* information. The groups all extracted information collectively from the case study, and then analyzed, questioned and clarified, negotiated, verified and synthesized. All the groups used roles

to help manage their information processes. In some groups leaders emerged, who worked to manage the group's processes and keep them on track. The use of tools varied greatly between groups. Some groups used a multiple computers, white boards and flip charts, while other groups mainly used paper. The case study was the main source for all the groups, but two of the groups did some external searching for information through the internet. Work within the group was fluid, individuals wanted to work separately at times, and kept some things private. Though they worked on the same tasks, the groups all had unique patterns of working together with information, which would require a flexible suite of tools. Despite these differences in approaches and strategies, a "group" information process could be observed and described.

CHAPTER 5   MULTI SESSION GROUPS

5.0 Overview

The objective of this study was to deconstruct knowledge intensive group work to understand the process of information need, find and use tasks within three multi-session groups, building on the findings of the previous study. This Chapter contains the description and results from the multi-session groups. The naturalistic lab study protocol outlined in Chapter 3 was used to collect data from three groups of students who met in the Group Work Lab for multiple sessions to work on their course assigned projects. The groups, their course projects, and any changes to the protocol are described, and the findings are presented. The research questions were assessed as summarized in Table 29. The chapter concludes with a summary of findings.

Table 29   Map of Research Question by Section

Research Question	Data Analysis	Data Used	Section
Which phases of group and task activities prompt students to seek, find and use information, and how can these phases be characterized?	Step 1 & 2	Video Morae	5.4.2
How are the key information tasks (need, find, and use) negotiated within each of the phases of student group and task activities?	Step 3	Video Morae Emails Post Study Individual Surveys	5.4.3
Analysis of the differences across the groups	Step 4	Video Morae Emails Post Study Individual Surveys	5.4.4

5.1 Groups

5.1.1 Group E

Group E was recruited in the summer of 2007 and included five second year undergraduate commerce co-op students (m=3, f=2), all of whom had completed at least

one work term. The group members ranged in age between 18 and 23 years old. Some members of this group had worked together on one previous project. The group formed itself naturally within the course. The professor did not create the group, nor was there any attempt to bring together specific skills sets for the group. Group E met in the Group Work Lab 5 times over the months of July 2007, each meeting ranging from 45 minutes to 4.5 hours, for a total of 7.2 hours to complete their project.

Based on the information gained from their Demographic Survey, all members of the group had a similar technology profile. That is, all members of the group identified that they used the internet for more than 10 hours a week, and all used email and web searched frequently (daily or weekly). All but one of the group members used Facebook, but only two members had participated in video or audio conferences. None of the group members had used chat rooms or blogs.

All of the group members indicated they had previous experience in student groups, and most (4 out of 5) had also worked as part of a group for high school activities. Three of the members had worked in groups in a work setting. There was a range of comfort with working in a group; one member indicated that they would rather work in a group; another preferred to work individually. Three members did not have a preference. All members had worked in groups with both friends and colleagues. Regarding the preference for size of group, four of the five group members stated a preference for working with two to four other people, while one would prefer to work in a pair.

5.1.2 Group F

Group F, worked on their project in the Group Work Lab from September to November 2007. This group contained four graduate students (m=1, f=3) ranging in age from 21 to 27. All the group members were in their first year of a Master's program in a professional-focused partially science - and partially social science-based discipline. As they volunteered for this study during the beginning of their first term, the group members had just met each other, and none had worked together in a group. Three members had studied science during their undergraduate degrees, while the fourth member had a social science background. None of the group had a graduate level degree; this was a first Masters for all. The students of Group F formed themselves into a group,

with no influence from their course professor, or the researcher. As part of this study, the Group F met six times to complete their project. Each meeting was two to three hours long, for a total of 14.3 hours.

Based on the answers in the Demographic Survey, there appeared to be some diversity in terms of technology use within Group F. One member stated they used the web 1-5 hours a week, two indicated they used it more frequently (6-10 hours) and only one member used the internet more than 10 hours a week. Only two members of this group used Facebook; all used email and searched the web frequently.

The members of Group F had a range of previous experiences working with groups. All had been members of student groups as well as been team members. Three of the four group members had work related group experience. All members also had significant experience with groups; three members indicated they had worked in groups frequently (more than 10 times), while one member said 5-10 times. Three members were neutral when asked if they would rather work as an individual or in a group; one member slightly preferred groups. All members agreed they would rather work with two to four other people. Data related to Group F, has also been discussed in Toze & Toms (2010).

5.1.3 Group G

The third multi session group, Group G consisted of six graduate students (m=5, f=1) ranging in age from 21 to 33. They were all in the same professional Master's program, but some were in the first year and some were in their second. Most members of the group were full time students, while one was part-time. Their undergraduate degrees varied, and included science, arts, and business; some had both undergraduate degrees and college diplomas. Members of this group had worked with each other on previous coursework, but they had never worked together as a group of six. Group G was also self-selected. The group selected their own project topic from a list of potential topics provided by their Professor. Group G met 10 times during the period from February to April 2010 to complete their project, each time for about an hour and a half, for a total of 18.4 hours.

All members of Group G used the web frequently. Three indicated that they used the internet more than 10 hours a week; the other three checked 6-10 hours. All members

used email, searched the web, and used Facebook daily. Three members indicated they used blogs daily or weekly. There was little experience with chat rooms, audio or video conferencing within the group.

All six members had worked in a range of types of groups, and all indicated they had worked in groups frequently. The majority (5 members) of the group had no strong preference between working individually or in a group. In terms of group size; 4 members said they would rather work with two to four others; 2 members liked to work in pairs.

5.1.4 Summary of the Groups

All three multi session groups had a mix of male and female members, and a mix of ages, with Group G having the largest range in age. Group E were undergraduate students, but the age range in their group overlapped with Groups F and G. Based on the Demographic survey, no significant differences were noted between groups in terms of their technology profile or prior experience with group work. Within each of the groups there was a range of comfort levels with technology, with Group E being the most homogeneous. All group members in all groups had prior experience with groups, and there was a mix within each group of those who preferred working in pairs or small groups, and those who preferred working alone. Table 30 provides a summary of the groups.

Table 30   Summary of Multi Session Group Characteristics and Data

Group	Group Size	Number of Sessions	Number of Stages	Hours	Timeframe
Group E	5	5	21	7.2	2 Months
Group F	4	6	29	14.3	3 Months
Group G	6	10	40	18.4	3 Months
Totals	**3 Groups**	**21 Sessions**	**90 Stages**	**39.9 Hours**	

5.2 The Tasks: The Course Projects

5.2.1 Group E

Group E's project included one main task, to analyze a case study given in the course text, and present their findings to the class.

This project included 5 parts, which were completed sequentially:

   1) Identify the key problem(s)

2) Analyze the problem(s)

3) Identify all alternatives

4) Determine a recommendation

5) Create an implementation plan for the recommendations.

The deliverable was the presentation. The group did not have to submit a full report. The same case study was being used for multiple purposes within the class, so students were familiar with the material, but not their specific problem. None of the students had any prior knowledge of the setting of the case study or the subject area.

5.2.2 Group F

The course assigned project for Group F was more complex and less structured. Group B's project included 4 parts, with the first part having two sections.

1) Completing a review of the literature to identify the key issues

    a. Delivering a substantive presentation with visual aids

2) Identifying 2 to 3 core readings to assign to the rest of the class

3) Identify and schedule guest speakers

4) Design and lead a class exercise

All parts of the project were due at the same time, there were no preliminary deadlines. This was a comprehensive project, representing 50% of the final course grade. The project topic was new to all members; no member had relevant prior knowledge. There was no individual component to this project; it was entirely a group project.

5.2.3 Group G

Group G's course assigned project was a research project. The project was divided into separate assignments in a structured and sequential fashion, with each assignment having a separate due date, and building on the previous one. The complete project represented 55% of the final course grade. The parts were:

1) *Literature and document review

2) Interview guide

3) Focus Group Guide

4) Draft questionnaire

5) Finalized questionnaire with responses

6) Class presentation

7) Final research report

(*Note this was completed prior to the group becoming participants in the study)

Their project topic was novel to all members. This was a group assignment with a group mark, but an individual component was included. All of the group members would be expected to be able to answer questions on all aspects of the project. There could be an individual grade reassessment if a group member could not successfully demonstrate their individual knowledge of the group project.

5.2.4 Summary of Course Projects

All three projects could be considered collaborative or "group projects", rather than cooperative learning (see for example Johnson et al., 2007). The groups formed organically, and members were not put together to ensure a particular mix of skills. Specific individual measures were only built into the task for Group G, and there were no guidelines or tutorials provided in the classes on how to work together. Roles were not assigned to members, and there were no teamwork building exercises as part of the process.

To compare the projects Li & Belkin's (2008) faceted classification of task was applied at the project level, as in Chapter 4 (see Table 31 below). The assessment of individual members and the group regarding task difficulty, complexity and knowledge of the topic will be accessed later, using group communication as evidence.

Table 31   Comparison of the Course Projects Multi Session Groups

		Group E	Group F	Group G
Description		Case Study	Understand a Complex Topic	Research Study
Task Facets (*Li & Belkin, 2008*)				
	Source	Externally Generated	Externally Generated	Externally Generated
	Task Doer	Assigned as Group	Assigned as Group	Assigned as Group
	Time	Long Term	Long Term	Long Term
	Product	Decision/Solution	Intellectual	Intellectual
	Process	Multi-time task	Multi-time task	Multi-time task
	Goal	Quality – Specific Quantity – Multi	Quality – Mixed Quantity – Multi	Quality – Specific Quantity - Multi

		Group E	**Group F**	**Group G**
	Task Characteristics	Moderate objective task complexity Assigned as a task with high interdependence	High objective task complexity Assigned as a task with high interdependence	Moderate objective task complexity Assigned as a task with high interdependence
Subtasks		Analysis of Alternatives Decision Presentation	5 Parts (same due date) Lit Review Pick Core Readings for the Class Presentation Identify and Select Guest Speakers Identify and Schedule Class Activity	6 Parts (staggered due dates) Lit Review Interview & Focus Group Guide Design/Test Survey Finalize Survey Class Presentation & Report
Course Weighting		20% Course Grade	50% Course Grade	55% Course Grade

5.3 Procedure

The protocol described in Chapter 3 was deployed with the following exceptions. As outlined in the protocol, the groups were free to ask for additional tools or equipment. The following was requested:

- Group F requested and was given a projector to view their presentation for their dry run.
- Group F requested Microsoft Publisher, which was loaded on the computer.
- Group G asked for SPSS, which was available on the laptops, through the Novell Network.

The Group Work Lab had been modified by the time data was collected from Group G. A large monitor had been added to the room which enabled the group to have a common view of the contents of one computer. A white board had also been permanently installed along one wall. Data was analyzed iteratively in stages, as outlined in Chapter 3 Section 3.6.6. The same process was used to analyze the data for each group.

5.4 Results

5.4.0 Overview

The results have been organized into sections, following the data analysis outlined in Chapter 3 (Section 3.6.6) and organized by the research questions. The first section (**5.4.1**) provides a descriptive summary of what the groups did by stage. The key elements (information tasks goals, information activities, tools, sources, artefacts, roles and shifts in participation) are identified, which will be analyzed in further sections. By providing a summary description of all the groups, organized in a similar fashion, comparisons can be drawn across sessions and groups.

The second section (**5.4.2**) relates to Research Question 1. The activities in each stages of each group were examined and compared to the phases identified in the analysis of the single session groups in Chapter 4 (Planning, Monitoring & Doing). Within each of these phases, the workflow of the group was assessed to examine how the key information tasks (need, find, use) were negotiated within each phase (Research Question 2) **(Section 5.4.3)**. The information task goals and activities of the groups were identified and described. The sources and tools used and artefacts created were identified and discussed. Shifts between individual, sub-group and group work during these tasks were identified, and any patterns that emerged in how the information processes were accomplished were also noted. For example did one participant always do the searching? The final section **(5.4.4)** examines the differences in GIP between the three groups.

5.4.1 What the Groups Did

Group E

Overview

Group E met for five sessions over two months, for a total of 7.2 hours, to accomplish their project. Not all five members were present for all meetings, and one member was absent from the final group meeting, which was over four hours. The majority of the actual work on the project was completed in this last session. The other four sessions were focused on the procedural and logistical aspects of their work; more on planning and monitoring than doing. The observed activities could be best described as

individualistic. Members focused on their own issues and concerns, especially in the early meetings. In sessions four and five more substantive collective brainstorming, problem solving and discussion was observed. Group E had three information seeking episodes (an episode involves moving through a set of activities related to identifying an information need through to finding information in external sources (internet/database) and extracting information) which occurred in the last two sessions. The group searched for information to confirm, and to find images. Detailed analysis of the participation of group members specifically during these information seeking episodes was analyzed in Toze, McCay-Peet & Toms (2011).

Table 32 below provides a summary of the workflow of the group within each session. Following this table, the highlights of the activities of the group during each session and stage are described. For the full details see Appendix 11.

Table 32   Workflow of Group E by Session

Group E	Stages	Time	
		Start	Stop
Session 1 12/07/07	Stage 1 Getting Started	00:24	00:26
	Stage 2 Planning and Dividing	00:26	00:33
	Stage 3 Logistics and Goals	00:33	00:44
	Stage 4 Adjourning	00:44	00:48
Session 2 16/07/07	Stage 1 Getting Organized	0	00:04
	Stage 2 Brainstorming	00:04	00:25
	Stage 3 Outline & Division of Labour	00:25	00:30
Session 3 18/07/07	Stage 1 Diaries and Greeting	0	00:15
	Stage 2 Scheduling & Adjourning	00:15	00:30
Session 4 20/07/07	Stage 1 Greeting & Off Task	0	00:03
	Stage 2 Update & Re-Division of Labour	00:03	00:06
	Stage 3 Discussing External Section	00:06	00:21
	Stage 4 Presentation Draft & Plan	00:21	00:37
	Stage 5-Adjourning	00:37	00:48
Session 5 22/07/07	Stage 1 Diaries and Organization	0	00:05
	Stage 2 Logistics	00:05	00:15
	Stage 3 Focus on PR Issues	00:15	01:00
	Stage 4 Multi-task- PR & Slides	01:00	02:00
	LUNCH BREAK	02:00	02:10
	Stage 5 Continuing PR	02:10	03:20
	Stage 6 Finalizing Slides	03:20	04:10
	Stage 7: Adjourning & Logistics	04:10	04:19

Session 1

Stage 1 Getting Started

The first session of Group E was primarily a planning or organizing meeting. The group started with general chatting. The trigger to start task work was Participant 3 asking "Ok who's read the Case"? There was some direction, where a member took on a role of directing another - "you ARE going to read it?" (Participant 3 to Participant 5), and one member (Participant 2) left the room to copy the case for another member (Participant 5), who did not own a copy of the text. During this time members were observed to work individually more than as a group.

Stage 2 Planning & Dividing

The group did not spend any time discussing or analyzing the work task itself; they jumped directly to how they were going to do it (Information task – how to). They divided the work. Members identified what they would like to do. The group worked mainly as a group during this time, and used email (tool) to confirm details. They identified their need for information collectively, and shared information.

Stage 3 Logistics and Goals

The group tried to plan their next meeting, which involved trying to coordinate five schedules. They assessed what the goals or deliverables for the next meeting should be, how they should share information (use email), and what they should "write up".

Stage 4 Adjourning

Members confirmed a meeting time, updated their schedules, and packed their books.

Session 2

Stage 1 Getting Organized

The group began the second session with general talk about other courses, and job opportunities. They quickly transitioned to the project, and discussed organizational activities. There was concern voiced about the time they had left to complete their project and frustration with the problem of finding convenient times to meet, due to conflicting schedules.

Stage 2 Brainstorming

The group then moved on to a discussion of how best to present the material, which involved negotiation and debate and brainstorming. The need for information was

identified through questioning. Members shared information from their interpretation of the case (main source), aggregating and integrating from the individual to the group level. Members asked questions to ensure comprehension and to discuss interpretation of the case, and their process (how they should be proceeding). They discussed the key information source (the case study), shared information from individual course notes, and discussed how their presentation (group artefact) should be organized and formatted. Members referred to the case study (source), and to how other groups in the class had organized their presentations. The group jumped from discussing content, to process, to format. Tools used included pen and paper, and emails.

Stage 3 Outline & Division of Labour

Participant 1 took on the role of leader. Based on a suggestion from Participant 1, the group decided to split the members into two groups, one focused on the internal issues (Participants 3 and 4) and one focused on external (Participants 1, 2 & 5). Within each of these groups however, they would still be working independently. Participant 1 also recommended that all members should try and work their "concepts" (from their course notes) into their section. Members made individual notes (tool – pen and paper). The group adjourned.

Session 3

Only four members were present for the third meeting (Participants 2, 3, 4 & 5). There was little general talking and their expressions appeared anxious. This meeting could not easily be divided into different stages.

Stage 1 Diaries and Greetings

Waiting for members to arrive the group began to work together

Stage 2 Scheduling & Adjourning

The main activities were planning what they still needed to do, and monitoring who was doing what. Members set goals for the next meeting, to ensure they were splitting the work appropriately, based on the disparate schedules and workloads of members. There was an increased sense of time pressure, and it was also clear from their comments that most members (Participants 2, 4 & 5) still had the bulk of their work to do. During this session members referred to the case study, and to other groups' presentations. Members talked about the need for slides for their presentation, and use of email. Participant 2

encouraged Participants 3 and 4 to work together, as participant 4 would not be there for the final meeting. Participant 3 resisted, he had his section completed, and did not want to spend more time. The group mainly worked with information through discussing, negotiating, and clarifying.

Session 4
Stage 1 Greeting & Off Task
General greetings and non-task related information were exchanged; there was little actual progress at this meeting, as most of the group members still had not completed their individual pieces.

Stage 2 Update & Re-Division of Labour
The members continued their discussion about how best to organize their work. The main activities were dividing the project among members. There were some technical issues with one of the computers. Members used email to send draft information to each other.

Stage 3 Discussing External Section
The group then moved to discussing the external section. The discussion involved the three members responsible for this section (Participants 1, 2 & 5). The other two members (Participant 3 & 4) worked independently. Participant 5 shared what he had written by reading out loud, and the other two members added their thoughts. The three attempted to brainstorm directly about the key challenge. They needed to confirm specific details (confirm facts) from the source (the case study) and to share ideas. Participant 1 asked for the syllabus to confirm project details and Participant 5 produced it. The group then noticed what Participant 4 was doing on his computer.

Stage 4 Presentation Draft & Plan
Participant 4 had started the slides for the presentation. Members walked over to look at Participant 4's computer (joint computer use). Members spent a few minutes discussing this artefact, and making suggestions, which Participant 4 implemented. There was some conflict about how the presentation should work, and frustration and confusion. Members (particularly Participants 1 and 4) did not agree on how they should be re-integrating the divided work into a final group product.

Stage 5 Adjourning
The session ended due to time pressure, but with no sense of agreement.

Session 5

The final session was the only time the group really attempted to integrate their ideas, and to think through their presentation as a whole, although this was hampered by one member not being present, and by another being persistent in wanting their section to remain intact.

Stage 1 Diaries and Organization

Some members (Participants 1 & 2) complained about this project "*Don't know why but I really don't know how we are going to do this*? *I don't really want to* (Participant 2).

Stage 2 Logistics

Members discovered that different members had done things in different ways. Some had slides ready and shared them with the group (Participants 3 & 5). One member had written their part, and emailed them to themselves. The email didn't come through, so that member needed to redo the work. No one had any understanding of what the missing participant (Participant 4) was planning on saying. He had not shared slides or notes. There was a discussion about how they could be more efficient. The group decided that they should work on slides together - the "shell" of the presentation. Then they would divide up who will say what, and everyone could work on their own part. From their conversation, the group appeared to have little shared understanding of their project.

Stage 3 Focus on PR Issues

The group moved from this fragmented stage to more focused work, on the PR or external issues (Participants 1, 2, & 5). These three members started collecting all their ideas. Participant 1 was typing (scribe). The three were discussing, negotiating, questioning and at times brainstorming. There were issues reaching shared understanding. Participant 1 was typing the communal notes on her computer, but the others could not easily see what she was writing. Participant 5 was not as involved. Participants 1 and 2 asked questions to confirm what he covered, and he offered his opinion. They were getting things done, but it was taking a long time. This concern over time prompted Participant 5, taking on a role as leader, to suggest a new strategy. Participant 1 and 2 should continue to work on the external section. Participants 3 and 5 would work on updating the presentation.
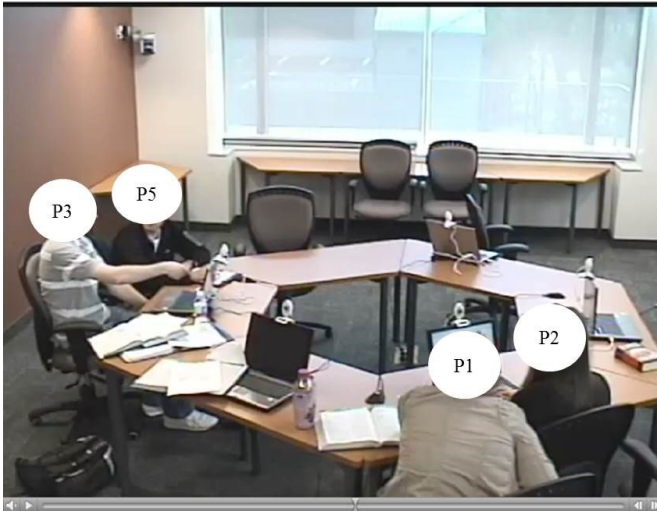
Session 5 – Stage 4 - Group E is working on their task. They are split into pairs. P1 and P2 are jointly using one computer to write. P3 and P5 are using the other computer to work on the group presentation.

Figure 22   Screenshot of Group E

Stage 4 Multitask – PR & Slides

Each pair worked together sharing a computer (see Figure 22). Participant 5 used a pen and paper at some points. After a while Participant 1 floated between the groups and eventually took over the presentation. She searched the internet using Google images and YouTube for pictures to add, and formatted the slides. Participants 3 and 5 moved away and appeared to both work individually. Participant 5 showed frustration at times. He needed to remain aware of what Participants 1 & 2 wrote about the PR/External section, as this was his part as well. They ignored his questions, but he persisted. From constant references to time, there was a clear sense that the group was concerned. The group did veer off topic at times. Participant 1, who took on the role of "searcher" searched for and shared a YouTube video with participant 2, for example, for fun. There was some information seeking to find supporting materials and pictures for the PowerPoint. Participant 2 shared a funny/sad zoo animal story she found on YouTube. She had found it looking for task related information, but the story did not have anything to do with their project. This stage ended with a break for lunch.

Stage 5 Continue PR

After their lunch break Participant 1 continued working on the PR/External section. The group was observed to move in and out of focused attention on the task. There were also some technical problems with the computer. Updates were being loaded, so its processing was very slow. This caused some concern.

Stage 6 Finalizing Slides

The Group worked to finalize the slides. Participant 1 rearranged the computers and took charge of the slides. Using the two computers side by side, she integrated information from the word document into the PowerPoint document. Participant 1 directed the others, but Participant 5 was more the leader, focusing on logistics, and finishing things. The group came back to the issue of the missing participant. They were still concerned that they did not know what he would say, or how it would fit. Participant 2 had been reading, but rejoined the group at this point. Participant 3 stayed in his seat, away from the shared computers, but did participate. There was more searching for zoo animals (Participant 1). They also needed to fact check and verify information from case study in the text (source). There was some humour. During this stage the group continued to move in and out of focused work.

Stage 7 Adjourning & Logistics

Finally Participants 1 and 2 saved the group artefacts and sent them by email to all. They confirmed that each member knew what they were responsible for presenting. The group determined how they would coordinate with the missing member, and made plans to meet quickly before class the next day. By the end the group did have a completed presentation, and a plan for solving the problem that all members present endorsed. The activities of the members between meetings were mainly procedural in nature. There was no sharing of substantive thoughts, or information resources. Individuals mainly worked as individuals.

Summary of Group E

Group E planned and divided the work through the early meetings, and only did substantive work on the class project in their final session. The need for information was identified by members through conversation, and in most cases this need was solved through information sharing. At times the need was ignored. The groups needed information to plan their work, to monitor or check their progress, and for task work. They did require some information seeking and retrieval to complete their project.

The group experienced problems working together as not all members had completed their individual work at the same time, so integration prior to the last session was not possible. The main source used was the case study, as well as individual notes,

and the course syllabus. The group used tools including laptops, pen/paper, cell phones, calendars, email, photocopier, and a flip chart and search tools such as Google and YouTube and programs such as Word and PowerPoint. They used cell phones and watches to keep track of time, and calendars to check schedules. These tools and programs were used heavily in the last session. In this session the group needed to jointly use a laptop and use two laptops simultaneously to see together, and transfer and integrate information. Members searched for information to find specific photos, to confirm facts, and to have fun. The group shifted through phases of working together, independent work, and working in subgroups (pairs, three). Members took on roles including leader, director, searcher and integrator.

Group F

Overview

Group F met 6 times over a period of three months to complete their project. Each of their sessions lasted two to three hours. Group F processes fell into a pattern. At the beginning of each session the group spent a few minutes in greetings, general discussion and updates, before beginning their course project work. Group F had substantive discussion and synthesis of information regarding their project in each session. Before ending members confirmed what had been achieved, agreed on new goals, and ensured appropriate division of labour and deliverables for the next session. Group F had 18 separate information seeking episodes during their six sessions.

Group F spent the bulk of their meetings discussing the literature review and the creation of the class presentation. Activities around finding guest speakers and organizing the class exercise were integrated in the middle sessions (sessions 2, 3, 4) and finalized before the last meeting. There were some references to identifying the core readings (Part 2) at various points, but there was not much emphasis on this within meetings. Between meetings the group actively shared information sources as well as updates on logistics through email. Table 33 below provides a summary of the workflow of the group within each session. Highlights of the activities during each session and stage follow. Full details are provided in Appendix 11.

Table 33   Workflow of Group F by Session

Group F	Stages	Time	
		Start	Stop
Session 1 19/09/2007	Stage 1 Greetings & Organizing the Room	00:18*	00:20
	Stage 2 Problem/Task Assessment	00:20	00:54
	Stage 3 Dividing & Refining	00:54	01:35
	Stage 4 Adjourning	01:35	01:42
Session 2 26/09/2007	Stage 1 Diaries and Chat	0	00:05
	Stage 2 Updates and Scoping out the Tasks	00:05	00:18
	Stage 3 Understanding their Topic	00:18	00:27
	Stage 4 Establishing Boundaries of their topic	00:27	00:50
	Stage 5 Re-Draft Outline	00:50	01:58
	Stage 6 Adjourning	01:58	02:13
Session 3 10/10/2007	Stage 1 Diaries and Greeting	0	00:06
	Stage 2 Updating & Clarifying	00:06	00:53
	Stage 3 Creating a Flow Chart	00:53	01:25
	Stage 4 Adjourning	01:25	01:35
Session 4 17/10/2007	Stage 1 Diaries and Greeting	0	00:10
	Stage 2 Updates and Discussion	00:10	00:29
	Stage 3 Decision Making	00:29	01:20
	Stage 4 Sub Meeting & Individual Work	01:20	01:38
	Stage 5 Outline & Flow Chart Re-Design	01:38	02:36
	Stage 6 Adjourning	02:35	02:38
Session 5 24/10/2007	Stage 1 Greetings & Logistics	0	00:13
	Stage 2 Goals for the Session	00:13	00:15
	Stage 3 Organize the Tasks	00:15	01:42
	Stage 4 Concluding Recommendations	01:42	01:47
	Stage 5 PowerPoint Slide Design	01:47	02:09
	Stage 6 Adjourning	02:09	02:12
Session 6 31/10/2007	Stage 1 Diaries and Discussion	0	00:10
	Stage 2 Getting Ready	00.10	01:36
	Stage 3 Dry Run	01:36	02:42
	no real "adjourning" – just ran out of time and left – make final changes to slides individually		

Session 1

Stage 1 Greetings & Organizing the Room

The group made the space their own. They agreed that they did not want to use the

computers (no tools), but just wanted to talk. Comments were made regarding the

cameras and being watched. Some members were uncomfortable with the space and the

idea of being watched.

Stage 2 Problem/Task Assessment

Group F came to their first meeting prepared to work, with one member (Participant 3)

bringing an outline (artefact), related to the literature review and class presentation,

which was used to help organize their workflow. A range of sources were brought to this meeting. A couple of members (Participants 1 and 2) brought books, one member shared an article (Participant 3), and all members referred to, and flipped through course notes. The group began to assess their topic (the project) and to identify the sub-tasks they would need to complete. They began by sharing; individuals within the group started to contribute their thoughts. During this process the group started editing the outline; it became a key group artefact. They looked at this collectively, but individually took notes on their own papers. They needed to clarify both the topic and their group deliverables (e.g. questions such as "Do we have to do a paper as well"?). Storytelling was used by individual members quite a bit in this session. There was a leader through much of this section; one member who the others seemed to be confirming things with (Participant 4). The group initiated a discussion about the best ways to share information over the course of the project. They would use PowerPoint for the presentation, but wondered whether the course management system (Blackboard) had space that groups could use to collaborate. The trigger to end this stage and start dividing the topic was affective - one member commented that the topic was "*almost overwhelming*" (Participant 4). The group was trying to understand their project by pulling information from multiple sources including books, articles and individual notes. They worked mainly as a group.

Stage 3 Dividing & Refining

The group divided the topic. To deal with their sense of being overwhelmed the group decided each member should pick areas of interest from the list and research them individually between meetings. The group thought this would work – "*as long as we share, to ensure we will not be duplicating work*" (Participant 3). As part of this process, the group continued to learn about their topic and initiated searching to find specific facts. To accomplish this, the group began to use the computer, contrary to their initial plan. The group collectively tried to determine their information needs, and used government web sites (sources) and Google as a tool. The group was learning about each other. Members were individually demonstrating their skills and prior knowledge, by telling stories, and providing examples. They discovered that one member had a social sciences background. The other three members had science undergraduate degrees. The member with the social sciences background (Participant 4) acted as the "leader" in the

discussion for much of this meeting. Members used their prior experience and interest to select the sections of the project they wanted to research.

Stage 4 Adjourning

Members established a list of objectives and goals for the next meeting, and organized their process. All members would independently research their topics, and bring a summary to the next meeting. Members continued their discussion of how best to communicate. They debated if they could they post things to a group space on the Blackboard site? Or should they begin to put things in a PowerPoint? Should they alert other members by next meeting of any changes that should be made to the planned outline based on their readings? Also any overlaps? Members agreed to bring to the next meeting any contacts or thoughts on the field trip or guests to invite to class.

Session 2

Stage 1 Diaries & Chat

General discussion while members filled out their diaries.

Stage 2 Updates & Scoping out the Tasks

Participant 2 updated the others on his activities between the meetings. The group systematically went around the table sharing their conversations, activities, and findings since the last meeting. The discussion centred on the field trip and guest speakers. They also discussed at a high level what they needed to cover in the presentation. Most of the discussion was at the level of negotiating the boundaries of their project, and ensuring they had a shared understanding of what they needed to do, and how they could accomplish their tasks. There was also some conflict over expectations of how they should work. Two members (Participants 1 and 2) came to this meeting with draft PowerPoint slides already created, while two did not. Participants 1 and 2 merged their slides. There were some issues with the computers, one was slow and non-responsive.

Stage 3 Understanding the Topic

The group discussed the presentation in greater depth. During this stage there was joint computer use (tool), and use of materials prepared individually and brought to the meeting (sources). The pattern of communication was one member to all, followed by a process of analysis. The group also commented frequently on the need to "*keep track*" (information activity – keeping track).

Stage 4 Establishing the Boundaries of Their Topic The group shifted focus from defining their topic, to differentiating their topic from other groups' in the course. To help determine the boundaries of the project group members searched and shared information from multiple sources. A member (Participant 1) searched for an association, another (Participant 4) "Googled" an international convention to clarify details, and another participant read from an article (Participant 1). There was frustration with all members trying to see one computer, and issues with slow computers. Mid stage the group requested (Participant 4) and was given a flip chart to help with the process of working collectively with information (Tool). This was a very information intensive session. There were a range of sources being used simultaneously; notes of individual members, the draft presentation, articles, books, as well as the information found on the internet. The group was looking for information to help them understand their topic, and to confirm specific facts. They were also trying to organize the information they had found. Members also discussed the usefulness of having the outline (group artefact) to keep them on track. They could just "plot things in as they moved forward" (Participant 4).

Stage 5 Re-Draft Outline

In an effort to move forward, the group decided to try and work on a redraft of the outline*.* There were parallel processes going on. Members used the flip chart (Participant 1, then 4, then 2). Participate 3 was updating on the computer. They were working with two copies of the outline, a communally constructed one on the flip chart, and an electronic one created from editing the original outline. This was also a very active part of the meeting. There was frequent moving of chairs, members physically changed places and roles and tasks. The group was working to analyze and synthesize the information found to date, and were still dividing the overall labour. There was some conflict related to decisions about the task. Members made comments like "*we need to get a grip*" (Participant 4), and that the topic was all over the place, "*overwhelming*" and "*unwieldy*" (Participant 3). There were moments of clarity – for example one participant (Participant 1) noted - "We just had a moment"; a flash of insight. Then members commented on the need to ensure they had captured these "moments". There was a sense they had to *keep track* or would lose something important. The group looked for information collaboratively, continuing to learn about the topic and confirm facts. In addition they

group acted to keep track of the information and ideas they found. They were using the flip chart, computers, Google, pen and paper. Participation shifted from working as a group, to completing some activities in pairs.

Stage 6 Adjourning

Members commented on their progress. "We started slow but good progress" (Participant 4). There was agreement that they needed to finish the new draft of the outline. There was some subgroup activities, two members working online, two on the flip chart. This final stage focused on logistics. There was discussion of how people work, and a recognition that they needed to understand each other's processes as well as the work task. In terms of their project, the group was still struggling to organize their topic. Members used colored markers to help organize the outline and keep track of changes. There was some discussion of the fact they were part of a study, and that they were being recorded (Participant 3). Summarizing their own sense of the meeting one member commented "*I was worried in the beginning…but this is coming together*" (Participant 4).

Session 3

Stage 1 Diaries and Greeting

The group was largely chatting about other things, not related to their project.

Stage 2 Updating & Clarifying

Each member provided updates. This was a very active stage. There was both joint and individual computer use and use of sources including books and websites. One member (Participant 3) received a phone call (tool- cell phone) from an "expert" who might be a potential speaker and who had ideas about the field trip. There was discussion of citations, and key articles (sources). One member felt all should read (this had been shared by email) a particular book. The group reflected on their process and decisions – "*what did we decide again*?" (Participant 3) The group discussed the need to talk to a key human source (information source – expert). Two members identified a person within the Faculty who was an "expert" in the area (Participants 3 & 4). They felt they should organize a meeting with this expert to ensure the group hadn't missed critical information, and to confirm other key resources they should be using. There was collaborative searching to confirm facts, and help clarify and make sense of the scope of

the topic. The trigger for the end of this stage was comments about being overwhelmed by the layers of the topic.

Stage 3 Creating a Flow Chart

The group used two tools, the flip chart and computer to create a flow chart. They spent quite a while trying to organize the stakeholders/legislation on the flow chart on the flip chart. One member took on the role of scribe, consistently writing, as well as providing leadership (Participant 4). There was joint and individual computer use, and both joint and individual searching. The group needed to search the internet for legislation, government sites and NGO sites. Participant 3 took on the role of searcher. In their conversation the participants concluded that although their flow chart wasn't working perfectly - it was a good start. Creating the flow chart helped the group move forward - "*this is how we are going to get through this*" (Participant 4).

Stage 4 Adjourning

The group recapped what they had done, and what they needed to do next.

Session 4

Stage 1 Diaries And Greeting

The group members chatted about things not involving their project.

Stage 2 Updates and Discussion

Members took turns reporting on calls made to potential speakers and experts for the field trip. One member would speak, all would respond to the ideas. There were no decisions, only negotiation and discussion. Members commented on feeling "*scattered*" and the need to "*nail down*" (Participant 4).

Stage 3 Decision Making

The group was struggling over making a decision about the field trip. They debated between several options, and made phone calls to confirm options. They were concerned about the time for the class trip, and questioned if in fact this task was necessary for the project. They searched the internet to provide background information to help make decisions. For example, they found and assessed details including distance and travel time to choose between options. This phase "ended" when some members left to discuss their concerns/frustrations with the course Professor. Participant 1 stayed to continue work on the flow chart.

Stage 4 Sub Meeting & Individual Work)

Work was split. Participant 1 remained behind to work on publisher using the flow chart on the flip chart as an information source. The other 3 met with the course Professor to confirm plans, receive feedback and assistance and to relieve their increasing anxiety and frustration.

Stage 5 Outline & Flow Chart Re-Design

The members returned. The group determined they did need to organize the class trip. All members resumed work on the outline and flow chart for the presentation. This involved sharing, analysis and synthesis. There was mention of particular sources such as the "*book*"- a core resource two participants were urging all to read (Participants 3 & 4). Members referred to notes, websites of regulatory bodies, and legislation. Their activities during this stage are captured in Figure 23.
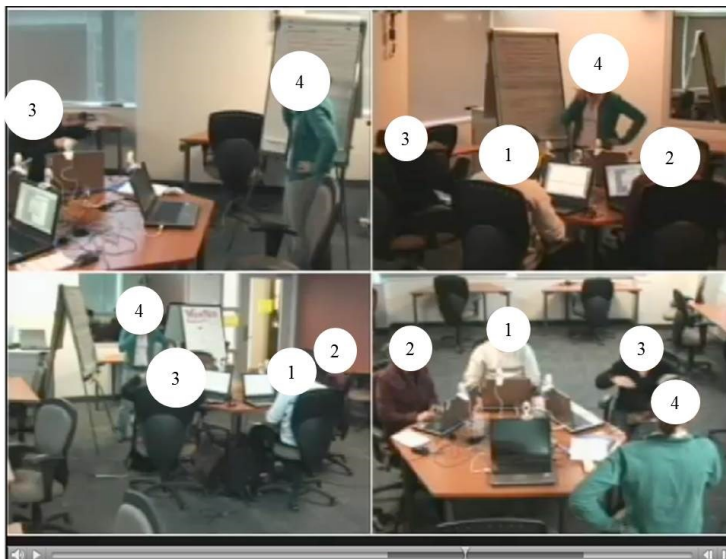
Group F is working on the flow chart to organize their topic. P4 is writing, P3 has been searching for information, and P1 and P2 are discussing. The members are analyzing and synthesizing information. They are using the flip chart, computers, notes, and articles.

Figure 23   Screenshot of Group F

Stage 6 Adjourning

The group made goals and plans for the next meeting(s), and confirmed what they had done/decided in this meeting. Specific follow ups were promised for the next day or so – and they would plan to meet the following week. As some members left and two remained (Participants 3 and 4), there was an indication of discomfort. One commented; "*I really need to get my head more into this*" (Participant 3). They reassessed the idea that the group, or some members, should speak to an expert, because "*sometimes you just get*

so stuck in your own view" (Participant 4). As the meeting ended each member was going off to work on their individual parts.

Session 5
Stage 1 Greetings & Logistics
The group discussed logistics. When should they do a dry run? What should they have ready for the next week? They continued to discuss the format choice for their slides. The group also debated how they were going to meet with the field trip person. When and how could they all get there? Because of this it took longer than normal to fill out their Diaries. The trigger to move to the next stage was task and time pressure. "*Can we set some goals for today* (Participant 2)?

Stage 2 Goals for the Session
The group was trying to focus on what they needed to do this session. They discussed the number of slides they should have in total, and the timing for the presentation. This was a brief discussion. For the bulk of this meeting the group tried to decide how all the parts of the project would be organized within the timeframe they had for their class session. The group used the flip chart as a tool to try and plot the time line. There was much sharing, synthesis and verifying, and comments that indicated uncertainty, anxiety and worry. They seemed to be struggling with not having a full sense of the topic - that each only knew their piece, and did not know how the whole was coming together. Members commented that they "*trusted*" that the other members knew their sections. But at the same time members needed to keep clarifying and checking. Some members (Participant 3 in particular) seemed uncomfortable that they did not yet really "know" what the others knew. Some members had done more work, or were further ahead in terms of their part of the presentation. This created an asymmetry in terms of the group. One member stated he felt comfortable (Participant 2), two clearly stated they were concerned (Participant 3 and 4), and one did not voice any strong opinion regarding their confidence level (Participant 1). There did not appear to be a sense of shared understanding.

Stage 3 Organize the Tasks
There was joint use of the computer. The group was moving between their slides, the flip chart, email, and notes. The discussion revolved around processes, how and when to put the final presentation together, and what kind of a style to use. Information sources

including Google Map and People (human sources) were used. Members referred to books and articles read. The group also need to "re-find" questions they had written down before – "*where are our questions? I think we jotted them down on a loose leaf*?" (Participant 4) They also referred back to the video (source) they watched in the first session – should they show this to the class and have a discussion question from it? Members made comments on how "hard" this was - to work together on such a large project (Participant 4). There was multi-tasking within the group - group, individual and pair activities. There were periods when the group was quiet, engaged in individual tasks.

Stage 4 Concluding Recommendations

The group then moved to a stage of summarizing and finalizing the results of their discussion. The group created a timeline based on their negotiations. One member commented on how much he had learned through this group project, and the amount of time they each had spent (Participant 2). Participant 1 commented "*no reason why we can't do well*" but the rest of group seemed uncertain. One member commented that they only had two weeks left. They *"knew"* that *"things"* would come together - but it "*feels like it is not there yet*" (Participant 4). Three members commented on how they don't have a grasp of the whole (Participants 1, 3 & 4). Two commented on feeling somewhat terrified (Participants 3 & 4). Participant 2, who felt more confident, tried to reassure the group.

Stage 5 PowerPoint Slide Design

The group tried to agree on a basic template for their PowerPoint slides. They worked in pairs on this, examining Google images, government websites and PowerPoint templates.

Stage 6 Adjourning

Most of the conversation was off task. They made comments about the Master's program, the amount of work, and specific projects in other courses. There was a general agreement that all felt overloaded, and some indication of frustration.

Session 6

Stage 1 Diaries and Discussion

There was a high level of stress. Group members were discussing issues with other courses as they filled out their digital diaries. The issues and problems they were having were discussed. There was little discussion of their project.

Stage 2 Getting Ready

The group attempted to merge their individual slides into one deck. They experienced a number of technical issues - some of which related to slow internet speed. They also had to "format" the slides once they were combined. There was a bit of difficulty getting the slides to show on the projector, which they had requested be available for this meeting. "*I love technology - makes our lives sooo much faster*" (Participant 3). Members used email and a memory stick to combine slides. One member (Participant 1) was working on the "Schedule" for the day". Finally all slides were combined and they were "Ready to go". There was a mix of individual, sub group and group work during this phase.

Stage 3 Dry Run

The group viewed the integrated presentation for the first time. There was tension as members did not all agree on how individual sections flowed with the whole. Members questioned and confirmed the information, the sources, and the order; trying to develop a "group" view of the topic. There were examples of divergent prior knowledge, discussion of prior experiences, and discussion of how language is used differently in different spheres (science vs. policy). There were gaps in their shared understanding at times. At times members directed each other – "*you should*". One member was more crunched for time than the others and had to leave early (Participant 2). There was task related conflict, and a clash between individual and group understanding. The meeting ended based on time, with members commenting on not quite feeling prepared.

Activities Between meetings

Group F used email to share logistical information as well as information sources between their meetings. The researcher was included in a total of 35 emails over the course of the study. The content of these emails included updates to the group on messages to external contacts regarding the field trip, guests for their class, and sharing of specific articles and books with the group. Participant 4 in particular sent articles to specific members and to the group, recommending them for specific sections. Participant 3 recommended a book which then Participant 4 also recommended. These particular emails were sent between the third and the fourth meetings.

Summary of Group F

Substantive work on tasks was distributed throughout all the sessions of Group F. Artefacts such as the outline and flow chart were used as collective and integrative tools to help move the group forward. Members in Group F "finished" their individual pieces at different times, but all had some work done for each meeting. They worked together in meetings as a group, but some individuals remained fixed in terms of their personal section. One member in particular was not willing to incorporate information or changes suggested by other members. The group had frequent information seeking episodes, to learn about their topic, find facts, confirm, for decision support and to keep track. A wide range of sources were assessed and integrated, using a variety of tools including a flip chart, laptops, pen/paper, cell phone, Google, Word, Publisher, PowerPoint and email. Members took on specific roles including searcher, leader, editor, and director.

Group G

Overview

Group G required 10 meetings over three months to complete their project. Group G's project included multiple assignments, with separate due dates, with each assignment building on the previous. Group G's meetings were structured. Each meeting began with general chatting, but then they quickly moved to establish an agenda (verbally) for each meeting. They used the agenda to monitor their progress both during the meeting, and at the end. Each meeting generally included the following stages; responding to feedback received on the previous assignment, work on the current one, and planning for the next.

The group became participants after the literature review had been completed. Through that assignment members of Group G had created a shared sense of their topic, which was evident through the constant references back to the literature, and to their findings from the literature review. Group G did substantive task work as a group in the room, and they created drafts of each assignment collectively in their sessions. Not all members were present for all meetings. Group G did not have many information seeking episodes during their meetings. Instead they used email to coordinate this activity between meetings, especially towards the end of the task, when they were creating the final report. Table 34 below provides an overview of the workflow of the group over the

project. A summary of their activities by stage follows. The full description of their activities is included in Appendix 11.

Table 34   Workflow of Group G by Session

Group G	Stages	Time	
		Start	Stop
Session 1 08/02/09	Stage 1: General Chatting	0	00:01
	Stage 2:Getting Situated	00:01	00:08
	Stage 3: Interview Guides Draft 1	00:08	00:45
	Stage 4: Adjourning	00:45	00:48
Session 2 15/02/10	Stage 1: Diaries and Waiting	0	00:14
	Stage 2: Getting Organized	00:14	00:27
	Stage 3: Revising Interview Guides	00:27	01:45
	Stage 4: Adjourning	01:45	01:50
Session 3 01/03/10	Stage 1: Diaries & Organizing	0	00:20
	Stage 2: Incorporating Feedback	00:20	01:00
	Stage 3: Questionnaire Draft 1	01:00	01:16
	Stage 4: Adjourning	01:16	01:20
Session 4 04/03/10	Stage 1: Diaries and Updates	0	00:20
	Stage 2: Interview Debriefs	00:20	00:31
	Stage 3: Questionnaire Take 2	00:31	01:19
	Stage 4: Adjourning	01:19	01:30
Session 5 08/03/10	Stage 1: Diaries& Organizing	0	00:18
	Stage 2: Transitioning	00:18	00:25
	Stage 3: Questionnaire Take 3	00:25	01:25
	Stage 4: Other Tasks & Adjourning	01:25	01:30
Session 6 15/03/10	Stage 1: Goal Setting & Interviews	0	00:08
	Stage 2: Finalizing Questionnaire	00:08	01:22
	Stage 3: Adjourning & Logistics	01:22	01:24
Session 7 19/03/10	Stage 1: Diaries & Getting Organized	0	00:05
	Stage 2: Multitask	00:05	00:25
	Stage 3: Planning	00:25	00:31
	Stage 4: Logistics & Adjourning	00:31	00:39
Session 8 29/03/10	Stage 1: Diaries & Collecting Survey Data	0	00:20
	Stage 2: Data Integration	00:20	00:31
	Stage 3: Examining & Cleaning Data	00:31	00:56
	Stage 4: Division of Labour & Adjourn	00:56	01:09
Session 9 05/04/10	Stage 1: Greetings & Organization	0	00:13
	Stage 2: Discussion of Statistical Trends	00:13	00:20
	Stage 3: Planning	00:20	00:24
	Stage 4: Crafting PowerPoint	00:24	01:24
	Stage 5: Adjourning & Division of Labour	01:24	01:27
Session 10 08/04/10	Stage 1: Greetings &Waiting	0	00:05
	Stage 2: Slide Review & Update	00:05	00:55
	Stage 3: Dry Run Presentation	00:55	01:28
	Stage 4: Adjourn & Logistics	01:29	01:35

Activities by Stage

Session 1

Stage 1 General Chatting

The group began with general chitchat, but quickly moved into work mode.

Stage 2 Getting Situated

Participant 4 drew attention to what the group had completed, and what they needed to accomplish in this meeting. "*So the consent form is looking really good, the next thing we need to do is the interview guide*" (Participant 4). Members discussed whether they had been given a copy of a sample interview guide, and checked the course website. After determining that they did not have a sample guide the group decided to not worry about the format for now, but to brainstorm about potential questions

Stage 3 Interview Guides Draft 1

The group established different roles for different members. Participant 2 was told he had a "free pass" as he took a lead on the literature review. Participants 5 and 6 went to the white board wall and started writing with markers. They both took a different section of the board, and concentrated on a different audience for the guide. Participant 1 started to copy what was on the white board onto paper, until Participant 4 suggested it should be done on computer so it could be emailed and edited later.

The group worked in the following manner, individual members would contribute an idea, which the group would collectively assess and debate. They worked through question and answer – "*What do we need to know*"? In response members would suggest ideas. Members were very supportive of others' ideas and the process, for example comments like "*those are good questions*" were made. The process during this stage was both structured and productive. They mainly worked as a group. Participant 4 took on a "leader" role. Noting the time, he suggested that they should be able to complete their work by 6:30. They did not use the computer to search for information, or even notes to look things up. This seemed to be a conscious decision. For example, at one point, someone asked if they should confirm a fact by examining the policy. The group agreed to - "*just write it down now, and check later*" (Participant 4). They concluded that their goal was to surface ideas, not confirm facts. This stage ended as Participant 4 noted the time – "*it is 6:30 – is there anything critical missing*?"

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Stage 4 Adjourning

The group assessed their progress. They had covered demographics, prior knowledge and barriers. The group determined that they could not finalize the guide until they had a copy of the template. Participant 2 emailed the Teaching Assistant to see if they could get the template. Participant 4, monitoring the group's progress, checked to see if everything on the white board has been typed into the computer. Participant 1 confirmed this, and committed to emailing the notes to all. The group used the white board, laptops, and email. There was some use of pen and paper. They only shared information, there was no information seeking episodes through external information. They did request assistance from an "expert" (Course TA), to obtain the template as soon as possible. They worked as a group for most of the meeting.

Session 2

Stage 1 Diaries and Waiting

Four members arrived early, and had to wait for two members who were coming from another class. There was general chat about common social events, and general news. Members seemed to know each other quite well.

Stage 2 Getting Organized

The meeting began with praise for the work done to date - "*Good job, again*". Participant 2 had a hard copy of their artefact from the last session, which they needed to share to work with in this meeting. They used a flash drive (tool) to pass this artefact around as there were issues with the laptops. To work more effectively as a group they decided to use the large monitor as a common interface. Once documents had been shared they looked at the sample template, and concluded it would be straightforward to make the necessary changes. Participant 4 stepped in as a leader asking - "*what are our goals for this meeting*?

Stage 3 Revising Interview Guides

The group decided to work on one interview guide. Members collectively and systematically edited the document, which took the bulk of the meeting. They worked largely as a group, with occasional side conversations about other courses and projects. Work was distributed in different ways among the members. Starting with this meeting, and continuing through the next, Participant 6 controlled the computer and the large

monitor, completing all data input (editor). At times he was also the content creator (writer), and other members actively watched. Other times he incorporated suggestions from others. The majority of the time the work progressed through the same process; members made suggestions, the suggestions were considered and analyzed by the group, and changes in the group artefact were implemented by Participant 6. Members followed their progress collectively, by observing the changes in the document on the large monitor. Participant 4 continued to lead their process, making suggestions such as -"*let's not waste too much time "wordsmithing"* to ensure efficiency with the group time. He commented that the group time should be used to ensure they were surfacing all the best ideas. Fine tuning could be done by an individual outside the meeting. Some members were also following the unedited version of the document on their computer. Some looked at notes or print copies (sources). Participant 4 passed around physical copies of templates they were given in last class. Participant 6 accessed their literature review (source) to confirm their Research Questions, accessing the marked copy through his email. Members also moved their seats to gain a clearer view of the monitor. When Participant 6 noticed attention was wandering he would ask a question to bring their focus back to the monitor. Participant 4 had to leave early, but the others remained to work through to the end of their document.

Stage 4 Adjourning

The group assessed their progress. Should they go through it again? Several members said no point - Participant 4 (who had left) would edit and rip it apart - "*but in a good way*" commented Participant 3. They congratulated themselves on their work to date - "*Fantastic document*". Participant 2 moved over to help Participant 6 create a linked table of contents, as the group finalized the document and moved to adjourning (Stage 4). They congratulated themselves – "Good work" and "ok team take care".

Session 3

Stage 1 Diaries and Organizing

The first part of the meeting was about organizing who they could interview and who would talk to the government and policy contacts. Participant 6 was back at the computer attached to the large monitor. He was typing a form email - which all members would use to contact participants. Other members, particularly Participant 4 suggested a few

grammatical changes. This email was saved and sent to all. There were some things the groups still felt unsure about related to Assignment 2. They needed to confirm a couple things with their professor regarding who they could interview. Participant 2 texted his sister (cell phone as tool) during the conversation to confirm the contact information of potential interviewees. They determined they had done as much as they can about the interviews, and moved on to their next goal.

Stage 2 Incorporating Feedback

The group systematically worked through the comments from their professor regarding the Information Guide, making revisions collectively. Participant 6 typed (scribe). All the group members provided suggestions and comments. They used the large monitor, and expanded the comments field so all could see the feedback. As they worked they did need to confirm facts and details. Members consulted sources including emails, course materials and individual notes. They did not actively search for information though the internet. The group communicated by email with the professor during the session to clarify a detail related to their project. As they finished the revisions there was a sense of progress being made – "*good work guys*" (Participant 4).

Stage 3 Questionnaire Draft 1

The group started to brainstorm ideas, but were not as organized. They thought about using the whiteboard, but ended up with Participant 1 typing their notes into a computer. There was an issue with the connection to the large monitor, so they could not share the common monitor. They spent 20 minutes suggesting and negotiating potential questions, and finished a rough draft.

Stage 4 Adjourning

They concluded that they had done as much as they could, and commented that they had accomplished a lot. They confirmed a schedule for their next meeting, and discussed who would email the new group artefacts to all members.

Session 4

Stage 1 Diaries & Updates
There was some general discussion of the timing of their project, and assignments for other courses.

Stage 2 Interview Debriefs

The group confirmed who had completed interviews. Two of the participants (1 and 5) would not be coming to the session today as they were conducting an interview. The other members provided updates on the results of their interviews, as they were unpacking and filling out the diary. They compared notes on who had contacted potential "interviewees", and leads that needed to be contacted. During this stage there was an information-seeking episode involving participants 4 and 6. There was a gap between the identification of the need, and the sharing of the information found.

Stage 3 Questionnaire Take 2

The group continued their work on the questionnaire. They did not have the notes from the last meeting. Participant 1 didn't send after the meeting - and was away this meeting. So they decided to brainstorm a second time. Participant 6 worked at the whiteboard, Participant 3 recorded their work in Word on a laptop. This was necessary because the connection between the laptop and the large screen was not working. For this part of the session they were working as a group, and really brainstorming. Members provided feedback to each other each (i.e. "*that's really a good point*") throughout this phase. There was information seeking related to a discussion over what was considered "mainstream" vs. "alternative" medicine. This led to animated discussion, but the information was not used to change the draft questionnaire. Participant 4 ended the searching with the comment - "*let's get back to the project*". They re-examined the questions - clarified a few points, and then agreed they have covered all the bases.

Stage 4 Adjourning

Members confirmed deadlines and schedules - and who would do what. Participant 3 found the missing notes from last week on the computer - and sent them to all by email. They checked this draft, but felt like they did cover everything in the new questionnaire. As they prepared to leave there was continued discussion related to their information searching. Participant 3 showed them all the YouTube video she found, just for entertainment.

There was some duplication of work on the questionnaire. The group took a picture of the white board with a cell phone - just in case. During this session the group tried to re-find information (questionnaire started the prior week), used information

sources including individual notes, people, and websites, and tools including email, computers, Word, the white board, Google, and cell phones.

Session 5

Stage 1Diaries and Organizing

The members who arrived first checked their email, and searched for, and watched, funny videos' on the large monitor (information seeking for fun). There was some discussion of their project tasks, but mainly just waiting.

Stage 2 Transitioning

Participant 1 announced that the Professor had just sent an email with updates and reminders about the questionnaire. The group needed to add open ended questions. Participant 6 started talking about his interview - sharing with the group and updating them. There was a mix of chatting generally and individual work. At the end of this transition phase the group moved to focusing on the questionnaire - question by question.

Stage 3 Questionnaire Take 3

Participant 6 had put the questionnaire up on the large screen so all could see -as they worked through it. Participant 2 had formatted the questionnaire on his computer (a Mac). He needed to make changes in parallel, as required. The copy on the shared screen was a PDF and was not editable. Participant 6 highlighted the question/words they were discussing to help all keep track. During this session they worked consistently at the group level - debating words and concepts, and generated the final copy. They analyzed each question in a systematic way. The discussion was quite animated. The group members had strong feelings about how to present some information (i.e. age, education, how to refer to alternative/traditional medicine). In addition members were incorporating feedback from the class on their draft questionnaire. Towards the end of this stage they confirmed the decisions they had made earlier.

All members participated. There were some differences of opinion, but the group worked through this. For example, at one point Participant 4 made a decision, and commented "*it's on my head if it is wrong*". The group consistently shared information and constructed new content- generating a shared understanding and agreement for the questionnaire. There was no external information seeking during this stage. Members referred to the literature review (prior group artefact), but no one looked at the actual

document, or confirmed any facts. The activities during this stage are captured in Figure 24 below.

Group G is working collectively on the questionnaire. They are using the large monitor to see and generate together. Members are using computers to bring things up in email, and are sharing and analyzing information.
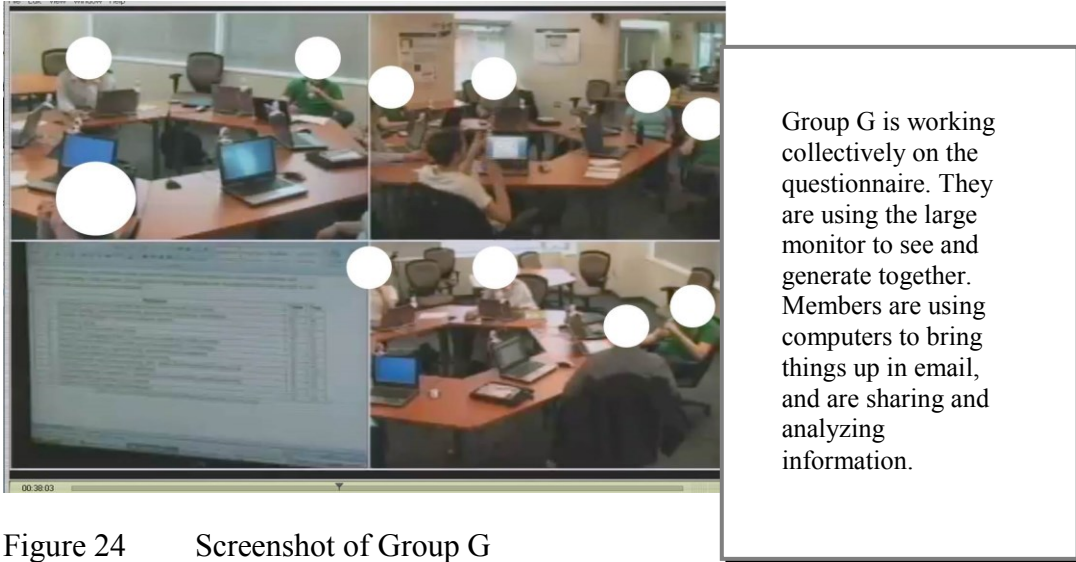
Figure 24   Screenshot of Group G

Stage 4 Other Tasks & Adjourning

As the group finished the questionnaire they examined their "to do" list. They discussed ideas for upcoming assignments. Participant 2 confirmed he has made all the changes necessary for the questionnaire. Sources used included individual notes, feedback from the professor, and the interview transcripts. A range of tools were used including the laptop, large monitor, a Mac, the white board, word, email and cell phones.

Session 6

Stage 1 Goal Setting & Interviews

Session 6 started off with focus. The group identified that they needed to finalize the questionnaire, and that they would like to be finished by 6:30. Before they started this, members discussed other aspects of the project. One member (Participant 4) commented that he had some free time this week, so would start on the introduction to the report. Members chatted generally as Participant 6 brought the questionnaire up on the monitor

Stage 2 Finalizing Questionnaire

The group needed to merge updates from multiple sources into the questionnaire. Each member had collected feedback from beta testing, and they had received feedback from the course Professor. They needed to assess and discuss all the feedback collectively, and

make a decision regarding what they should change. This was a complicated process involving the large monitor, individual notes, and emailed notes from the Professor. The group worked by sharing and analyzing, at the group level for the most part. Participant 6 was consistently the editor, and also contributed content. There was information seeking, done individually and then shared - to provide synonyms (Participant 1). Even with the shared view the group used the white board to brainstorm around how to format some sections of the survey – they needed to be able to sketch free hand to show what they wanted to say.

Stage 3 Adjourning & Logistics

The group confirmed who would do what. They took a team picture with a camera brought by Participant 5. The group had looked for information to find facts, and to keep track. They mainly worked as a group.

Session 7

Stage 1 Diaries and Getting Organized

One member commented they had been doing more activities between meetings than any time prior. Several expressed how helpful the large monitor had been. "Love that thing". There was a greater sense of anxiety, comments related to the amount of work they had to do, and the fact they needed to get going. Participants 2 and 4 started to move to the computers and began working.

Stage 2 Multitask

Participant 4 and 6 worked together, using 2 computers, the Mac for the questionnaire, and a tablet computer with the email with the feedback from the professor. The others joined in as the questionnaire and email were displayed on the large monitor. They worked through the questionnaire feedback systematically, discussing the comments. There was some pair and sub group communication and work. There was a technical issue with computer attached to large monitor. It was rebooted.

Stage 3 Planning

Participants 2 and 4 continued with the Questionnaire, while Participant 5 started organizing how they would recruit participants to complete the questionnaire. Using the white board they tracked the numbers and locations where they would try and recruit participants.

Stage 4 Logistics & Adjourning

The group confirmed timelines, deadlines, and who would do what. Participant 4 asked Participant 6 to pull up calendar, and the syllabus - so they could see the due dates, and confirm what needed to be delivered. They discussed logistics including how they would get the survey printed. A member called the Teaching Assistant (Information seeking – external to the group) and confirmed she would assist with the printing. The meeting ended with the group searching and watching a You Tube video for fun.

Session 8

Stage 1 Diaries and Collecting Survey Data

Group members arrived at different times. As they waited the group worked on integrating the survey results into one SPSS file. This proved difficult, as members had emailed their files, but the DalMail server was down. Members left the room to go to the computer lab with a memory stick to transfer the data.

Stage 2 Data Integration

Data integration was carried out by Participant 6. He took the data from the memory stick and integrated it into the SPSS data file. The other members watched, but generally chatted off topic. Participant 2 walked over to Participant 6 to help. He provided suggestions. They checked the descriptive statistics to ensure all the data was there.

Stage 3 Examining & Cleaning Data

Once the data was integrated, all members were involved in the analysis. The descriptive data from SPSS was shown on the large monitor. The key people were Participant 6 who worked with SPSS directly (data analyst role), and Participant 2 who made notes about the key statistics in the hard copy of the survey. The group noticed there were some issues with the data, and started to clean it up. Participants 4 and 2 worked together at the monitor gesturing, and helping Participant 6 delete the bad files. They moved between paper copies and the large monitor integrating comments from all. At the end the group felt that data was in good shape. To clean the data collectively the group required multiple computers, print copies of the survey, email, SPSS and input from all.

Stage 4 Division of Labour & Adjourn

Once they were happy with the data the group moved to organizing. They discussed what still needed to be done, and agreed on a workable schedule. They couldn't finish some

things until the data analysis was complete. More time was needed to work with the survey data. The interviews and appendices could be standardized. Participant 4 reminded the group he already volunteered to start the introduction. Participant 3 offered to standardize things for the report. All members volunteered for something. All members had a common task - they were to think about what they might need to compare in the data. They would learn how to code the qualitative data in class, and could continue with the data analysis next meeting.

Session 9

Stage 1 Greetings & Organization

The members arrived at different times. Participant 6 moved directly to the computer and large monitor, and opened emails and files - displaying the document that had the statistical analysis.

Stage 2 Discussion of Statistical Trends

Participant 6 started reading some of the findings, and other members started to discuss. The group discussed the significance of the data, linking back to what they predicted in their literature review. The stage ended when Participant 4 (role of leader) said "*I think we should figure out what we need to do to finish this*".

Stage 3 Planning

The group took a few minutes to 'regroup" and confirm what they still needed to do. They discussed what needed to go into their presentation. Participant 3 mentioned that she had started a PowerPoint and sent to all. People claimed sections and suggested they had already, or could, update them for final report. To help organize their final report, members' commented that they needed to get this on some sort of timetable. They used tools including the large monitor to display a calendar and the outline of the report, as well as the draft PowerPoint.

Stage 4 Generating the PowerPoint

They used the draft presentation started by Participant 3, and incorporated information from the following: the standard report template given to the class, their data analysis, their literature review, and other documents (group artefacts) that they had created to date. Email was used to share documents, and then they were displayed on the large monitor. At times the group was working at the group level. A member would comment,

and all would assess. They were also integrating information from memory – "*oh we need this*"…or "*what about this form*". At times all were engaged, at times there was much off topic chat, at times there was good debate. Participant 6 consistently took on the roles of integrator and scribe. All participants were involved in giving some suggestions. All gathered around another computer to look at a form at one point. They shifted between programs on the computer - Data/Email/Presentation. At times members were doing things individually on their computers. As they discussed the presentation they were also talking about what was needed for the report. The group worked actively, until the combination of time and technical problems prompted them to stop. "*Ok is that good for now*? (Participant 4)

Stage 5 Adjourning & Division of Labour

Participant 4 volunteered to work with the data analysis section. He will add to the qualitative data, and rework the results section. Participant 5 volunteered to help. The group reviewed deadlines and deliverables. They decided to book one more meeting to go over the PowerPoint. The group moved off task and chatted generally as they left.

Session 10

Stage 1 Greetings & Waiting

Three members arrived and Participant 6 linked the computer to the large monitor. There was general chatting and Participant 1 searched and showed a video of his nursery school class, others watched and laughed.

Stage 2 Slide Review & Update

The group started reviewing the slides, discussing the overall content of the slides, making suggestions and generating new content. They were working both on changing the content and editing the format. They also were determining what would be said in the presentation vs. what was written on the slide. There was a great deal of overlapping conversations. They broke into pairs (2 groups of 2) at one point. Participant 5 arrived. Participant 3 was not able to make the meeting. Participant 6 was consistently the editor. All members took turns explaining and questioning. Participant 4 was concerned about time. He wanted them to be efficient as possible as he needed to leave at a specific time. Tools used included the common monitor, the laptop and the Mac. This stage ended when the group was satisfied with the presentation and decided to do a dry-run.

Stage 3 Dry Run Presentation

The group did a full run through the presentation. The three presenters did their sections, and one member timed them. There were interruptions, and the group still made some changes as they went through. Members flipped through sources including books and notes to confirm facts. They alternated between "presenting" and asking for feedback from others. At other times a member would volunteer comments. Their process was informal in some ways – members did their presentation from where they were sitting, but they did run through the whole presentation.

Stage 4 Adjourn & Logistics

As they finished the presentation and moved to leave, the group confirmed the timing was ok. They made one more slide for the presentation, for questions from the class. Participant 6 agreed to save and email the presentation to all members. The final report was discussed – members reviewed what still needed to be done. Each member commented on their availability and what they would take on over the weekend.

Activities between meetings

Group G had substantive and organized communication between meetings. The researcher was included in a total of 120 messages during the span of the sessions above. The group communicated to share documents and versions, ask for feedback, to organize their meetings in advance, and to continue to work through revisions between meetings.

As with their meetings, the communication of this group was organized and systematic. One member was frequently in charge of a particular artefact, and would send updated versions asking others for feedback. Members would frequently respond by making positive comments on the work that had been done, and noting any changes. At times group members would specifically ask for opinions or debates. The communication was extensive before all the project due dates, with multiple emails being sent to ensure that all group members had a chance to view and comments on copies before they were submitted. In addition, towards the end of the study, as the group worked on their final report, there were requests for information seeking tasks, for citations to be verified and particular facts to be found.

One member would outline the specific details of what was needed, and another member would provide the needed information. The tone in the emails mirrored the tone in the meeting. All members were consistently courteous, helpful, and open to others' opinions. There was effort to make things explicit, and to be clear. The group also managed their assignments and schedules through emails, and re-distributed work.

Summary of Group G

Group G used their meeting times and space to construct their guides and surveys as a group, to discuss their data analysis, and to create, edit, and test their presentation. Between meetings individuals took on specific updating tasks, to provide new and updated materials for the next meeting. The group seemed to be more aware of time pressures in the later meetings, but they consistently worked efficiently and seemed happy with their process and their progress. Sources used included individual notes, course syllabus, the literature review, as well as specific websites. The group used an array of tools including the white board, the large monitor, the tablet laptops, a Mac, cell phones, email, calendars and specific software including Word, PowerPoint and SPSS. The group searched for information to find facts, to learn, for entertainment, to re-find and to confirm. They worked as a group for much of their sessions, occasionally working individually or in sub-groups. Members took on specific roles including Leader, Editor, Data Analyst, and Integrator.

5.4.2 Classifying Group Processes

The descriptive narratives above provide rich data about how the groups accomplished their tasks. The differences between the groups were many; they had different tasks, organized their work in different ways, and produced different outcomes. Despite these differences, the common patterns across all the groups could still be identified and classified. The classification process used with the single groups (see Section 4.4.2) was used here. The results will be discussed first for each group, and then summarized.

Group E

The stage of activities described above for Group E did map into the categories Planning, Monitoring and Doing, established in the Single Session Group (Chapter 4). For example in *Meeting 1 Stage 2* – the summary notes created to describe Group E's activities

included the following comment: *At this stage the group tried to organize how there were going to divide up the work and their major plan or strategy for their presentation.* This description identifies that the group was working to both specify their goal, and formulate a strategy. This description of the activity came directly from the notes created while watching the video. This phase fits with the description of a Planning phase...

Working through the original video notes other examples can be found. The following example showed a time when the group was working on another Planning phase, specifically "strategy formulation and planning":

> *Meeting 2 Stage 3 Outline and Division of Labour: At this stage the group came to a consensus about how they were going to organize things, and divided the group into those focused on the internal issues (2 members) and those focused on external (3 members). Within each of these groups they would still be working individually. All should try and work the "concepts" into their section.*

Other stages mapped to Monitoring phases. At the initial meeting for example the Group E identified that the key resource was the case study, and that one of the members does not have the text book. A participant leaves the meeting to photocopy this key resource for another member, an activity that can be classified under "systems monitoring".

Members were also observed to be directly monitoring each other, and who has accomplished what. In the final meeting (Session 5) for example, there was consistent reference to Participant 4 who was missing, and how they are going to accommodate and coordinate his part. Members made comments at multiple points regarding their assessment of how the group was doing. In particular Participant 5 was often the member most concerned with keeping the group on task; identifying what had been done, and what still needed to be done. The group also needed to coordinate their activities, both within and between meetings. Group members emailed slides to each other, and worked together in Meeting 5 in particular to merge their ideas into a presentation. Much coordination was needed to accommodate the missing Participant 4 in the final meeting

Group E did not spend a great deal of time in Doing phases, until the 5th meeting. At times the groups could be observed doing things that had no relationship to their course

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project, or planning or monitoring their process, but rather phases that involved interpersonal or Social activities. Table 35 classifies each stage for Group E in terms of the key phases of group activities.

Table 35   Classification of Stages of Group E by Session.

Stage	Planning	Doing	Monitoring	Social
Session 1				
Stage 1 Getting Started				x
Stage 2 Planning and Dividing	x			
Stage 3 Logistics and Goals	x			
Stage 4 Adjourning				x
Session 2				
Stage 1 Getting Organized			x	
Stage 2 Brainstorming	x			
Stage 3 Outline & Division of Labour	x			
Session 3				
Stage 1 Diaries and Greeting				x
Stage 2 Scheduling & Adjourning	x			
Session 4				
Stage 1 Greeting & Off Task				x
Stage 2 Update & Re-Division of Labour	x			
Stage 3 Discussing External Section		x		
Stage 4 Presentation Draft & Plan		x		
Stage 5-Adjourning	x			
Session 5				
Stage 1 Diaries and Organization				x
Stage 2 Logistics			x	
Stage 3 Focus on PR Issues		x		
Stage 4 Multi-task- PR & Slides		x		
Stage 5 Continuing PR		x		
Stage 6 Finalizing Slides		x		
Stage 7: Adjourning & Logistics			x	

Group F
Group F typically moved through each of the phases in each session. The beginning and end of their meetings were time for either setting goals (Planning), or confirming progress (Monitoring), while the middle of the meetings the group worked on their course project (Doing).

The following example shows a time when Group F's activities could be classified as Planning:

Recognizing the time, the group began to conclude the meeting. The group
established a list of objectives and goals for the next meeting, and set out

their process. All members would do independent research on their
topics, and bring a summary to the next meeting. They continued the
discussion of how best to communicate. They debated. Could they post
things to a group space on the Blackboard site? Or should they begin to
put things in PowerPoint? Should they alert other members by next
meeting of any changes that should be made to the planned outline based
on their readings? Also any overlaps? They should bring to next meeting
any contacts or thoughts on field trip or guests to bring to class.

Group F frequently ended meetings in this manner.

The example below, taken from the descriptive narrative illustrates another time
when the group was Planning, focusing on identifying all options, and choosing between
them.

...the group tried to assess options and make decisions. They struggled
and debated over their class field trip choice in particular. They debated
between several options, and made phone calls to confirm options....They
searched the internet to provide background information to help make
decisions, for example they found and assessed details including distance
and travel time to choose between options.

In almost every session Group F spent time Monitoring their progress on their project,
and ensuring everyone was on able to meet their deadlines. The group moved into this
phase near the beginning of their meetings, when they would systematically update each
other on their progress, and deal with any issues or problems. They would often go back
to this phase towards the end of their meetings.

Group F spent time in each session doing work on their course project. They
worked together to try and understand their topic, and to determine the best way to
manage the literature and present the information to the class. During this time worked
through creating and revising several group artefacts, including their outline, a flow chart
and their presentation. The beginning of each meeting included periods of time when the
group was just generally chatting, and not planning, monitoring or doing. Table 36 below
shows the pattern for Group F over each session.

Table 36   Classification of Stages of Group F by Session

Stage	Planning	Doing	Monitoring	Social
Session 1				
Stage 1 Greetings & Organizing the Room				x
Stage 2 Problem/Task Assessment		x		
Stage 3 Dividing & Refining			x	
Stage 4 Adjourning	x			
Session 2				
Stage 1 Diaries and Chat				x
Stage 2 Updates and Scoping out the Tasks			x	
Stage 3 Understanding their topic		x		
Stage 4 Establishing Boundaries of their topic		x		
Stage 5 Re-Draft Outline		x		
Stage 6 Adjourning			x	
Session 3				
Stage 1 Diaries and Greeting				x
Stage 2 Updating & Clarifying			x	
Stage 3 Creating a Flow Chart		x		
Stage 4 Adjourning	x			
Session 4				
Stage 1 Diaries and Greeting				x
Stage 2 Updates and Discussion			x	
Stage 3 Decision Making	x			
Stage 4 Sub Meeting & Individual Work		x		
Stage 5 Outline & Flow Chart Re-Design		x		
Stage 6 Adjourning	x			
Session 5				
Stage 1 Greetings & Logistics			x	
Stage 2 Goals for the Session	x			
Stage 3 Organize the Tasks	x			
Stage 4 Concluding Task Work			x	
Stage 5 PowerPoint Slide Design		x		
Stage 6 Adjourning				x
Session 6				
Stage 1 Diaries and Discussion				x
Stage 2 Getting Ready			x	
Stage 3 Dry Run		x		

Group G

Group G processes were quite structured, and they moved through Planning, Monitoring and Doing phases in each meeting. Their pattern seemed to be either: Plan, Do, Monitor; or Monitor, Do, Plan. The group, particularly one member (Participant 4) established clear goals for each meeting, and consistently checked to ensure they were meeting their goals. For example in the second session Participant 4 prompted - "*what are our goals for this meeting*?" Participant 4 also provided time guides for the group – getting them to establish a realistic point when they should have completed their task.

Group G monitored their progress and process consistently through the meetings. Members all provided positive feedback to each other, as in the example below. This example shows how the group also confirmed what they needed to accomplish their tasks, making sure they had all the resources required.

> *During this phase the group reviews what they have done – "So the*
> *consent form is looking really good", and that they next thing they need to*
> *do is the interview guide (due next Friday). The take stock – "do we have*
> *a copy of the interview guide?"*

The group spent the middle part of most sessions working collaboratively on their course projects (Doing). They were able to complete solid drafts of assignments collectively, and circulated the draft for revision between meetings. They were very aware of using the "group" time effectively and efficiently, suggesting editing and fact checking could be done between meetings. There were times, particularly at the beginning of their sessions that the group talked about other courses and social events (Social). This "other" time was often about interpersonal relationships. Table 37 following table traces the phases of Group G.

Table 37   Classification of Stages of Group G by Session

Stage	Planning	Doing	Monitoring	Social
Session 1				
Stage 1: General Chatting				x
Stage 2: Getting Situated	x			
Stage 3: Interview Guides Draft 1		x		
Stage 4: Adjourning			x	
Session 2				
Stage 1: Diaries and Waiting				x
Stage 2: Getting Organized	x			
Stage 3: Revising Interview Guides		x		
Stage 4: Adjourning			x	
Session 3				
Stage 1: Diaries & Organizing			x	
Stage 2: Incorporating Feedback		x		
Stage 3: Questionnaire Draft 1		x		
Stage 4: Adjourning	x			
Session 4				
Stage 1: Diaries and Updates				x
Stage 2: Interview Debriefs			x	
Stage 3: Questionnaire Take 2		x		
Stage 4: Adjourning	x			

Stage	Planning	Doing	Monitoring	Social
Session 5				
Stage 1: Diaries & Organizing				x
Stage 2: Transitioning			x	
Stage 3: Questionnaire Take 3		x		
Stage 4: Other Tasks & Adjourning	x			
Session 6				
Stage 1: Goal Setting & Interviews	x			
Stage 2: Finalizing Questionnaire		x		
Stage 3: Adjourning & Logistics			x	
Session 7				
Stage 1: Diaries & Getting Organized				x
Stage 2: Multitask	x	x		
Stage 3: Planning	x			
Stage 4: Logistics & Adjourning			x	
Session 8				
Stage 1: Diaries & Collecting Survey Data				x
Stage 2: Data Integration			x	
Stage 3: Examining & Cleaning Data		x		
Stage 4: Division of Labour & Adjourn	x			
Session 9				
Stage 1: Greetings & Organization				x
Stage 2: Discussion of Statistical Trends		x		
Stage 3: Planning	x			
Stage 4: Crafting PowerPoint		x		
Stage 5: Adjourning & Division of Labour	x			
Session10				
Stage 1: Greetings &Waiting				x
Stage 2: Slide Review & Update			x	
Stage 3: Dry Run Presentation		x		
Stage 4: Adjourn & Logistics	x			

Summary of Group Processes

This classification helps illustrate the similarities and differences between the groups. Planning and Monitoring phases were most frequently found at the beginning and ending of sessions, with Doing happening in the middle. Each group developed a pattern or structure for their sessions, and used it for several sessions. Whether they began with Planning or Monitoring depended on how far along the group was with relation to their tasks. For example Group G frequently had a different subtask to work on in each session, so often needed to start a meeting with planning. Group F had continuous tasks, using the beginning of meetings to monitor their progress.

Not all groups did actual task work in every session. As described and illustrated in Table 35, Group E spent Sessions 1 through 4 primarily focused on Planning and

Monitoring rather than task work itself. The pattern of phases and activities in Group F was more structured than E. The group started each session with a mix of planning and/or monitoring, and then moved to doing. Group G was the most structured and sequential of any of the groups in terms of their workflow. The group set clear goals for each session, including the time they would allocate to specific subtasks. They checked back at points during their task work to see how they were doing, and make adjustments if necessary.

5.4.3 Analysis of Group Processes

This section will focus on understanding how the student groups worked with information in each of the three phases, Planning, Doing and Monitoring. This section addresses Research Question 2, identifying how the following key elements of GIP were used to negotiate through the key information tasks (Need, Find, Use). In addition to the codes that emerged through the analysis of the Single Session Groups, new codes emerged during this study. The Tables below (Table 38, 39, 40) describe the Information Tasks Goals, Activities and Roles added during this study. The characteristics of the phases of Planning, Doing and Monitoring are then described.

Table 38   Information Task Goals Added from the Multi-Session Groups

Goal	Definition	Origin
Entertainment	Actively looked for information for fun, to entertain group members. Observed during the *Social* phase	Emerged from the data
Re-Find	Information needed to be re-found, as it has been lost.	Emerged from the data

Table 39   Information Activities Added from the Multi-Session Groups

Information Activity	Definition	Origin
Select Search System	Group or member determines the best route to find information (i.e. person, notes, computer, cell phone)	Marchionini, 1995
System Set-up	Logistical steps to prepare the system that will be used to search for information	Emerged from data

Table 40   Information Roles Added from the Multi-Session Groups

Role	Definition	Origin

Role	Definition	Origin
Data Analyst	Group member(s) were observed analyzing data using SPSS. Related to the Information USE task.	Emerged from the data
Editor	A group member was observed to assume the job of editing an artefact within the session.	Emerged from the data
Integrator	A group member was observed to take the responsibility for pulling information from multiple people. This was mechanical – they merged files from group members into a single document.	Emerged from the data

Planning

During Planning phase, the groups were engaged in activities related to setting goals, identifying different options for achieving their goals and assessing them. Planning was essential to all the groups, at different times during their processes. Each group spent time setting and renegotiating goals. Each group went through the process of taking their project and breaking it into manageable sub goals. As noted above, Group G was quite structured and frequently set goals for each meeting, related directly to their tasks. Group F had the most trouble with deciding how to best meet their goals, as their project was large, and complex. The group frequently needed to re-establish and reset their strategies, using flow charts and outlines to help. Group E set goals, but often did not achieve them, and in the end achieved most of their work in the last session. The groups also frequently went back to their goals, or reassessed when they ran into problems or felt pressured. In addition to goal, each group spent time in processes related to division of labour, and distributing or assigning responsibility and due dates for the individual work. For all the groups the distribution of work was largely based on individuals volunteering.

For Group G in particular, members with particular skills (statistics, editing, presenting) volunteered for these specific tasks, taking on specific roles. All the groups required activities related to determining common or standard formats for slides, for citations, and for reports. Over the three groups, there were 25 stages which could be classified as planning. To better understand how the groups worked together to Plan, the Planning stages were deconstructed to identify the elements (information task goals, information activities, sources, tools, artefacts, shifts in participation and roles).

Example - Group E Session 1 Stage 2

The group then moved on to a discussion of how best to present the material, which involved negotiation and debate and brainstorming (Stage 2). The group spent most of the meeting in this stage. Members shared information from their interpretation of the case (main source), aggregating and integrating from the individual to the group level. Members asked questions to ensure comprehension and to discuss interpretation of the case, and their process (how they should be proceeding). They discussed the key information source (the case study), shared information from individual course notes, and discussed what their presentation (group artefact) should look like. Members referred to the case study (source), and to how other groups in the class had organized their presentations. The group jumped from discussing content, to process, to format. Tools used included pen and paper, and emails.

From this narrative the following was noted. To determine the best way of accomplishing their course project Group E shared information to determine for the following goals: to best accomplish their task; and to make decisions. They used one source, the case study, and used email as a tool. They worked at the group level, and their main information activity was questioning and clarifying. No members took on any specific role during this particular planning stage, they all made decisions jointly.

To accomplish these information goals, specific information activities were observed. These activities could be organized by information task (e.g. Need, Find, Use). To identify their needs related to Planning for example, the groups, or a member, had to first recognize a need. As highlighted in Chapter 4, this was a cognitive act, which became observable when it was voiced. A member would signal the need to the group – generally in the form of a question. The group would then ask more questions, to work together to understand what their need for information was.

During the planning stage there was not usually information seeking and retrieval through the internet or databases. In some cases, particularly with Group F, the internet was used to locate directions or to confirm specific details. But the most common way of solving the information need in Planning phases was through sharing information among group members, or searching through specific documents such as the course project document, or the class syllabus. To use this information the group shared, analyzed and

synthesized and extracted information. In some cases groups had to consult with an expert (i.e. the course instructor/Professor) to clarify something before they could continue planning, and at times they needed to re-find a fact or decision they had made earlier. This confirmed the pattern observed with the Planning phases in the Single Session groups. Table 41 below describes the elements of GIP during a Planning.

Table 41   Elements of Planning (Multi Session Groups)

Information Tasks	Need, Find, Use
Information Task Goals	Confirm, How to, Keep Track, Decision Support
Information Activities	Signal Need, Recognize Need, Understand Need, Information Seeking and Retrieval Episodes, Questioning & Clarifying, Extract Information, Negotiation, Request for Assistance, Share
Sources	Case Study, Class Notes, Syllabus, People (external to the group)
Tools	Computer, Email, Word Watch/Clock (time) Pen/Paper Calendar Need for a shared group view
Artefacts	Outline, Email
Participation	Mainly Group
Information Related Roles	Director, Leader

Monitoring

Across the three Multi Session groups there were 20 stages classified as monitoring. They were analyzed using the same process as the Planning stages. During Monitoring phases, the groups were observed to be spending time updating members on progress made, and checking to confirm what other members had done. All the groups needed to ensure everyone was doing their part, to compensate or help those members who were running into trouble, and to see if any of the subtasks should be redistributed. These processes were often accomplished at the beginning of the meeting, but could also be continuous. In Group F, for example, they systematically went around the table identifying the progress they had made individually. Members of Group G seemed very aware of each other commitments, and actively tried to balance the workload to accommodate different schedules (one member worked full time), different skills (two members more comfortable with statistical analysis, one with editing and formatting, one with proofreading) and to keep things fair. Comments such as "*you have a pass on this task*"

indicate that if a member played a greater role in one task, they were released from the next. In Group E, monitoring was prompted by the fact not all members were present for all meeting. For example in their last session, the group had to try and accommodate the missing member. They needed to balance allowing him time to update his part, while ensuring all other members felt comfortable his part would fit, and that the group had covered everything they needed to.

During Monitoring phases, as with Planning, the information process was fairly simple. For example, a group might simply want to check to see if they are on target with their stated plans. To do this, members might refer back to a written agenda or shared goals to remind the group of what they said, and compare to their progress. Groups shared information, updated other members and shared documents, using email, word and memory sticks. All groups were observed checking things against the course syllabus, or the assignment guidelines, and utilized general tools such as a calendar.

As these groups were meeting face to face, much of the monitoring was verbal. Issues emerged when a member was missing, and other members did not have a document to see what the missing member had done. Cell phones were used on occasion to connect with missing members for a status update. The most effective group at monitoring was Group G. The following example (Group G, Session 1 Stage 4) shows a typical Monitoring phase.

> *This prompted the group to assess their progress. They had covered demographics, prior knowledge and barriers. The group determined that they could not finalize the guide until they had a copy of the template. Participant 2 emailed (tool) the Teaching Assistant to see if they could get the template. The other members confirmed they achieved what they could at this meeting. Participant 4, monitoring the group's progress, checked to see if everything on the white board has been typed into the computer. Participant 1 confirmed this, and committed to emailing the notes to all. Members agreed that once they looked at things on paper they would likely all have more ideas. The meeting ended.*

In this example Group G can be seen to be keeping track of what they had done, compared to what they needed to do. They assessed this information, and made a

decision. They assessed the group artefact created during the session, their notes, and the course syllabus. They send a message to their TA to confirm a template required, using email.

Monitoring allowed the group to maintain awareness, a key element of groups. During the Monitoring phases, there were fewer information activities observed than in the Planning stage. As noted, members largely asked questions, and shared information to find the required information. They used the artefacts they created, and compared them to the syllabus or course project guidelines. New artefacts were not generally created. Table 42 identifies the elements found during Monitoring phases.

Table 42   Elements of Monitoring Multi Session Groups

Information Tasks	Need, Find, Use
Information Task Goals	How To, Keeping Track, Decision Support
Information Activities	Recognize Need, Signal Need, Understand need, Extract Information, Questioning or Clarifying, Negotiation, Request for Assistance, Share
Sources	Other members, Group Artefacts, Syllabus
Tools	Computer, Email, Word, Watch/Clock (time), Pen/Paper, Calendar, Need for a shared group view, USB stick
Artefacts	Email
Participation	Mainly Group
Information Related Roles	Director, Leader

Doing

During the "doing" phase the groups were working directly on their course projects. As in Chapter 4, the "Doing" phase will be analyzed in terms of the following three work task goals: problem solving, generating and decision making.

Problem Solving

The class assignments of all three groups required some degree of problem solving to complete. To solve problems collectively, the group need to share their ideas, and information, and frequently had to search and retrieve information external to the group. Of the three groups, Group F spend the bulk of their sessions involved in problem solving. Of all the tasks, problem solving required the most amount of information searching. Once the group members had enough information shared and gathered, they frequently iterated through a process that included analyzing, interpreting and extracting

– identifying the most relevant "bits" of information they needed to help solve the problem. Sometimes this also required synthesizing information in new ways. Problem solving also frequently included some form of negotiation; individual members would need to persuade others to agree to a particular solution.

Information seeking episodes occurred throughout this process. Groups would discuss the task, recognize they needed more information, determine where they should look and then search and retrieve the information, as also found by (Fidel et al, 2004). This information seeking was sometimes done collectively, with all involved, sometimes by pairs, and also by individuals. The actual typing of queries was usually done individually (see Toze, McCay-Peet & Toms, 2011). Tools used to accomplish these information tasks, and solve the problem varied from using Google, and the internet, pulling up emails, using a cell phone to call an "expert", and re-finding information in notes, artefacts or texts. To help them solve problems, the groups frequently needed to create artefacts. Group F, for example, whose topic was the most complex, needed to constantly refine their outline and to create a flow chart to try and collectively determine how their presentation should flow. Table 43 below identifies the common patterns during Problem Solving for all groups were assessed.

Table 43   Elements of Problem Solving for Multi Session Groups

Information Tasks	Need, Find, Use
Information Task Goals	Keep Track, Confirm, Fact finding, Re-Find, Making Sense
Information Activities	Signal Need, Recognize Need, Understand Need All Activities necessary for Information Seeking & Retrieval, Questioning & Clarifying, Analysis, Synthesis, Extract Information, Negotiation, Verification, Generate, Share
Sources	Case Study, Specific Web Sites, Prior Knowledge, Books, Group Artefacts, Syllabus, Course Project Guidelines, Class notes, Journal Articles, News video, Expert Sources (People)
Tools	Pen & Paper ,Computer, Joint Computer Use, White Board, cell phone , USB stick, Flip Chart
Artefacts	Word document, Presentation slides, Flow Chart, Outline
Participation Changes	Individual, Pair, Sub Group, Group.

Information Related Roles	Analyst, Data Analyst, Director, Integrator, Leader, Scribe, Searcher

Generating

The code "generating" was used to identify times when the main activity of the group involved brain-storming, or coming up with a range of ideas. All three groups needed to create or generate something new to accomplish their tasks. In contrast to problem solving, generating involved more information sharing than information seeking. Of the three groups, Group G spent the most time generating. Generating typically involved sharing thoughts between individuals and the groups. After the information was shared, others would analyze, interpret, and as with problem solving, extract particular facts. The final result often involved synthesizing information or ideas from many members, and the generated material had to be captured in some manner, for further revision.

To generate new material the groups used tools including: a projector, the large monitor, the white board, a flip chart, word processing tools, and occasionally email. They also created many artefacts including interview guides, questionnaires, outlines, draft presentations, and flow charts. Group G in particular required complex processes. For example to analyze their questionnaire data the group had to merge individual files using email and a memory stick, flip between applications including word, excel, SPSS and email, and copy and paste between these applications. Table 44 provides a summary of the key elements for all groups for the Generating task.

Table 44   Elements of Generating for the Multi Session Groups

Information Tasks	Need, Find, Use
Information Task Goals	Decision Support, Keeping Track, Confirm, Fact finding, Re-Find
Information Activities	Signal Need, Recognize Need, Understand Need All Activities necessary for Information Seeking & Retrieval, Questioning & Clarifying, Negotiation, Analysis, Synthesis, Extract Information, Verification, Share
Sources	Case Study, Articles, Group Artefacts, Specific Web Sites, Prior Knowledge, Government websites, Generate
Tools	Email, Pen & Paper, Computer, Joint Computer Use, White Board, large monitor, SPSS, cell phone, Excel, SPSS, Email, Need for Shared View and Tools to manipulate information

Artefacts	Word document, Presentation Slides, Survey, Interview Guides, Data Analysis
Participation Changes	Individual, Pair, Sub Group, Group.
Information Related Roles	Director, Leader, Analyst, Reader, Scribe, Searcher, Integrator, Writer

Decision Making

Decision making was used to define times when the main activity of the group involved choosing between options. All three groups also needed to make decisions to accomplish their subtasks, and required information to accomplish this. As part of the process of decision making the Groups had to assess all their options and make a decision. At times the information to make a decision came from members, from the case study (Group E) or from external people (Group F). Websites and searching were used to ensure all options had been collected and explored (Group F and G). At times the groups did not feel that they had enough information to make a decision (Group F and G) and interrupted their meeting to contact the Professor or Teaching Assistant, or potential guest speaker. Making a decision between options can lead to conflict, but there were no cases where the groups were unable to negotiate through differences of opinions. At times the groups wanted a quick way to keep track of the decisions they made (Group F and G). Group G joked about the fact they were being taped, and that the researcher should be able to provide them with a video or transcript to help them keep track. The following table represents elements of group decision making. It was created by examining and comparing the descriptive narrative and codes for all the groups during periods of decision making.

Table 45   Elements of Decision Making for Multi Session Groups

Information Tasks	Need, Find, Use
Information Task Goals	Decision Support, Keep Track, Confirm, Fact finding, Re-Find Making Sense
Information Activities	Signal Need, Recognize Need, Understand Need, All Activities necessary for Information Seeking & Retrieval, Questioning & Clarifying, Analysis, Synthesis, Extract Information, Verification Negotiation, Generate, Share
Sources	Case Study, Government websites, Google images
Tools	Pen & Paper, Computer, Joint Computer Use, White Board
Artefacts	Document, Outline, Presentation, Survey,
Participation Changes	Individual, Pair, Sub Group, Group.
Information Related Roles	Director, Leader, Data Analyst, Reader, Scribe, Searcher, Editor

Social

The focus of this research was to identify the process through which groups identify their needs, find and use information. Much of this process is social, which was outside the scope of this research. Aspects of their social phases were noted only as they related to group information process. Interestingly two of the three Multi Session groups actively searched for information at times when they were not Planning, Monitoring, or Doing. Members searched for videos and shared them with the group for fun. The information goal of "entertainment" seemed to be related to building team spirit and managing their interpersonal processes. This result was not expected, and is noteworthy for further study.

5.4.4 Differences between Groups

The final phase of analysis for the Multi-Session groups involved examining the differences in GIP between the groups. All three groups transitioned between Planning, Doing, and Monitoring. These processes were observed across all groups; however were substantive differences in how the groups worked. For example Group F had significantly more episodes of seeking information through the internet and external databases, while Group G generated most of their content collaboratively in their meetings. Group F had persistent challenges trying to understand their topic and integrate information which persisted across tasks and sessions. The group discussed their need for tools to help them keep track, and to put the pieces together collectively. They needed not just a common visual space but to manipulate information together. There were more shifts in their meetings between individual and group work, as well as working in pairs. They wanted to preserve some things as "private", and selectively share. They also jointly used computers frequently.

By contrast, Group G whose task and topic were more structured and with staggered due dates, worked collaboratively almost exclusively in their meetings and appeared to be consistently focused. They had access to the enhanced room, and used the large monitor from sessions 2 through to 11. They did not have the same need to "keep track" of important ideas, perhaps because they were constantly producing artefacts that needed to be submitted for a grade. Their subtasks required less group information

seeking. The group seemed sufficiently aware of members' progress, and what needed to be done. When prompted, members made suggestions about how technology might better support them, but overall they were happy with the tools used and the results. Group E had the greatest issue with goal setting and monitoring. Much of their work was left to the last session. They rarely solved problems or generated as a group, and between the group meetings individuals worked to entirely different schedules. Some members completed their individual work prior to each meeting, others still had major parts of their subtasks to complete in the last meeting. The following factors emerged from this process of analysis as potentially affecting the information processes of the groups.

Approach to Group Work

Limberg (1999) examined how students worked together in groups as a component of her research of information use by students. She described two approaches to group work, atomistic and holistic. Groups who were atomistic divided the work into discrete tasks which were accomplished individually with little reflection across tasks. In contrast holistic groups made consistent efforts to connect across tasks and information sources. Based on the observed patterns of behaviour Group E would be classified as atomistic. The majority of work, both within and between meetings was accomplished individually. Group F and G were both holistic in their approach to group work. Given the findings here, it is speculated that holistic and atomistic groups would have different patterns of GIP, while the elements of GIP would be the same. This is an area for further research. While the different in attitudes towards group work was notable, both Groups F and G were holistic, yet there were significant differences in how they worked with information. Other factors such as task differences, discussed below, also need to be considered.

Task Differences

Unlike in the Single Session groups, in this study the groups were working on different tasks. To what degree did the task differences contribute to the differences in GIP? In Chapter 4, Table 12 identified the characteristics of the Single Session task according to Li & Belkin (2008) faceted task taxonomy, and Table 31 (Chapter 5) provided the same information for the Multi Session group assignment tasks. Comparing these two tables the following was found. Group F's task had the highest degree of objective task complexity. Group F spent a great deal of time in each session using multiple tools and

artefacts to help make sense of their topic. From their conversation it was clear they found the topic, and integrating the necessary information overwhelming, and worked hard to synthesize from their individual sections and to understand collectively. Part of this problem might have been related to the fact different members completed their work at different times (a factor noted by Hyldegård, 2006). But the more critical problem was the need to make sense of the whole topic collectively. Comments regarding their frustration, feelings of information overload and of being overwhelmed were noted in multiple sessions.

Group G's task was structured and sequential, compared to the other two groups, and their processes matched. The group set clear goals for each session, including the time they would allocate to specific subtasks. The group checked back at points during their task work to see how they were doing, and make adjustments if necessary. They consistently worked collectively on their actual tasks each session, and made strategic decisions about what should be done at the group level (thinking and brainstorming) vs. what should be done individually between meetings (wordsmithing). From observing their behaviour the group appeared highly productive, and their comments at the end of meetings, and in their post study interviews and surveys confirmed that they thought they had worked together very well. In contrast, Group E's task did not have a high degree of objective task complexity, but at times members commented that found their task, and processes challenging.

Full analysis of task complexity would have required additional data, including analysis from the participants. The analysis above is intended to highlight complexity as a potential issue. In further studies of GIP task complexity could be examined more systematically.

Shared Understanding

Shared understanding is an essential element of groups, and information processes have been linked to the creation of shared understanding. Identifying and understanding how shared understanding is created is difficult, and outside the scope of this research. While shared understanding was not the focus, the code *shared understanding* was applied to indicate times when groups could be observed to be building a shared language, context, and frame of reference. These were times when members used terms or phrases from

others, and when it was clear they were using language in the same way. In addition, group members would actively acknowledge agreement with others statements, and perhaps extend or add to their thoughts. In contrast, at other times group members would comment on not seeing how things would fit, on being frustrated, or confused, providing evidence of a lack of shared understanding.

For example, from the narrative for Group E, Session 5 Stage 2 we find the following:

> *At this point in their workflow, the group appeared to have little shared understanding of their project. This was identified through their conversation. For example Participant 1 commented "What are we going to talk about"? Group members were not clear about the suggested text already on the slide. Participant 1 asked "disconnect - what does that mean anyway?*

Differences in degrees of shared understanding were observed between the three groups. In Group E, there were very few moments when the group seemed to be working at the group level and actively engaged in shared understanding. The group seemed content to merge together individual sections, and allow the individuals to present their section as they wished. They agreed to a common format for the presentation, but never really a common intellectual thread. Members frequently commented directly "*I don't get it*" (Participant 2), in relationship to how their group presentation was going to come together. Group E did not seem to come to shared understanding regarding their processes or their task.

Group F worked very hard to achieve shared understanding, but felt it only at specific moments. Some members wanted to press deeper, and keep renegotiating, but other members were content to leave their section as it was. The tone was pleasant; they worked well together, but did not successfully find a "group" voice. Their lack of shared understanding may be attributed to several factors: 1) the complexity of their problem, 2) the fact that individuals completed their tasks at different times, 3) that members had different attitudes towards sharing, or changing their individual work, and that 4) that members had different backgrounds. The examination of these factors represents a future research project.

Group G worked most consistently at the group level and frequently reached an acceptable level shared understanding. There were frequent discussions and disagreements, but they were able to negotiate these successfully. Members would consistently acknowledge others "good ideas" and "important points" both in meetings, and in their email communication. They did have frequent discussions or negotiations about what they wanted to say, which would end in real agreement, rather than just one member capitulating to another. The group was consistently enthusiastic and happy with their work and their progress.

This group had their literature review completed before they started, and had done it through an interactive and collective fashion. In their comments members would refer each other back to this document, and their findings. This helped to maintain a successful level of shared understanding. In addition members seemed to know each other well, and appreciate their respective strengths and skills. In the final group interview they commented on how they viewed each other as the "top of the class". There was a great deal of overlap in work ethics, and general understanding of what a group member should do. Members themselves commented in the final interview that this group was exceptional in the way members volunteered to get a head start on sections and take responsibility.

The analysis of the Post Study Individual Survey data verifies the findings above. The development of a shared understanding appeared to be most pronounced in Group G. The table below presents the questions in the survey, and the mean answers. All questions were rated on a 5 pt. Likert scale where 1 was strongly disagree, and 5 was strongly agree. The average of the scores for each question were similar for both Groups E and F. Interestingly the average scores for Group G were consistently different, and represented a stronger sense of satisfaction and agreement within the group. Of particular interest are the score for question 3 which relates to having a clear sense of the groups goals, and questions 17 and 18 which relate to how often members felt that decisions were changed based on the group discussion. It is also noteworthy that Group G had a mean score of 5 for several of the questions related norms of information sharing (i.e. questions 12 and 13). Given the small survey size, statistical analysis is not possible. The pattern of the answers however, does confirm the observational findings.

Table 46   Post Study Individual Survey Responses

	Questions	Group E	Group F	Group G
1	It was very easy for me to get information from other team members when I needed it.	2	2.25	5
2	There were disagreements in my group about who should be doing what task.	3	2.25	1.5
3	Each member of my group had a clear idea of the group's goals.	2.25	2.25	4.5
4	I always received the information I needed from other group members on time.	1.5	2	4.5
5	I often found myself duplicating work that other group members had done.	3.75	3.25	1.33
6	People in this group were able to do their jobs without getting in each other's way.	2	2.75	4.66
7	There were disagreements in my group on what plan to adopt for our project.	2.75	2.75	1.83
8	My group knew exactly what things it had to get done	2	2.25	4.5
9	Tasks were clearly assigned. I knew what I was supposed to do.	2	2.25	4.5
10	Schedules were clear. I knew when I needed to have tasks completed.	2	1.5	4.33
11.	It was expected that group members would provide information if it could help other group members.	1.75	2	4.66
12.	In this group, it is expected that any information that might help other team members would be provided to them.	1.75	2	5
13.	It was expected that we keep each other informed about events or changes that may have affected other group members.	1.75	1.75	5
14.	I often talked to people outside my group to obtain the information I needed.	3.75	4.25	3
15	Sometimes members of my group talk about how we could have handled the project differently.	2.75	2.25	2.33
16	My group usually considers the different perspectives of various group members when deciding how to proceed with the group project.	1.75	2	4.16
17	My group often used ideas developed in group discussions to solve specific problems	1.75	1.75	4.66
18	My group used ideas developed in discussions to set new project goals.	2	1.75	4.5

5.5 Summary of Multi-Session Groups

This study involved examining the interactions of three groups over multiple sessions, to better understand how they negotiated the key information tasks in different phases of group activity. The findings confirmed and extended the findings of Chapter 4. Through the analysis of three groups, over 21 sessions divided into 90 stages, the following was found: groups use information to support three key processes - to Plan their tasks and time, Do their projects, and Monitoring their processes and resources. This confirmed the phases identified in the Single Session groups.

In each of the three phases the Multi Session groups identified information needs, found information and then used that information, frequently collectively. To accomplish these tasks, the elements described in Chapter 4 (information task goals, information activities, sources, tools, artefacts, shifts in participation and roles) were also found to be key to GI. In this study however, additional information goals were identified, as well as new information activities, and new roles.

As in the Single Session groups, the Multi Session groups did not spend a great deal of time analyzing their information needs as a group. While there was more evidence of collaborative information search, these groups also most frequently satisfied their information needs through *sharing* information between group members. Groups were found to spend the majority of their time in all three phases *using* information collectively which involved analysis, synthesis, and verification. Group information process, particularly during Doing phases, was observed to be complicated. Groups had difficulty keeping track of information and ideas across multiple group members and tasks. Consequently the groups experienced difficulties maintaining awareness and building shared understanding.

These difficulties appeared to be linked with issues in their group information process, specifically the challenges of "seeing" all the information pieces together. Members in all the groups commented on their frustration keeping track of important facts, citations and thoughts, and all groups had challenges at times manipulating information as a group. Groups were found to need support for multiple IS&R sessions within projects or tasks – including revisiting or re-finding information and collecting and

monitoring, particularly with complex, unstructured tasks (as with group F). Also, activities related to Planning and Monitoring, especially at the beginning and ending of meetings could have been better supported.

The tools the groups used did not appear to allow for fluid participation changes, from individual, to pairs through to the entire group, yet these shifts were common in all the observed group activities. Tools were also needed by the groups to support the integration of information from multiple sources. These sources included various websites, books, notes, and other people. Tools were also required to allow this information to be more seamlessly integrated into presentations and reports. At the same time, the observed students wanted to keep some activities private, and to separate their working space and the group space. To further the understanding of GIP, the next chapter provides a synthesis and an integration of the findings from Chapter 4 and Chapter 5. Research Question 3 will be examined and the information process of student groups will be defined and modelled.

6.0 Introduction

This chapter includes the synthesis and integrative analysis across both studies to address the key research questions. The definition of group information process is revisited and refined, and a model of group information process is proposed and described. Based on the needs observed and identified across both studies, tools and processes to better support the group information process are described.

6.1 Research Question 1

Question one of this study related to the procedural level of group work. Investigating the structure within the group processes of student groups, the aim was to understand the relationship between the patterns of group activities and information tasks. As group information process emerges from the interdependent acts of group members as they work together to accomplish tasks, the goal was to deconstruct this process. As identified in Chapter 2 (Section 2.2) group processes have been examined extensively in group literature, but with overlapping concepts which are not clearly defined, as also noted by LePine et al., (2008). Further, while many things may be known about groups and what makes them effective, we do not have robust knowledge of how teams systematically integrate internal *and* external knowledge dynamically over time (Gardner et al., 2012). To address this problem one key objective of this current research was to increase our understanding of group processes, while building on prior conceptual models. The recurring phase model proposed by Marks and colleagues (2001) was used as a basis for this work.

Findings from both studies provided evidence in support of their model at their higher conceptual level. There was clear evidence of phases of Planning in all groups, which mapped to the transition phase in the recurring model (Marks et al., 2001). All the student groups examined had stages where their main activity was strategizing how they would accomplish their assignment, including discussing options and creating plans. All the groups examined were also observed to require stages of Monitoring, when members

would check their progress against their goals, ensure they had the right resources, or monitor and potentially back up the activities of other members. These group activities correspond to the Action processes within Marks et al.'s (2001) model. Times when groups were concerned with interpersonal relations were noted (Social), but not analyzed, as they were outside the scope of this work.

Marks et al.'s (2001) taxonomy focused on group processes that did not relate to task accomplishment. The goal of this research was to understand the relationship between group and task processes and information tasks. This study extended their phase based framework to also examine times when the groups were directly involved in task work. This research examined the actual task work of the groups themselves, examining how groups moved from activities related to their processes (Planning and Monitoring) to periods of task accomplishment (Doing). This allowed for a holistic look at how the groups identified their needs, found and worked with information across multiple tasks and time.

The following description of the phases of group activities does not reflect one particular group, but rather the overall pattern found across all groups in both studies. Analyzing the stages of Planning, Monitoring and Doing across all of the groups the following was observed. Each student group needed to take their class project and translate it into a set of group processes and task related activities. The groups shifted between trying to decide how they should achieve their projects (Planning), working on them directly (Doing), and checking back to see if things were working according to the plan (Monitoring). Each of these phases generated an information process at the group level. This information process involved a series of activities related to identifying the need for information, using a particular channel to find information, and then working collectively to use the information to accomplish their project and manage their processes. The typical information tasks and activities at each phase will be summarized below, and then discussed in more detail in Section 6.2.

6.1.1 Planning

Phases classified as Planning had the following characteristics. During planning phases the groups were focused on determining how they would accomplish what they needed to do. Planning was frequently observed at the beginning of a group session, or as the group

began a new task. It was also noted when groups ran into problems, for example when they were not sure that they were working effectively, or when members were not sure that they understood their topic or goals. Planning often involved "brainstorming" or generating, where members shared and debated ideas.

The goals of the information tasks observed during planning phases included: confirming particular details about the task (*Confirm)*, identifying possible strategies or deciding between different strategies that had been suggested (*Decision Support*), keeping track of decisions the group had made (*Keep Track*), and investigating how to accomplish a specific task (*How to*).

Information activities observed by the groups during Planning stages included the following. The need for information would be signaled (Signal Need), and then recognized by another member of the group (Need Recognized). The group might then work together to understand what they needed to know (*Understand Need*), questioning and clarifying the information that was being shared (*Questioning or Clarifying*), and extracting particular bits of information. The groups were also observed to negotiate (*Negotiation*) to determine the relevance of the information to their plans. As these were students working on class assignments the sources most frequently required during planning included their syllabi, assignment guidelines, case study, and handbooks or instructions for the assignment.

As the groups moved through the Planning phase individuals made their own notes, and in some groups a particular member agreed to summarize (*Role – Leader*) the decisions for all. Tools used included pens and paper as well as computers, and specific tools such as calendars were used in some cases. Planning most frequently involved the entire group, but some groups used members in different ways. In some groups a leader (*Role – Leader*) emerged during the planning, someone who took control of setting the agenda and strategy. In other groups there was not a single leader, but members directed (*Role – Director*) others to perform specific tasks. Through this phase it could be observed that the more the group discussed and negotiated their decisions collectively, the more they built a shared understanding of the task, as was noted through their conversation, and their ability to work effectively without frustration.

6.1.2 Monitoring

To monitor their progress towards their goals, manage their resources, and ensure work was integrated the student groups needed to identify their information needs, share and use information to make decisions (*Decision Support*), confirm how to (*How T*o), and to keep track (*Keeping Track*). Monitoring phases were frequently shorter than planning or doing, and occurred at the end of tasks, or when a group needed to ensure they were progressing. In essence monitoring tasks correspond with the coordination aspects of collaboration. It was during this phase that the groups' tried to manage their interdependent activities and make adjustments. This stage also involved awareness. During Monitoring phases groups would update their knowledge of what other members had done, and build situational and task awareness.

A typical Monitoring phase might consist of a group member checking on their goals and deadlines, and confirming (*Information Goal Confirm*) with members that all were on target. Members were found to offering advice and help to another members, if they appeared to be struggling. In some cases members would proactively share information (*Information Activity Share)* with another member, when they located information they thought might be of use to another member. This occurred both in meetings, and in emails exchanged between meetings. Monitoring frequently involved shifting from individual to subgroup or group activity, in contrast to Planning, which most frequently involved all group members.

The key source required during Monitoring activities was other members; the groups mainly solved their information needs through *Sharing*. Notes were made on paper, on the computer, dates put in calendars, and documents merged or shared and sent using email. During Monitoring phases, resources were sometimes reallocated. For example a group might determine that one member should keep track of a specific kind of information, or be the "go to" person, for specific information. This demonstrates Wegner's (1987) transactive memory system.

6.1.3 Doing

The groups observed accomplished projects which included intellective tasks that could be classified as making a decision, generating, and problem solving. There were

differences in how each of these tasks were achieved, but overall all groups required a greater range of information tasks and activities, and required more tools and sources to complete their projects (Doing) than to Plan or Monitor. Information seeking from electronic sources was sometimes required during Doing phases. For most groups task work took up the majority of time in their sessions, with the exception of Group E.

Across all the groups, *finding* was required for all eight information goals during this phase, and all of the information activities were observed, though not all for all groups. Similar patterns were observed for all groups. For example group members would typically share task related information in turn, and then assess and evaluate the information in terms of their project goals. Members would negotiate around specific pieces of information, needing to determine collectively if something was relevant. Having a common space, with multiple surfaces (white boards, flip charts, large monitor) to work with information visually was frequently critical to this process. For example in the single session groups, all the groups kept the map of their strategic area in the middle of the table, so they could use it to orient aspects of the problem geographically and examine impacts together. Several groups (C, D, F & G) spread the information they wanted to consider and analyze across multiple white boards. The creation of common group artefacts was also essential to the process of task completion for all groups. Specific artefacts were seen being adapted over several meetings.

To accomplish information tasks related to their projects individual members frequently took on specific roles. In several groups one member initiated the searching (Role -Searcher), in some groups one member took on the role of scribe; another - analyst. Groups required multiple actions and tools to assist with using information collectively. Groups might for example brainstorm or create flow charts or tables on the white board, while simultaneously typing the content in a document (*Information activity – Generate*). Groups tended to be quite active during Doing phases, using flip charts, moving to see the same computer, handing documents to others, or examining key artefacts together. Similar to making a physical object, cognitive task work involved groups wanted to see, touch and move pieces of information.

6.1.4 Rhythm of Group Phases

Based on the findings across all the groups, the following extension to Marks et al. (2001) rhythm of team task accomplishment is proposed, as illustrated in Figure 25.
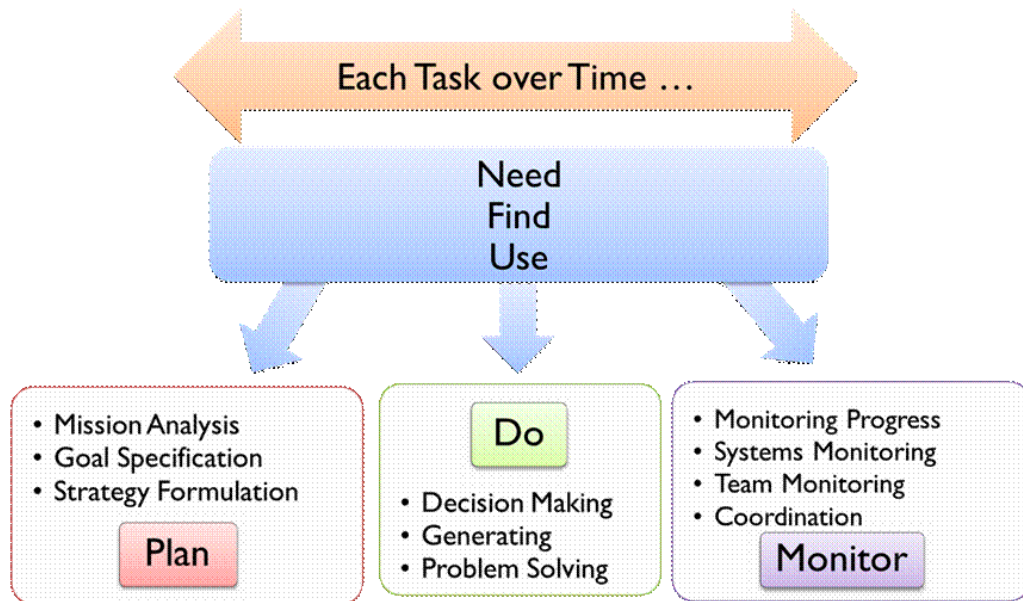
Figure 25   Rhythm of Group Phases in Group Work

The time the group spent in each phase varied based on a range of factors including: the task, especially the task complexity; feelings of information overload; and time pressure as discussed in Chapter 4 (Section 4.4.4) and Chapter 5 (Section 5.4.4). There were differences noted, for example, between the groups in Study 1 (Chapter 4) which had a single session to complete their tasks, and the groups in Study 2 (Chapter 5), who required multiple sessions to complete their tasks. Perhaps because of time pressure, the Single Session groups were more likely to start working directly on their projects (Doing), rather than Planning. When they ran into problems they needed to either reassess their strategies – how they were working together or making decisions, or they needed to confirm they were interpreting their instructions correctly. Their need to Monitor was related to looking at their tasks, and assessing how they should work based on the time they had left. This suggests that time is likely a key factor affecting group information process, as also noted by Reddy& Spence, (2008) in their examination of collaborative information seeking in health settings and Widén-Wulff and Davenport, (2005) in their comparison of information sharing in two companies.

Specific triggers were observed which prompted groups to move from one phase to the next. In addition to completing a task (*Task*), or making a decision regarding a strategy (*Decision*), time and information acted as triggers to move a group from activity to another. In all the groups, time, specifically the awareness of time caused a member or members to focus the groups' attention on what they were doing, and if they were meeting their goals. This frequently caused the group to stop or suspend a particular phase of activity, and move to another. Information acted as a trigger in a couple of different ways. Feeling overloaded with information was a trigger for groups to stop Doing and assess how they were working (Monitoring), and how they might be more efficient (Planning). This led to reassessing their strategies, or to using their resources in different ways. Similarly, lack of appropriate information caused groups to suspend their work, to seek help from people external to the group.

As discussed in Chapter 2 (Section 2.2) there are other groups models, frameworks or lens that could have been used to examine the information processes of student groups. Hyldegård & Ingwersen (2007) for example used a modified version of Tuckman's (1965) development sequence in small groups as one of the lens used to examine their data. Looking for similarities across the five student groups, they found two patterns, groups that were "forming/storming", and those that were "norming/performing". The information processes of these groups classified in these different stages were also found to be different. Those groups who "formed/stormed" had difficulty finding a shared focus, did not ever seem to reach the performing stage, and group members had negative feelings (uncertainty, frustration, stress, disappointment) even at the end of the task. The information behavior of these groups could also be described as "forming/storming". These groups had limited discussion and distribution of information, and behaved as a collection of individuals rather than a group.

This lens helps explain differences between groups, and could also be applied to the data in this research. Groups A, C, E, and F stayed in forming/storming, while Groups B, D and G moved to norming/performing. Focusing on Tuckman's sequence helps describe aspects of how groups work, but the focus is more on the interpersonal or social aspects of group work. The phase model proposed in this current research provides a more structured analysis can be used to identify specific procedures and tools that could

be make these processes more effective, as will be discussed in Section 6.4 below. For example, having group focus more on the information activities related to the *need* task (identifying a need, signalling a need, understanding a need) might help them surface more information, and increase their shared understanding of the task, potentially moving a group from forming/storming to norming/performing. Interventions at the needs stage *might* help groups work more effectively. Findings from this research suggest such research should be considered. Such research could add to the literature on group sharing, and may provide a way of countering the tendency of groups to focus on information help in common (e.g. Stasser & Titus, 2003)

Alternatively Shah (2012) provided a framework for the process of collaboration, identifying three key phases. The first phase is *pre-negotiation* or problem setting, followed by a *direction-setting* phase and an *implementation* phase. Interestingly, while these stages involve managing the interdependence among group members, they are not dissimilar to the task stages discovered by Vakkari (2001) from research on individual writing tasks which included stages of *Pre-Focus*, *Formulation* and *Post-focus*. The findings of this current research highlight that while there are three phases of group activities, the phases may not always occur in sequence, and there is iteration between them. Also, as discussed in Section 2.2, groups are more likely to be juggling multiple tasks and subtasks, which have different trajectories. Student groups for example might do little planning, and start working directly on one of their tasks (Doing), and only when they run into problems go back and Plan. They may move between the implementation phase of one task, and then the pre-negotiation of the next. Throughout their work members are also monitoring activities, often across tasks, to ensure things are progressing appropriately. The proposed model above (Figure 25) provides a more robust description of how groups manage multiple tasks over time, and allows for the investigation of the information process at each phase. This model augments our understanding of group processes.

6.2 Research Question 2

The second research question applied an information behaviour lens to deconstruct the information related activities of the groups in each of the three phases. Based on prior

research the following eight elements had been identified as potentially key to this process: information tasks, information task goals, information activities, sources, tools, artefacts, participation and roles. Findings from this research confirmed that these are key elements of the process, and allowed for the observation of the relationship between these elements over time. The elements will be summarized in the next section, and then their relationship will be explained through a proposed framework.

6.2.1 Information Tasks and Activities

Information Task Goals

At the beginning of this work a number of different information task goals were identified from previous research. Through the two studies the groups were observed to need information for the following eight goals:

Table 47   Group Information Task Goals

Goal	Definition	Origin
Confirm	Information is found and used to verify another piece of information.	Taylor (1991); Choo et al (2007)
Decision Support	Information is found and used by the group to balancing information in order to make correct choices	Limberg (1999); Freund, 2008
Entertainment	Groups in Study 2 actively looked for information for fun, to entertain group members.	New Goal – Generated from this research
Fact Finding	Information is found and used to determine the facts of a phenomenon or event, to describe reality.	(Choo (2007); Taylor (1991), Limberg (1999) and Freund (2008) Find Facts
How to	Information is found and used to answer questions such as *How do we? Or What do we need to do?*	(Freund, 2008; similar to Instrumental Taylor (1991)
Keep Track	The group works with information to ensure information is not lost, but that it is saved somewhere to be used again.	New Goal - Generated from research
Make Sense	Find or use information to better understand or make sense.	Like problem understanding (Taylor, 1991); Sense-Making, (Dervin, 1998; Choo, 2006)
Re-Find	Information needs to be re-found, as it has been lost.	New Goal - Generated from Research

These set of task goals emerged from the examination of groups working on varied intellective tasks rather than a specific one such as writing a term paper. The goals of group information seeking were not found to be dissimilar to the goals found from the

examination of individual information seeking. The highlighted goals represent new goals that were added through this research. Two of these new goals (Keep Track and Re-Find) relate directly to the challenges inherent in group work, the difficulties in organizing information and ideas over multiple people and tasks over time. The third relates directly to Social or interpersonal activities in groups. While this was not the focus of this work, this task was included as it was novel to groups, and was observed in several groups. It also indicates social related group information process should be further investigated.

As highlighted throughout this research, working in a group adds another layer of complexity to accomplishing information related tasks. By identifying the range of goals which motivated the information seeking in groups, and linking these goals to specific phases (Planning, Monitoring and Doing), more targeted tools to facilitate these processes can be created. For example to help groups "keep track" of things a group information space could include a shared space or folder or bucket for things that are considered critical.

Information Activities

To accomplish the information task goals outlined above, the following 19 information activities emerged through the observation of the groups in Studies One and Two. The information activities found are summarized below, organized by information task. The highlighted rows represent new information activities which emerged from this research. For example *signal need* emerged from the fact that within a group, a need might be recognized by an individual, who would need to voice this need, or *signal it*, so it could be considered by the rest of the group. Three novel information activities were also noted to support group information use. Groups worked collaboratively to put different pieces of information to *generate* something new, used information to *negotiate* points of view, opinions, or decisions with one another, and went through stages of *questioning and clarifying* information "bits" to ensure they were building a shared understanding.

The activities associated with each task are not necessarily linear or sequential. Even with the need task, and need for information might emerge, but might not be signaled immediately, and the group might not work collectively to understand the need. Especially during the *use* task, the activities listed below might not all be required for all

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tasks. The activities during *use* are presented in alphabetical order, as a particular

sequence was not confirmed for all groups for all tasks. Rather, they represent the range

of activities that might be present.

Table 48   Group Information Activities by Information Task

Information Task	Activity	Definition	Origin
Need	Need Recognized	When at least one member of the group realizes they need information to complete their task work, or to manage the process of working together. Cannot observe this until the need is signaled.	Marchionini 1999
	Signal Need	Group member(s) asks a question or prompts the group to for information.	Emerged from research
	Understand need	The group, or part of the group has a discussion centred on clarifying the need for information... for example what would help - where they could find it etc.	Marchionini, 1995
Find	Formulate Query	Activities related to determining what to type into the search box	Marchionini, 1995
	Execute Query	Execution of a query by clicking on the "search" button, following links within results, webpage, or information object, or clinking back or forth function and following links from within an information object	Marchionini, 1995
	Examine Results	Examination of results or surrogates.	Marchionini, 1995
	Reformulate Query	Modification of an existing query or composition of second and subsequent queries	Toze, McCay-Peet & Toms, 2011
	Select Search System	Group or member determines the best route to find information (i.e. notes, computer, cell phone)	Adapted from Marchionini, 1995
	System Set-up	Logistical steps to prepare the system that will be used to search for information	Toze, McCay-Peet & Toms, 2011
	Request for Assistance	Group needs to consult with Instructor, or a key person external to the Group to move forward with their task	Emerged from this Research
	Reflect and Iterate	Summary evaluation or assessment of information found and not found.	Marchionini, 1995
	Share	Times when a group member voluntarily made information available to others, in response to a need	Davenport, 1997, p. 87
Use	Analysis	Group needs to examine information and assess its usefulness to help make a decision, solve a problem etc.	Blake & Pratt, 2006

Information Task	Activity	Definition	Origin
	Extract Information	The process of extracting information by reading, scanning, listening to information found in information object. In a group situation includes discussion. Refers to not only extracting information from found information, but also from shared information.	Marchionini, 1995; Blake and Pratt, 2006
	Generate	Group members use different pieces of information to create something new	Emerged from this Research
	Questioning or Clarifying	Activity related to group understanding. To make sure all members have the same understanding of the information being discussed individual members asks questions, restate or clarify (Did you mean…?). Different from verification, which was used to code times when the group wanted to confirm an external fact or decision.	Emerged from Research
	Negotiation	Actions related to group members discussing and debating the relevance of information	Emerged from this research
	Synthesize	Process by which a group assesses information (both found and shared) and attempts to fit things together, and discover patterns.	Blake & Pratt, 2006
	Verification	Actions related to confirming a fact or decision that the group had made	Talja & Hanson, 2006

The particular activities observed during this research may be specific to the assigned tasks and the specific student groups. For example the activities required during the information *use* task may be highly variable depending on the work task. What is of particular interest is to understand if there were similar patterns that could be observed and identified across all the student groups. Through the analysis of the information activities by information task across all the sessions of all the groups the following patterns emerged.

Needs
A notable finding across all the groups was that the need for information emerged in response to all group activities (i.e. Planning, Monitoring and Doing), not just task related activities. Also specific to *group* information process compared to individual student information seeking was the additional efforts required to manage needs across multiple people, and maintain awareness of needs over multiple sessions. For example a need for information might be identified by an individual, and then signaled to the group, who

then discussed and debated the need. Alternatively there were times when a member might identify a need, but no one in the group might follow up, and the need was ignored or deferred to a later time. Interestingly, a time gap was noticed in several groups (i.e. Group F) between a need emerging, and the need being acted on, as also found by Reddy and Dourish (2002).

As identified in Chapter 2 (Section 2.6.1) in the prior research on Group Seeking, both Reddy and Spence (2008) and Reddy and Jenson (2008) focused on this specific transition point. The examined what factors moved an information need from individual to collaborative, illustrating the shifts on a continuum (Figure 13). They identified three factors that acted as a trigger for collaborative as opposed to individual searching; lack of expertise, lack of immediately accessible information, and the complexity of information need. Similarly, Fidel et al (2004) described a shift in groups to collaborate search based on specific triggers. Analyzing the interactions of the student groups in this current research, there is some evidence that these "triggers" could be observed. The most frequent way of satisfying needs in all the groups was through *sharing* information among members, not collaborative search. Group F, the group with the most unstructured task (an element of complexity) most frequently searched for external information during group meetings. In addition these students were in the first two months of a Master's program. Their prior knowledge of the topic and of each other was limited. This does suggest that groups only seek information collectively when there are a specific set of factors in play. These factors, or triggers, require further study to be fully understood.

In cases when groups decided not to collaboratively search to answer a need (i.e. Group B, D and G) there was evidence that members "trusted" the information they shared from another member. It can only be speculation, as members did not specifically comment on this fact, but it appeared that members did not feel the need to confirm information from sources external to the group, and the shared information was considered sufficient. The findings of this study confirm that groups do tend to focus on information held in common (Stasser & Titus, 1985).

Whether groups identified their need for information explicitly or not, and how the identified needs are followed has significant implications in terms of the information

that a group has to work with. Evidence from the groups studied would suggest that more attention needs to be given to the process of group needs. Suggestions will be discussed below, but a process of "needs assessment" could be built into group tasks and tools (See Section 6.4).

Finding

The student groups observed in this study used three main channels for *Finding* information. Commonly, the need for information within the student groups was satisfied through the process of sharing "known" information among members. This sharing led to a range of activities related to *use* (i.e. questioning & clarifying, analysis, extraction, synthesize, negotiation). The second channel observed involved finding information from an "expert" outside the Group. As these were student groups, this often meant asking their instructor or teaching assistant, but occasionally meant trying to contact an expert (especially with Group F). Less often, a third channel was chosen, external databases or sources. In these cases the groups solved their need for information through episodes of information seeking and retrieval using the web or a database, or through information found in articles or books. This third channel might include all the information activities required for individual search (i.e. Marchionini's 1995 model). The difference was that in a group situation each information activity (i.e. enter a query) might be accomplished by an individual, sub group or group. Participation and roles shifted.

Specifically, the activities related to *Finding* were most frequently accomplished individually; though the need for a common view during the *Finding* stage was noted in some groups. Members did huddle around a single computer and did suggest terms to search in some cases, as previously noted by Twidale and colleagues (1997) and Morris (2008, 2013). Groups needed to re-find information, showing inefficiencies in their processes, related to keeping track of things over different sessions and tasks. Some groups had issues with when and how to share their best "finds" (Group F). Timing also appeared to be important. Several members of Group F shared a key source with the other members, but commented on how they wished it had been found sooner. Similarly they expressed frustration that they had not talked to an "expert" earlier in their process. This would have helped them understand their topic, and refine their need for information.

Using

All groups spent the majority of their time *using* information. A number of activities were required to help the groups work with information. All the groups used the process of asking questions to clarify and confirm information, actively negotiated the relevance of specific pieces of information, and worked together to analyze, extract information and synthesize. At times the group, or a member, needed to verify something, and at times they needed to re-find information they had previously found or shared. The information manipulated by the group was collected into ongoing group artefacts (outline, flow chart, PowerPoint) or became the outcome (a report). The process of using information together created more needs, and additional cycles of needing/finding/using.

While many of these activities would be found in individual information use, critical to group *use* were activities related to negotiating and questioning. The process of *using* information as a *group* was found to be a very physical process. The groups frequently used walls (white boards), flip charts, and the large monitor to see and manipulate information together. Groups moved frequently while using information, and actively gestured, erased, moved, and drew. Given the findings in this research, the idea of a table top information tools, such as WeSearch (Morris et al., 2010) might be helpful for groups to accomplish the information *use* task, rather than search, for which it was designed.

6.2.2 Tools, Sources & Artefacts

Tools

The design of this research allowed for the close observation of how and when groups used tools to aid their information processes, and when they became frustrated as they tried to use the tools they had to accomplish their work. The table below summarizes the tools used, by information task and phase.

Table 49   Group Tool Use by Task

Task /Phase	Tool	How it was used
Information Task - Need	Email	For the most part needs emerged and were recognized through conversation. In Study 1 groups did specifically identity information needs through email, requesting help either from a specific member or all.

Task /Phase	Tool	How it was used
Find	Google	Groups used Google to find websites, specific facts and definitions
	Cell phone	Cell phones were used to call other people. During the studies cell phones were not used to search for information.
	YouTube	To locate specific videos
	Email	Members went into their email to find specific documents, and to confirm facts.
	Electronic Databases	Some groups searched databases to find particular sources.
Use	Email	To send other members copies of articles, documents and updates. Email was used both within and between meetings.
	USB stick	To move documents from one computer to another during meetings.
	Camera on cell phone	Groups used the camera on their cell phone to take a picture of what they had created on the white board.
	Pen/paper/highlighters	All groups used pen and paper to make notes. Highlighters were used at times to organize information.
	Flip chart and coloured markers	Several groups used flip charts to create artefacts. Similar to highlighters, different coloured markers were used to draw attention to specific things, and link information.
	White Board and coloured markers	Many groups used white boards to create and organize information.
	Large Monitor	Not all groups had access to the large monitor. When it was available it was used frequently (i.e. Group C).
	Joint Computer Use	Group members gathered around a single computer to examine documents and create content.
	Dual Computers	Groups used two computers next to each other at some points to integrate information from different sources.
	Word, PowerPoint, Publisher	Groups used word, PowerPoint and publisher in meetings to create and edit information.
	SPSS	One group required statistical software which was used collectively.
	Projector	Prior to the installation of the large monitor, one group requested a projector to see their presentation and work on it together.
Planning and Monitoring	Email	Both within and between meeting groups send emails to each other, and to people external to the group to confirm goals and timelines and monitor progress.
	Cell Phone	Group members called people external to the group such as their TA or guest speakers to confirm plans.
	Text Messaging	Members texted other members to confirm plans and timelines.
	Calendar	Calendars were used to keep track of and establish deadlines.
	Clock	Members used time to keep themselves on track and establish goals.

Groups required the greatest range of tools to *use* information. All the groups were working on intellectual projects; however the process of using information was in fact quite physical, as noted above (Section 6.2.1). The group interaction related to using information was similar to watching a group put together a physical jigsaw puzzle. Members needed to bring together all the relevant "bits" of information, and used a range of tools to physically rearrange, move, highlight, circle or erase things.

The white boards and flip charts were tools that seemed to best accommodate the need for physical manipulation of information. The large monitor was used for more structured editing of existing documents. The disadvantage of the white board and flip charts for the groups in this study was their persistence. The flip chart was brought back to the room so that it could be changed over multiple meetings. But between meetings members did not have access to it. The white board for the multi-session groups did have to be erased between meetings. Because of this the contents of the flip chart and whiteboards were duplicated electronically – using Word, Publisher, or through taking pictures of the artefacts and emailing these.

Interestingly the groups did not use many tools to identify, understand or organize their need for information. Needs most frequently emerged through conversation and interaction, and were either discussed and resolved, or ignored. As highlighted above, this represents a task within group information process where technology could assist more, as also noted by Fidel et al., (2004) and Sarcevic et al., (2008).

To Plan and Monitor the groups used a range of single user tools, including email, individual calendars, and clocks. These functions could have been better managed or controlled with project management type tools. CIRE (Romano et al., 1999) the first collaborative tool which integrated search with other group tools might have just been a tool before its time.

There were certain technologies that the groups talked about, but did not use. Members made reference to Facebook, but the students did not use this to communicate or organize their processes. Similarly, Blackboard Learning Systems (BbLearn), the learning technology at the university was mentioned by students, but was not used to facilitate their processes. Students did not use Google Docs or Dropbox other similar

shared document spaces. It would be interesting to see if the data were collected now, if this might change.

Specific problems or difficulties were observed associated with specific phases, where groups seemed to require tools or features they did not have. During their Planning phases the groups had trouble keeping track of decisions they made, how they should divide the labour most effectively, work on the same timeline, and determining how overlaps between members should be accommodated. For example Group E had difficulties with planning as members completed their work at different times. Group F had difficulty keeping track of decisions made. Group G had the least difficulties Planning, and in this group one member often assumed the leadership role. All the single session groups had difficulty dealing with determining how they should work with the matrix, and each group had to ask an expert (the instructor) for assistance.

During phases of Doing, the groups had trouble keeping track of information and ideas, and replicating work they had done on the white board or flip chart. They also had challenges determining the relevance of information, updating or remaining aware of what others were doing, and key resources found, and required tools to help the group work with information together. To assist with the Monitoring of their projects, the groups needed tools related to time and process, in other words, project management type tools.

Across all their phases, the groups needed to *keep track* and have a place to highlight key decisions and timelines so they would not be lost. The single session groups needed to return to the arefacts created in earlier tasks to complete the later ones. For multiple session groups they needed to "re-find" things from one meeting to the next. All groups needed to integrate time into their workspace. There also needed to be better support for shifts in participation, from individual through to group. Additionally, groups also had trouble maintaining a common view of the artefacts they created. This led to joint computer use, using two computers, or having to move to access or see what others were doing. At times members had problems being aware of what others were doing, both within and between meetings. Members also were observed to want to keep some things private, and only share selectively. For example in several groups members would

search for information, but not immediately share it, or not share it at all. This suggests a need to accommodate different levels.

Sources

The groups used a range of sources to accomplish their tasks, and work together. The sources can be classified into four categories: 1) other group members; 2) experts outside the group; 3) artefacts generated by the group; 4) course materials; and 5) documents, websites, books.

Groups used other members as sources for much of their information needs. Generally this was facilitated through conversation, either oral, or in written emails. At times group members shared notes. All the groups sought out people external to the group as sources. Members talked to people who were considered "experts" on their project topic, and their course instructors. As they worked through their project, the artefacts they were creating became sources, and were re-used to generate further artefacts. As these were student groups, their course project materials were used frequently, as well as the course syllabus, course slides, text book, and notes from classes. Groups less frequently used scholarly articles, books, government websites, YouTube, electronic dictionaries, inter-government organization sites, and databases. These finding mirror the findings from the research, particularly Saleh, 2012. The emphasis on human sources mirrors previous research on groups particularly Hertzum (2002), and the findings from the Group Sharing research (e.g. Stasser & Titus, 2003). As groups most frequently use each other as sources, information sharing was a critical group activity to examine. In prior research information sharing has been looked at separate from integrating information from external sources. This current research methodology provides a way to examine both.

Artefacts

To facilitate the synthesis of information from the individual to the group level, all groups created information rich artefacts, which were amended and revised, providing a trail of information flow. All the single session groups (Study 1) needed to complete the matrix, which became a key group artefact. To complete Part 1A some groups created a table or diagram on the whiteboard (Group D), which they reused for subsequent tasks;

other groups created a word document. Three of the groups created a PowerPoint (Groups A, B, and D). The groups completed their task in a single session but the creation of artefacts still played a key role in their process. For the multi-session groups Group E created and revised a PowerPoint. Both Groups F and G had several complex artefacts that recurred through several sessions.

Group F's use of artefacts illustrates importance of artefacts to group information use. A member of Group F created and brought an outline to their first meeting. This outline was then shared, enhanced and edited between meetings, and brought for discussion to successive meetings. The outline persisted in electronic and print form throughout all their sessions. They also worked on an outline on the flip chart, which overlapped, but was slightly different than the print version. As Group F was struggling with how to present their complex topic they also created a flow chart. Each entry on the flow chart reflected multiple information tasks and activities of the group. For example one member might suggest a name of an organization, another might ask a question about it, and a third would verify the jurisdiction of the organization. Then all members might discuss if it fit at that spot on the chart, and finally come to an agreement. The flow chart was critical to the Group F's process; they commented "this is what is going to help us get through this". The group also integrated their PowerPoint slides into a final presentation format, and then revised and edited the content and format.

As part of each of their tasks, Group G created specific artefacts, which eventually, after successive stages became outcomes for the individual tasks. For example the group created and revised an Interview Guide and a Focus Group Guide, and several versions of their survey. In each case these artefacts were created collectively, revised both individually and collectively, and then amended to include feedback from the Professor and other class members. The use of artefacts by these groups mirrors the findings from previous studies including: Paepcke (1996); O'Day & Jeffries (1993); Gorman et al, (2002); Hirsh & Dinkelacker (2004) and Hertzum (2002). What is noteworthy is the lack of tools to support the creation and persistence of group artefacts.

6.2.3 Participation and Roles

The groups managed their interdependence by shifting from individual through to group work, and developing particular roles.

Participation

As the interactions of the groups were analyzed and coded, the change in who was participating was noted (individual, subgroup or group). Given the many hours of group activity examined, a fine grained analysis of participation at the information activity level was not possible. In future research specific information activities could be analyzed in greater depth to provide a more detailed understanding.

The analysis of participation in this current research did identify shifts at the group phase level, and at the information task level. There was variation between groups, but the following pattern was true of most groups. Planning phases most frequently involved the entire group while during Doing and Monitoring phases there were fluid shifts from individual through to Group. This provides a deeper understanding of the shifts in participation noted by Hyldegård (2009).

At the information task level, the identification of needs was frequently by an individual, who signaled the need to the group. At this point sometimes the need was discussed by the group, sometimes by a couple of members, and sometimes the need was ignored. The activities related to finding information were less commonly accomplished by the group. To use information, groups most frequently worked collectively.

Roles

In addition to participation changes, specific group members took on particular roles to accomplish their information tasks and activities. Over the two studies the following ten roles were observed: Analyst, Data Analyst; Director; Editor; Integrator; Leader; Reader; Scribe; Searcher; and Writer. Roles were used in all phases of Planning, Doing and Monitoring, although more roles were required during the Doing phase.

As with the information activities, the particular roles observed may be specific to the type of groups and their tasks. As such, the particular roles are not as notable as the fact groups' consistently do manage information tasks through individuals assuming specialized roles. In some cases members choose specific roles, while in others groups' roles were assigned. The use of roles has been noted in previous studies, particularly Prekop, 2002. There are overlaps between Prekop's list and the roles found in this study. For example the role of searcher found in this research is similar to Prekop's information gatherer, while his role was more structured. This suggests that there may be standard

information roles in groups that could be better supported, and the roles are an important factor that should be examined in other studies.

There was some evidence that the use of roles in the student groups was part of a "transactive memory system", as described by Wegner (1987). Especially in Group G, members specifically identified responsibility for particular types of information (e.g. statistics) with specific members. This group used the most number of roles, and used them explicitly. While analysis at a finer grained level would be necessary to make conclusions, there is some indication that transactive memory systems are built in groups, and that they help groups work effectively.

Tools to support groups could provide specific features to ensure efficiencies with this practice. For example Shah, Pickens and Golovchinsky (2010) distributed different search results to collaborators based on their roles of gatherer or surveyor. The effect of leadership on GIP was interesting, and is worth future research.

6.2.4 Putting the Elements of GIP Together

Of particular interest to this current research was the need to better understand the relationship between these key elements of GIP. Regardless of the specific project, all the groups moved through phases of Planning, Doing and Monitoring. All three processes generated the need for information within the group. To satisfy these needs, all the groups worked with, and manipulated information, which required specific information tasks and activities, as outlined above, to allow them to integrate information from a range of sources, including humans as well as print and electronic documents. This was also found by Hansen & Järvelin, (2005) and Fidel et al. (2004). To enable this information work, all the groups used a range of tools; at times working inefficiently with tools that were not designed for group use. All the groups created artefacts, to help them work with information collectively, to keep track of their information "pieces", and to preserve decisions and processes as noted in prior research including studies by Gorman et al. (2000) and Hirsh & Dinkelacker (2004). The relationship between the eight elements of GIP is illustrated in Figure 26 below.
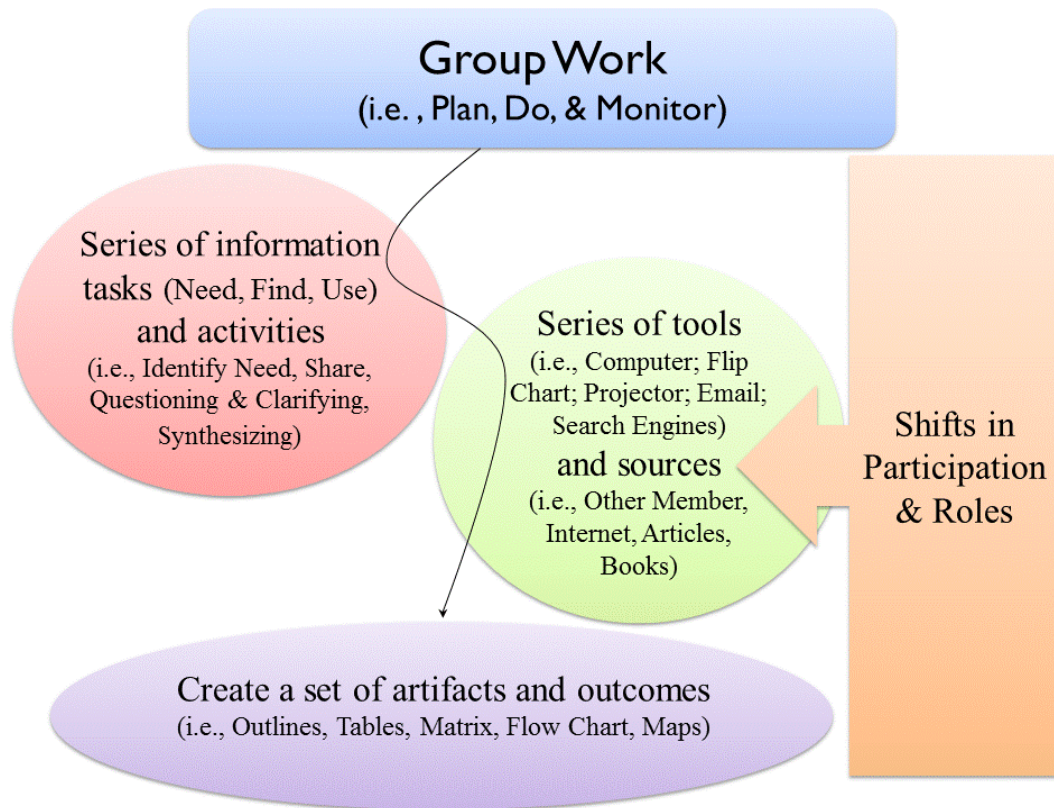
Figure 26   Elements of Group Information Process

6.2.5 How Groups Work with Information

As noted in Section 2.4, based on their examination of collaborative information behaviour in design teams Bruce et al. (2003) concluded that the concept of CIR (which they defined as "any activity that is undertaken by members of a work team to collectively resolve an information problem" p. 140) was elusive and difficult to conceptualize. Through this current research, and the close analysis group information interactions over time, a much greater sense of the concept has been gained.

Group information process is triggered by their task (Doing), and also by the need to Plan and Monitor their work collectively. The framework of GIP incorporates concepts and models from information science (e.g., information tasks and activities), organizational behaviour (e.g., rhythm model of group processes) and CSCW (e.g., use of tools to support group work). The information tasks emerge from the group activities related to task, and also from Planning and Monitoring.

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Groups were found to seek information for eight goals: Confirm, Decision Support, Entertainment, Fact Finding, How To, Keep Track, Make Sense and Re-find. Groups chose sources, used tools, and members needed to take on various roles. To accomplish these information goals the groups required 19 information activities to work with information and generate artefacts and final products.

This framework of GIP incorporates and extends prior research on groups and information. Similar to the findings of the Washington Group (Fidel et al, 2004; Bruce et al, 2003; Poltrock et al, 2003) participation in GIP involves shifts from individual through to the entire group, and a diverse range of sources (including human) are utilized. The fact that group members often take on specific roles reflects the findings of Prekop (2002), although the particular roles varied. The need to find information for entertainment was unexpected. There did not seem to be any discussion of this aspect of group information behaviour in previous research.

The detailed analysis of video possible through the Natural Lab Study design allowed for a more fine grained analysis of *when* and *how* collaboration occurs, and a more robust classification of information tasks and activities. This conceptualization extends the work of Blake and Pratt (2006) which focused specifically on the literature synthesis task, by including more tasks and incorporating information seeking from humans, and sharing activities.

The choices the groups made regarding sources, tools, and the creation of artefacts appeared to be affected by a range of different factors, which were outside the scope of this research, but which are mentioned here to indicate interesting avenues for future study. The attitude towards group work (atomistic/holistic) appeared to affect the process of finding and using information as a group. Some groups had members who took on leadership roles, while others did not. How this affected GIP would be interesting to investigate further.

Given the data collected it was not possible to analyze why some groups searched databases to solve their information needs, while others, working on the same task, relied on sharing within the group. Time may have affected the decision, as well as trust in the knowledge of other group members. Task differences and motivation of group members may have also had an effect. These all represent interesting avenues for further research.

6.3 Research Question 3

Through the analysis of the interactions of the seven groups, did a rich understanding of the group information process of student groups emerge that could be defined and modelled? This next section attempts to answer this question. First the initial definition of GIP (Section 2.1.1) is examined, and the concept is re-defined in light of the findings. Then a model of GIP is proposed and explained.

6.3.1 Re-Defining GIP

At the start of the research, an initial definition of group information process was proposed, with the goal of refining and expanding this definition based on this current research. The initial definition was as follows:

> *Members' interdependent acts involving information tasks and activities, tools and sources that enable groups to accomplish their work tasks and work together.*

Through the two studies the workflow of 7 different groups, representing 25 sessions, and 156 stages were deconstructed to identify how groups Plan, Monitor and accomplished (Do) their work task(s) over time. The framework above highlights the common patterns in the way student groups work with information. In particular it identifies the three key phases of activities groups work through to accomplish tasks, planning, doing, and monitoring. Within these phases the following elements were identified: information tasks and actions, sources, tools, artefacts, participation and roles.

Based on the analysis of all the groups, the following is proposed as an enhanced definition of the group information process of student groups:

> *Group information process refers to the range of information task goals and activities required by groups to plan their work, accomplish tasks and monitor their progress over time. Through these information tasks and activities, and facilitated by tools, groups integrate information from multiple sources, at times assigning different individual roles to make decisions, solve problems and generate new content. Traces of their information activities are embedded in group artefacts and final products.*

Group information process was found to involve a fluid mix of interactions including shifts between individual, sub group and group level activities. Through this information process groups manage their independent work, and build shared understanding and awareness. GIP may be affected by the following: the nature of the tasks(s); the approach to group work (atomistic/holistic); the prior knowledge of individual members; how the groups structure their work (i.e. having members assume specific roles based on their skills); the level of trust with other members; and if, and how, leadership was maintained.

The closest definition to GIP is Hinsz, Tindale & Vollrath's (1997) definition of groups as information processors (which was presented in Section 1.4), which focused on information sharing. This research extends their definition. This research examined not just sharing, but also the process of identifying needs and using information. It also adds to the understanding of the mechanics of information work in groups. It provides a description of the key elements through which information is processed. The definition of group information process fits within Foster's (2010) definition of Collaborative Information Behaviour (CIB); "the study of collaboration with, though, and in relation to information; along with the systems and practices that support this" (p. xiii) but looks particularly at a specific type of collaboration, that found in student work groups.

This definition and the conceptualization above provide a framework to ground future research. Group process has been deconstructed to identify constituent elements. This research provides a structured framework which can be further tested and extended.

This definition acknowledges the unique aspects of groups. Through their interactions group members share and exchange prior knowledge, and they build shared understanding through the process of actively working with information. Hertzum (2007) theorized that "collaborative grounding" was a key aspect of collaborative information behaviour, while Saleh (2012) found collaborative grounding to be a key part of the information behaviour in engineering student teams.

6.3.2 A Conceptual Model of GIP
In addition to defining GIP, a goal of this research was to create a conceptual model of GIP that would focus on group process through an information behaviour lens. As illustrated in Figure 3, in an attempt to make information "visible", information was put in the centre, within task and group processes. The relationship between these three

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constructs was deconstructed through this work. This research found that information tasks are triggered not only by task work, but also by the need for groups to plan, and monitor their progress. Through applying an information behaviour lens, each of these three phases of group and task activity (Planning, Monitoring and Doing) were found to have different patterns of GIP, which included a different configuration of the key elements (information task goals, information activities, sources, tools, artefacts, roles, and levels of participation). Across all phases, a holistic picture of student group information process emerged.

Through this research, aspects of group information process were observed, but not fully explained. For example an individual group member could be observed searching for information, and keeping it private. But it was not possible to infer from the action (or lack of action) the reason. In some cases the individual might share this information at a later point in time. The query, and the information found could be observed, but unless they talked about their thinking process, it was not possible to understand their motivation for sharing or keeping information private. The need to keep some things private was observed across all groups.

As highlighted above (Section 6.2.1), the information task that consumed the most time of the groups was using information. Groups required more activities, created more artefacts, and seemed to need more tools to work collectively with information than during the Find task. Across all of the group phases, groups needed to keep track of what they were finding, and needed to re-find things.

During the three key tasks (need, find use) the need for information, or information itself might surface, but in the end be ignored, representing a loss of potential information. The information need might not be acted on, found information might not be used, and information that was assessed might not be included in the outcomes. While this is similar to individual information seeking, the process in groups is more complex, as there are more ways information can be lost, as well as found. Further, participation during information tasks was fluid. At times information activities were completed by individuals, at times pairs or part of the group, and at other times all members participated. Groups at times divided the labour in information seeking according to particular roles. Specific activities, such as negotiating are unique to groups.

Given the above findings, aspects of the following three models were considered, and extended to better reflect the group process:

1)   Wilson's First Model of Information Behaviour (see Figure 7, Section 2.4.1)

2)   Leckie, Pettigrew & Sylvain Model (1996)
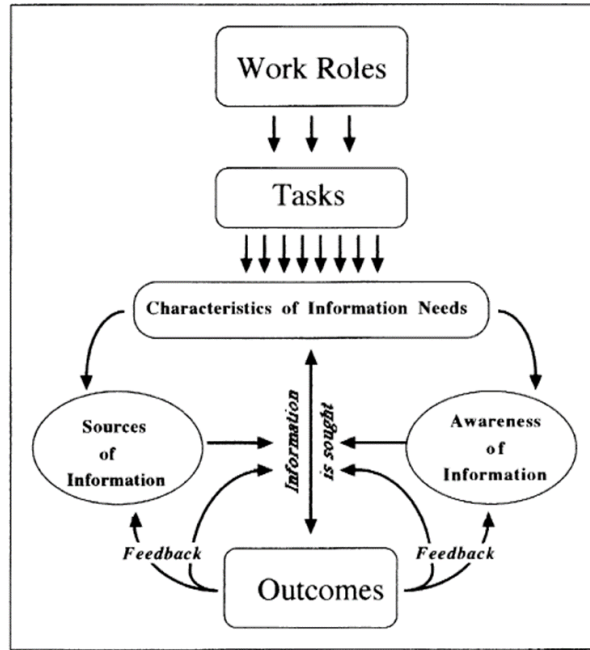
FIG. 1.—A model of the information seeking of professionals

Figure 27   Leckie, Pettigrew & Sylvain Model (1996) p. 180

3)   Krikelas (1983)
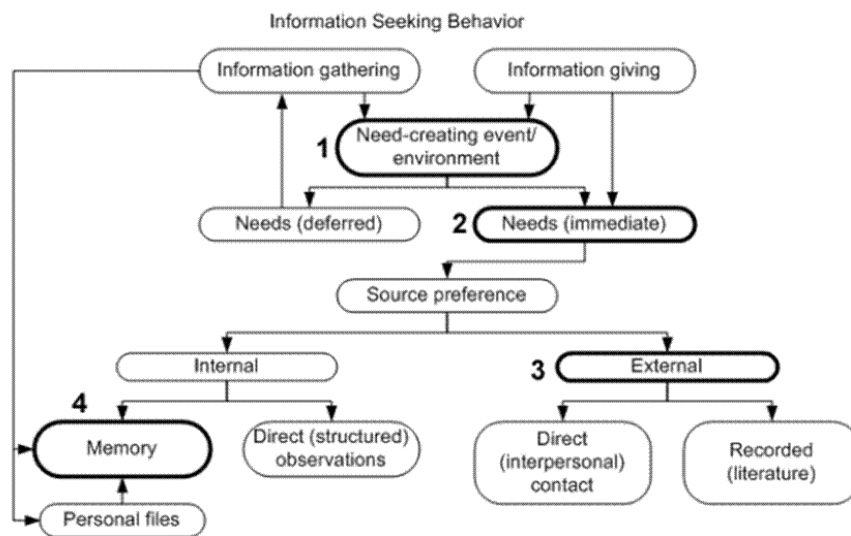
Figure 28   Adapted from Krikelas Model (1983) p. 13

Both the Wilson (1981) model and Krikelas' (1983) model's incorporate the concept of information sharing in their models, which is an essential part of GIP, as well as the idea of solving information needs through other people. Leckie et al, (1996) focus on professional information seeking, and include the task as a key trigger for information needs. They also include the outcome, how information is used, as an essential aspect of their model.

Figure 29 illustrates the proposed conceptual model of GIP that emerged from patterns observed across all groups. It is intended to provide a high level conceptualization of group information process, which can be used to frame future research. Further it highlights points during the group process that information is "lost". Based on the recognition of these points, tools can be designed to enhance information process in groups. For example tools to better track, and perhaps assign information needs to individuals may prevent needs from being lost. In this way, the model is intended to be used to diagnose groups, highlighting barriers that affect the key information tasks. To illustrate this, the model will be explained in terms both in terms of the key information tasks, as well as the key group phases (Plan, Do, Monitor).
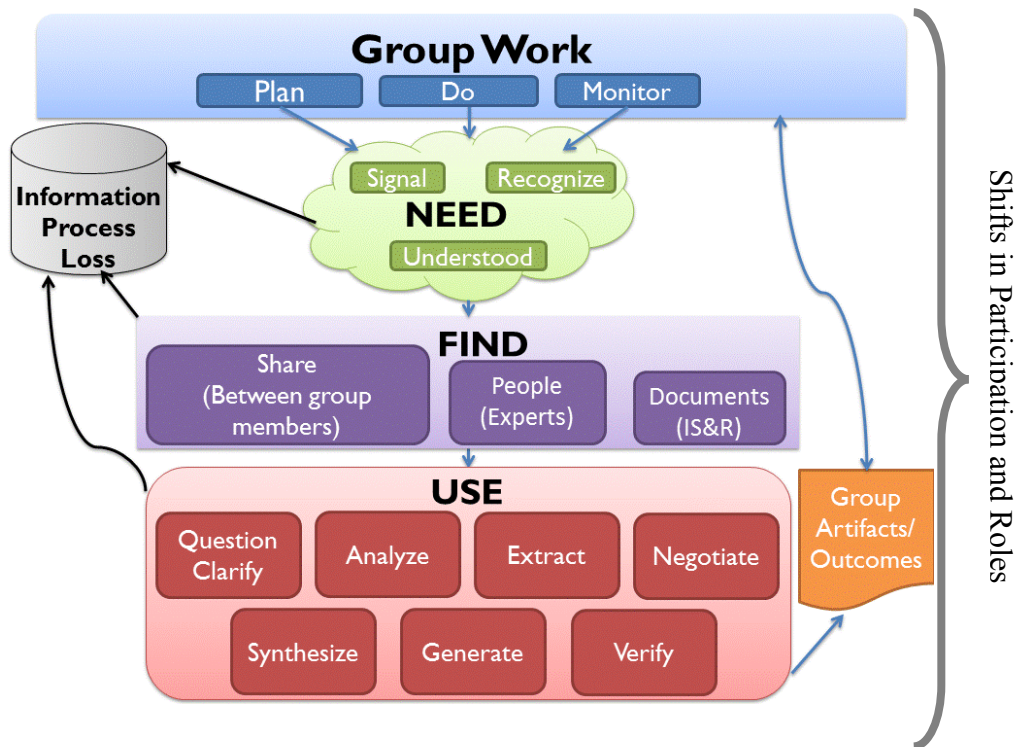
Figure 29   Conceptual Model of the Group Information Process of Students

Examining the Model by Information Task

Needing

As identified through the above analysis, the need for information could emerge from activities related to Planning, Monitoring or Doing. The three main information activities related to the need stage were signaling, recognizing and understanding the need. In a group, rather than an individual information process, these activities might be accomplished by different individuals or by the group collectively. As observed across the seven groups in this study, a key issue with the need task is lost needs. Needs emerged that were not recognized by others, or that were not fully understood. The information need tasks in groups represent a task that has not received much attention, and is flagged for further study. For example encouraging groups to collectively understand the need might help the information bias problem in groups. Through deeper reflection on their needs, groups may decide they need multiple strategies to seek information, which would potentially increase the amount of *unique* information that enters the group. By highlighting the need task during group work, and the associated activities, this model provides a new point of intervention to enhance group effectiveness.

Finding

As noted in Section 6.2.1 above, student groups observed used three main channels for *finding* information:

1. Share – As identified above, and illustrated by the size of the channel, most frequently the need for information within the student groups was satisfied through the process of sharing "known" information within the group.

2. Experts – at times the group determined the best way to solve their need was to ask an expert source (person) outside the group.

3. Find a Document/Information – At times the groups or a member of the group solved their need for information through episodes of information seeking and retrieval using the web or a database. This could include all the activities in individual search, but each activity might be accomplished by an individual, sub group or group.

For each of these channels there were times when information was identified and ignored, and times when the information was seen to be used.

The research that focuses on how authentic groups search together is limited. Comparing these findings with other research on group "finding" is difficult. The majority of studies have focused on collaborative information seeking, rather than the group level specifically. Where there has been a focus on groups, the focus has been on virtual or online groups. The participation observed in this study during finding was most frequently individual. Information on collaborative search behaviours gathered from surveys (e.g. Morris, 2007; 2012) including: jointly using a computer; looking over someone's' shoulder; suggesting search terms; sharing search results (in person and by emails); and forwarding particular information to other members, were also observed in this research. These types of behaviours could be better supported with tools. As noted above, the need to re-find information also indicates that group search could use support.

The groups observed in this research needed to consider both when, and how, they would share "best" finds with other group members, which has implications for the information considered by the group at different tasks stages. For example member of Group F reflected on finding a key book late in their process, and that speaking to an expert earlier would have also saved them much time. The timing of sharing information is potentially a factor which may influence group effectiveness. This model describes the specific activities observable during the Finding stage, providing a more robust understanding of this stage, and how tools or interventions may aid.

Using

All the student groups observed spent the majority of their time *Using* information. A number of activities were potentially required to help the groups work with information. As noted earlier, the activities identified in this document are not meant to be exhaustive, but to represent the key activities observed by the student groups.

All the groups used questions to clarify and confirm, and worked together to analyze, extract information and synthesize. At times the group, or a member, needed to verify something, and at times they needed to re-find information they had previously found or shared. Negotiating with information is a new information activity, identified in this research. The manipulated information was added to an ongoing group artefact (outline, flow chart, PowerPoint) or became the outcome (a report). The process of using information together led back to the group activities, and additional cycles of

needing/finding/using. There was a great deal of complexity to the activities related to information use, and a great deal of frustration. Group information use was also found to be a very physical task, group members used the space around them to help organize, understand, and generate new information. Prior research has focused on sharing, but not on the activities related to use. This model helps identify key activities that student groups need to accomplish, providing more details to guide the development of tools.

Examining the Model by Phase

The model can be used to explain information processes for each group phase.

Planning Phase

During planning the student groups might realize that they did not fully understand aspects of a particular task. They could not assess best strategies for accomplishing the task until they confirmed understanding of the assignment details. This need might be met simply. Another member might locate the syllabus, assignment guideline or handbook, and share by reading the relevant section for all members. The group might then discuss this shared information, collectively ask questions to clarify, and then extract the necessary information. Their discussion and decision might be put into a group outline, or an email, or may be just discussed and be implemented in a specific decision.

At other times to solve a planning related need a student group might decide they do not have enough information among themselves, and their shared documents, and may decide to contact an instructor, a teaching assistant, or someone they view as an "expert". They would then wait for the information to be received from this source before using it to inform their decisions.

Depending on the task it was also possible groups might actively search for "best practices" to help them determine the best way to manage a task. This might involve searching through electronic resources, determining the relevance of the information and collectively analyzing and synthesizing the found data.

Monitoring

During the monitoring phase the information processes might, as with planning, be fairly simple. The group might simply want to check to see if they are on target with their stated plans. Members might refer back to a written agenda, and share goals to remind the group of what they said, compared to where they were. Activities related to monitoring might

include verifying information through sending emails to other members, or to the group, as well as providing verbal reminders.

Perhaps because of the time pressure, Groups A through D constantly monitored their progress, and in fact tried to determine how they were doing in relation to the other group. As they worked through their subtasks for example, a participant might look at their watch, and suggest the group reassess. What have they accomplished, what do they still need to do, and how should they adjust their work. This might prompt them to divide the work in a different way, set an ambitious role (let's finish this part in 20 minutes), or go ask for clarification on their process.

Doing

To accomplish their tasks the student groups required information for multiple goals using nineteen different information activities. Working on the task generated the most complex pattern of group information seeking. To highlight this complexity, Group F provided the best example, as the group had the most robust information search processes. To make sense of their complex topic they needed to share information found during their individual work, including sharing found sources. They also collectively sought information to inform particular decisions they had to make, and problems they had to solve. The information activities of groups working on tasks are complex, fluid and dynamic. This model helps to make these activities concrete, so that group information process can be better supported.

6.4 Supporting GIP in Group Work

To work effectively student groups' transition through phases of planning, doing and monitoring, which are not necessarily sequential, and they need to manage information within and across these phases. As observed, to accomplish this, the students used multiple tools, which were not linked through a single appliance, and many of which did not easily encourage or even allow collaboration. The design of this study was deliberate. Rather than imposing specific types of technologies or tools, the group were encouraged to work as "normal". It was also emphasized to the groups that they could ask for any tools or technologies that might aid their work. The goal was to see how group actually worked, rather than how groups adapt their behaviours to specific tools. From the

examination of the seven groups in this study the following set of requirements emerged, for features and tools to facilitate group information process.

6.4.1 Support for Planning

Planning often occurred spontaneously in groups. There were no tools used, such as project management tools, or collaborative tools, to prompt the groups to consider an overall strategy or plan. Further groups did not always start planning, but moved to this phase when then hit a wall, or were unsure how to move forward. Groups rarely recorded their plans in any way, so did not have an artefact to refer back to, or keep them on track. Because of this, the student groups observed needed assistance keeping track of decisions they had made about their goals and strategies. They could have used a common space for storing and tracking their goals, and in some cases an alarm or timer to let them know when their "time" was up. To coordinate plans over multiple sessions, groups needed to track who was tasked with what, and to synchronize calendars.

6.4.2 Support for Monitoring

Monitoring phases in groups were often short, and were related to coordination and awareness. Based on this, the groups observed in this study needed tools related to time and process to help monitor their resources and members. Specifically, groups needed to: 1) map things to calendars; 2) alert each other if there were problems accomplishing individual tasks, 3) determine the best way and timing for sharing of information between meetings; and 4) agree on a platform to facilitate this necessary communication and coordination. The most common way groups managed monitoring activities between meetings was through email. Several groups discussed if they could use their course site (BbLearn) to work collaboratively, but did not think this was possible.

6.4.3 Support for Doing

Groups needed the most support to accomplish tasks, both in their meetings and between meetings. The need to keep track – of information, ideas, and decisions - was a recurring theme for groups. They also needed to re-find. A space for "valuables" would be a significant feature of a useful group space. There were also specific needs for support observed in the groups related to each of the information tasks, as identified below.

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Need

The student groups observed did not have good processes for managing their information needs. As noted through the analysis, groups rarely discussed their need for information in any substantial way during the meetings. Yet our knowledge of individual information seeking has focused on the need for intervention during this process (e.g. Taylor, 1991). Technology could be created and used to assist with this, by providing groups with project tools, and building a needs assessment into their process. Support for needs was also recognized by Poltrock et al (2003), who suggested that information needs could be explicitly recognized in a common group information space, discussed, and even assigned to particular individuals. These individuals would seek (either individually or collaboratively) information to resolve the need, than post the results back to the common space. Notification features could be used to ensure all members were aware of the updates and changes.

Find

The seven groups observed at times needed support for multiple information seeking and retrieval episodes within projects or tasks – including revisiting or re-finding information and collecting and monitoring. Further the tools they used did not allow for fluid participation changes, from individual, to pairs through to the entire group, yet these shifts were common in all the observed group activities.

The set of requirements that have emerged from the Group Search research (Section 2.6.2) 1) awareness, 2) division of labour 3) persistence (to provide trace information of the group's past searches) 4) communication 5) ranking or recommendations 6) private and shared space and 7) data synchronization were confirmed in this research. An interesting finding from this current research is that *finding* did not need as much support as the *need* and *use* tasks.

Use

The student groups also had significant challenges when they tried to solve problems, make decisions, and generate new information together, frequently related to difficulties "seeing" all the information pieces together. Sarcevic, Marsic, Lesk & Burd, (2008) based on their study collaborate information processes in trauma rooms found similar

problems. They also recommended a common integrated display would be critical for bringing together dispersed information. Student groups have the additional challenge of needing to work with group arefacts between, as well as in, meetings. Ways of easily replicating visual displays for offsite access would be helpful.

Tools were needed to support the integration of information from multiple sources including electronic resources, books, notes, and from people, and to allow this information to be more seamlessly integrated into presentations and reports. At the same time, the group members wanted the flexibility to keep some activities private, and to separate their working space and the group space.

Most strikingly, the student groups needed tools to help them physically manipulate and rearrange information. During the *Use* task all the groups observed were active, writing on the space around them, using the large monitor, or moving to jointly see thing on a computer. Easy to use visualization tools and the ability to move information between computers, large screens, and or tabletops would allow groups to truly work with information.

6.4.4 Summary of Supporting GIP in Group Work

Emerging from the study of the information interactions in seven authentic groups were a set of elements that need to be better supported, to allow groups to accomplish their tasks. Some of these features had been identified in earlier research, and were confirmed in this research. Perhaps novel to this research is the need to better support the information need and information use task, and the recognition of the need to support three core phases, Planning, Monitoring and Doing.

These features identified in this current research bring together, confirm and extend the findings from prior research on group seeking, search and sharing (Section 2.6). Reddy & Jansen (2007) for example, found that awareness needed to be supported, that there was a need for additional communication channels such as chat or conferencing, and that tools to aid visualization were critical for collaborative information processing. This research also found the same technology needs.

Sarcevic, Marsic, Lesk & Burd, (2008) also found that tools were needed to enhance the visual display and allow for manipulation of information, and to facilitate information sharing between providers and seekers. Looking specifically at synthesis,

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Blake & Pratt (2006b) made the following recommendations: 1) Integrate the retrieval, extraction verification and analysis tasks 2) improve document management capabilities 3) provide support for collaboration and information sharing 4) Improve precision & recall of retrieval and extraction systems 5) provide visual interfaces to verify and explore findings. The importance of these features was confirmed in this research.

Additionally, this research suggests that student groups need project management features, to organize their Planning and Monitoring activities, and help them move information between their phases (Planning, Monitoring, Doing). Rather than focusing on the Find task, this research emphasized that the activities during the Need and Use tasks need more support, which could counteract information loss during group work.

6.5 Envisioning a Group Information Space

New types of collaborative tools have emerged over the course of this research. Based on the observations in this research, and an understanding of the collaborative tools which are currently available, how should a group information space be designed, to better facilitate group information process over multiple tasks over time? The features observed relate to the core elements of GIP: groups need assistance managing their different phases of activities (Plan, Do, Monitor); to negotiate through their information tasks and activities effectively; to integrate multiple sources and different features of different tools; to coordinate participation and roles, and to enable group artifacts to be manipulated both within and between meetings.   The following list summarizes the categories of software or tools which would enhance a student group space.

1. Student groups could use Project Management software – which could track, and help organize the planning and monitoring stages of group work, as well as the actual task work. This could integrate time, allow for the division of labour or assigning of tasks to manage group member roles and shifts in participation. Such a tool would help groups keep track of important things, and plans. Currently the student groups observed had access to standard Office software, and BBLearn a course site. Neither of these added the robust features students needed. A range of collaborative software is currently available, including open source products, which may provide the flexible project framework students need. For example

twoodo (https://www.twoodo.com/) is a collaboration tool currently in beta that offers features including: note taker, build a knowledge base, to do lists, communication, polls, shared task lists, better file management and priorities. twoodo is built around the use of hashtags, and is flexible and easy to use. It can be used across multiple platforms. Such a tool may be able to be structured to allow groups to focus on *planning* and *monitoring*, while *doing* may still need additional tools.

2. Student groups could use interactive tools such as smart boards, touch screens or collaborative tabletops to allow information to be created jointly, manipulated, and saved for future editing outside the meeting. For example collaborative tabletops such as WeSearch (Morris et al., 2010) may be flexible and helpful tools for synchronous group work, especially if they were used to focus on activities related to *needing* and *using* as well as search.

3. Student groups need flexible communication tools that allow groups to share information between meetings, and to maintain awareness of group members, and the task over time. There are many choices for this, including using social tools such as facebook. However a single interface that coordinated all the necessary features may be more efficient and practical for groups.

4. Finally student groups need tools that integrate the information tasks into the work flow. This is perhaps the most challenging category. To date most collaborative search tools are separated from other general office type tools, are not widely available, and focus mainly on the find task (e.g. Shah, 2012). From this research the recommendation would be for tools that encourage groups to spend more time understanding their information needs, and provide a more flexible range of features to support working with multiple types of information (documents, electronic materials, expert sources) over time. An information process type of tool would also have to be integrated with the project management tool, to integrate the three levels – group work, task work and information work.

6.6 Summary of Integrative Analysis

The preceding chapter has synthesized the findings across both studies, and provided answers to the questions motivating this research. Through this research a detailed picture of what a *student group information process* looks like has been gained, and it has been described and modelled in terms of the key elements. GIP emerged in the groups in response to three critical group activities: planning, doing and monitoring. Each of these phases of group activities generated cycles of needing, finding and using information, though the pattern was different for each phase (see Figure 25). This research identified, defined and described 19 unique information activities, which groups used to accomplish their 8 different information task goals. To accomplish the information activities the groups needed sources (including human) and tools. The relationship between the tools and information tasks and activities was discussed in Table 48. Further the groups created artefacts to allow them to put pieces of information together, so that they could all examine and see together. The change in participation within the group, and development of ten particular information roles was discussed (Section 6.2.3). The relationship between these elements was conceptualized (Figure 26), and GIP was re-defined and modelled (Figure 29). This model was explained in term of the phases of group activities and the key information tasks, with an emphasis on what this research has made "visible" in terms of information process. Finally the findings of this research are used to suggest features for collaborative tools to better support GIP (Section 6.4.5), and to envision a group information space (Section 6.5.5).

CHAPTER 7   CONCLUSION

7.0 Overview

This chapter will summarize the contributions of this research, discuss the limitations, and identify opportunities for future work.

7.1 Contributions

This research started with the identification of a core problem. Information is central to group task accomplishment. However, we do not have a conceptualization of groups that describes *all* aspects of the process through which groups identify a need for information, find, and work with information to accomplish something new (e.g. Gardner et al., 2012). In knowledge based work information is the core resource of groups; their ability to use information resources well has an impact on the effectiveness of the group (e.g., Hackman & Katz, 2010). As more work is being accomplished by groups, a better understanding of the *information* part of group processes is critical.

This problem is particularly challenging as information is often invisible within group processes. It is difficult to separate information work from task work, as noted by Fidel et al, (2004) in their examination of collaborative seeking in design teams. Further, information process in groups is often achieved through communication, making it difficult to separate information tasks, conversation, and social activities. The objective of this research was to study the information process of groups over time, and as naturally as possible, to better understand what groups actually do with information.

As this is a complex and multidimensional problem, the approach taken in this research is interdisciplinary. A model of group process (Marks et al., 2001) was used to help classify common group activities, which were then deconstructed using an information behaviour lens, which focused on three information tasks (Need, Find, Use) (Choo, 2006; Marchionini, 1995; Wilson, 1981). Data was gathered using a novel Naturalistic Lab Study Design, which allowed all interactions of authentic groups working on authentic tasks over time to be captured. The data was analyzed using a

structured task based analysis, to identify the key elements of group information process. This allowed groups to be examined as complex adaptive systems, but also for this complexity to be unravelled. This design enabled the examination of the details of information interactions over time, so that a "group information process" could be examined and understood. This design focused on the unique aspects of groups, their interactions, interdependence, and how they build awareness and shared understanding. This provided a detailed analysis of how "group information process" fits with group processes. The findings of this research provided contributions to information science, group research, and CSCW as well as providing two methodological contributions.

The results of this research has added to the conceptualization of group processes, by focusing on how and when information needs emerge, the tools and sources used to facilitate the finding of information and the tasks and activities required by groups to use information collectively. The understanding of the key information tasks of groups and how they are performed in the three phases of Planning, Doing and Monitoring provides a more holistic and robust understanding of group information work. It suggests points where interventions can be made that might help groups use their information resources more effectively. The detailed analysis that emerged from the rich data collected provided specific evidence of the features and tools needed to better support group information process.

7.1.1 Theoretical Contributions

Augmenting the Understanding of How Groups Work with Information through Time

While there has been much research on groups, and particularly on group effectiveness, group processes have themselves have been a concept that remained elusive, complex and difficult to measure (e.g. Hewes & Poole, 2012; Hackman 2012). Despite much research the concept of group processes, as noted in Section 2.2, is itself not clear; group processes are often depicted as a "black box". By examining and classifying group information process this research added to the understanding of the concept, and integrated models of groups and information science. Specifically, it applied an information behaviour framework over a group work flow process, as described below.

This research started with a model theorized by Marks et al, (2001), and examined the transition (Planning) and action (Monitoring) phases of groups. All the groups examined were observed to alternate through these specific phases, but the names of the phases were adapted to better reflect the core activities. Transition phases were found to be phases of *Planning*, where the group members determined the overall mission and strategies for their task, choosing between options, and confirming priorities. The action phases were times where the group was mainly *Monitoring*. During monitoring group members were found to be doing things related to coordination, for example managing their interdependence, and updating the group's awareness of the environment, key resources and the activities of other members. This research integrated the investigation of group process with group task work, analyzing *how* groups used information to directly accomplish their task, the *Doing* phase. This research found that groups alternative between these three phases, providing a model of team task accomplishment.

Further the research applied an information lens (Choo, 2006; Marchionini, 1995; Wilson, 1981) to each phase of group activity. It examined how groups identify their needs, find and use information during these phases, integrating frameworks from information science to more fully understand group processes in each phase. The information process at each of the three phases was described through the following eight elements (see also Figure 26):

1. Information tasks (Need, Find, Use);
2. Which had eight different information goals (confirm, decision support, entertainment, fact finding, how to, keep track, make sense, re-find);
3. Requiring a set of 19 information activities (e.g. recognize a need, formulate a query, examine results, extract information and synthesize);
4. Multiple sources (including human);
5. Multiple tools;
6. To create artefacts and outcomes;
7. Requiring shifts in participation
8. And 10 different information roles.

By identifying the core elements of GIP and their relationship, this research deconstructed the complex and dynamic information process required by groups to

maintain awareness and build shared understanding as they work over time. It also provided a set of elements that can be tested with other groups, in other contexts.

This research suggests that groups do not move in a linear fashion from a pre-focus through to post-focus, but instead alternate between phases of doing, planning and monitoring, transitioning between phases as problems were encountered. The cycle of planning, monitoring and doing was related to the task. The groups worked on complex assignments, which included multiple tasks, as such they iterated through these phases (planning, doing, monitoring) multiple times over the course of the project (see Figure 25).

The findings of this research extend our understanding of how information is integrated over the workflow of a group. Specifically, group information process was found to emerge from group interactions, and allow groups to manage their interdependence, and build the necessary awareness and shared understanding. Group information process was found to be a critical aspect of group work. In the planning phase groups worked with information to build a shared understanding of their task, during monitoring phases they exchanged and worked with information to maintain awareness, and shared understanding of their process (who is doing what) and to make any necessary changes or adjustments. Groups' manipulated information to accomplish their actual task during their "Doing" phase, which helped build the shared understanding of the task. This research confirms that groups are a unique level and type of collaboration, with a particular information process which needs supporting.

Extension of Information Behaviour Models to the Group Level

Typically models of information behaviour have focused on the individual information user, or on social or collaborative seeking. This research found that groups represent a unique level, with specific attributes that needed to be better understood. Through applying an information lens based on the models of Wilson (1981), Marchionini (1995), and Choo (2006), and focusing on the key information tasks (need, find, use) this research proposed and conceptualized a new definition of GIP (Section 6.3.1). This definition extended our understanding of the triggers for information behaviour in groups. Group information process was found to be triggered not only by the task (*Doing*) as in past models (e.g. Leckie et al., 1996), but also by the need for *Planning* and *Monitoring*.

Further each of these phases was characterized by different information profiles. This research also identified and described a set of eight elements that comprise a group level information process, as noted above. Each of these elements represented an augmentation of individual models to the group level. Three new information task goals were added by this research: entertainment, keep track, and re-find. Four new information activities were added: signal need, generate, question and clarify and negotiation. Additionally ten information based roles were identified and described: analyst, data analyst, director, editor, integrator, leader, reader, scribe, searcher, and writer.

The elements of group information process were organized into a conceptual model of GIP (Figure 29) which can be used to ground future research. This model built on prior models, emphasizing the activities necessary for the need, find, and use information tasks within groups (e.g. Choo, 2006; Marchionini, 1995; Wilson, 1981).

This model adds to our understanding of information behaviour at the group level by highlighting the process through which information may be "lost" during each task. It integrates the eight elements of group work, and extends the understanding of the particular information activities associated with each task, illustrating how information flows through the tasks into group artefacts and outcomes.

This research also identified specific challenges during GIP. Groups were found to need assistance *keeping track* of information and ideas, they needed to *re-find* information, and had particular difficulty trying to manipulate, analyze and synthesize information collectively. Groups needed a *group information space* to share work in progress, and to remain aware of what others were doing both within and between meetings. To manage their interdependence, remain aware and build shared understanding group members needed to assume roles related to information, and groups needed to manage how shifts in participation affected their information processes. Group information needs are not well supported, and groups required the most time, tools and cognitively intense activities to work with or use information. These findings provide a robust conceptualization of a group level information process, in contrast to individual, organizational or community level information behaviour.

7.1.2 Methodological Contributions

Method for studying Groups

Group researchers reflecting on the progress of group research (e.g., Hackman, 2012; Ilgen et al, 2005; McGrath et al, 2000;) have consistently noted that new methods are required to allow groups to be examined as complex systems that adapt and change over time. This research contributes a Naturalistic Lab Protocol that allowed for the capture of rich, longitudinal data of "natural" groups over the length of time required to complete their real complex tasks. The design allowed for ethnographic data to be collected from groups in a lab. This method was found to provide the following advantages; 1) it allowed groups to be examined in context and "naturally", 2) it allowed for the capture of rich data, and for group level data to be captured, 3) it allowed for the interactions, interdependence, awareness and shared understanding to be traced as they emerge over time, and 4) it can be replicated for multiple groups.

The method included the following elements as also identified in Section 3.4.

1. Participants should be "real" groups that have a mandate outside of the research study

2. Groups bring their own group project – which have goals and objectives outside the research study

3. Groups are allowed to set their own meeting schedules

4. Groups agree to hold all meetings in a controlled setting (such as a Focus Group room), where all activities and actions can be observed and video and audio recorded

5. Groups agree to use computers with tracking software installed (either by installing software on their own computers, or agree to use research computers during their meetings)

6. Groups agree to allow the researcher to become a "silent" group member, included in all group communication

7. Groups agree to complete diaries summarizing their individual work on the group project between meetings if required.

8. Groups agree to individual surveys and a group interview after the group project is completed, if required.

This research applied the protocol in a specific context, to gather data from student groups to examine group information process. How well did this method work? What changes in the elements above are recommended?

In terms of this research elements 1 to 4 worked well, particularly for student groups. Unlike organizational groups students do not have an office, so they are used to using different spaces and rooms to meet. This is "natural" for them. The meeting room provided was in many ways better than other spaces, and software and tools were provided to them as needed. Watching their interactions, it was clear that they did "forget" about the videos and focus on their group and task (see also 7.2.1 below).

Element number 5, the requirement to use the lab computers was a potential limitation, and will be discussed below (Section 7.2.3). Similarly, element 7, the use of diaries were also problematic in this study, and is also discussed below, while element 8 was not able to be applied for all groups. The ability to capture longitudinal data of group interactions is a significant contribution of this method.

Process for Analyzing Group Work

A key challenge at the beginning of this work was the difficulty in separating information tasks from their context – group processes and the work task. Through this research a structured method for deconstructing and analyzed complex group work was created and tested (see Figure 17, Section 3.6.6). This process included identifying phases of activity, then analyzing the information tasks within these phases. While there is a long tradition of coding group interactions, starting with Bales (1950) interaction process analysis, to date there has been no systematic process for coding the information related interactions of groups. This research provides a description of the method and a set of codes that could be used in other group studies.

7.1.3 Practical Contribution

Recommendations for Tools to Support GIP

Designing tools to support collaboration in information seeking and retrieval is a challenging and emerging research area. As noted by Shah (2012; 2014), we need a more robust understanding of collaborative behaviour, better models, theories, and evaluation metrics to support collaborative information seeking (CIS) effectively. This research

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provided rich analysis of the information processes of real groups working on complex problems over time. The needs for support identified through this research, enhances our understanding of how and when collaboration needs to be supported during group work.

Findings included that groups need tools to help them manage their information needs and to use information collectively. They need support both within and between phases of work. The following were identified as key features needed to enhance the information processes of group. At a higher level, accommodating the work of knowledge based groups involves considering their main activities, that groups need to plan (transition phase), do (task phase) and monitor (action phase). Group technologies to date consider these as separated activities, requiring groups to use a range of different tools. Groups need tools to support shifts in participation from individual through to group, to keep track of decisions, ideas, and information, as well as division of labour and how is doing what.   Groups need help remaining aware, even when they are collocated; which artefacts are being updated, and what critical resources should be shared.

In terms of the key information tasks (need, find, and use) this research found that groups need help integrating search into their standard word processing suite of tools. The greatest need was for tools to assist with collectively using information. The student groups observed required multiple types of displays (monitor, white boards, flip charts) to help them see all the relevant pieces of information collectively and determine how they should be integrated. This research suggests that easy to use visualization tools and technologies would add to the effectiveness of GIP.

7.2 Limitations

7.2.1 Does Watching Change Group Behaviour?

A potential limitation of this study is the "Hawthorne effect". The Hawthorne effect emerged from the observational studies of workers at the Hawthorne Plan of the Western Electric Company in Illinois, during the 1920's. The workers studied were found to have increased their productivity during the time they were observed, *regardless* of the changes that were made, and even when the original conditions were restored. "Regardless of the conditions, whether there were more or fewer rest period, longer or shorter workdays…the women worked harder and more efficiently" (Freedman, Sears &

Carlsmith, 1981, p. 49). The implication was that the participants changed their behaviour based on their awareness of being observed, not based on any other factor. While this effect is discussed in the research on observational or "real-world" studies, there is also significant controversy regarding if the Hawthorne effect was real. Recently for example, Levitt & List (2009) re-analyzed the original data. They concluded that there was little evidence to support the Hawthorne effect.

While groups may not change their behaviour solely because they are being watched, they may also be affected by what they believe the researcher wants to investigate (Levitt & List, 2009). When students were recruited for this study, the research was described in terms of studying group effectiveness. The title of the research on the consent form was "Exploring Information Processes in Groups". The consent form included the statement "the overall purpose of this research is to better understand how people work effectively to complete a project." In this way the actual details of the study and the proposed analysis were left vague. Participants could not anticipate the behaviours the researcher wanted to examine. These decisions were intentionally made, to mitigate the chances the groups would change their behaviour to fit.

7.2.2 Social Aspects of Groups

This research was motivated by the recognition that groups have the potential to create novel solutions and generate new knowledge, a potential that is not always met. By understanding more about how groups work with information in a specific context, specific tools and interventions can be created to help ensure student groups meet their potential. However a limitation of this work is that it excluded the examination of the interpersonal, or social, aspects of groups. This was done intentionally, to try and understand the elements, or mechanisms, through which all student groups work with information, regardless differences in interpersonal processes.

However, this exclusion may also represent a limitation of this work. As highlighted by Choo (2007), group members sharing of information is often affected by social aspects including: 1) information as hidden profile; 2) information as cognitive influence; 3) information as social credit; 4) information as social comparison; and 5) information as concurrence-seeking. The suggestion is that these social factors affect information sharing and the use of information resources in groups significantly.

Defining GIP without considering these social impacts may limit the effectiveness of the construct. Yet it was a necessary step to a better understanding of the information aspects of group processes. Planned future research will investigate how the social aspects of GIP can be integrated into the concept.

While integrating the social aspects of GIP was beyond the scope of this work, some interesting social findings did emerge. The seeking of information for "entertainment" was an example of an unexpected finding. It indicates that the "social" phases of groups should be analyzed in a similar fashion to Planning, Doing and Monitoring. Further the information activities generated from this research, such as *questioning and clarifying*, and *negotiating* relate to social aspects of information use within groups. Group members used information to "negotiate" a position, or argue for the relevance of a particular piece of information. The definition, and model of GIP, and description of the elements of GIP proposed in this research may in fact enable a better understanding of the social aspects of information seeking and sharing in groups. For example moments in time when groups were "negotiating" with information could be examined to see the impact – how were artefacts changed? What was included, and what was left out? The method, and the data collected in this research could be further analyzed to more fully understand the relationship between social interactions and GIP.

7.2.3 Methodological Considerations

As noted above, the naturalistic lab design was a methodological contribution of this work. To understand the contribution, it is useful to reflect on the fit of the method for this research. Overall, it was found that aspects of this method worked very well, while some elements need to be further considered.

At the heart of the method was the recruitment of "real" groups, and the ability to record all their activities, both within and between sessions. The video recordings emerged as incredibly rich data sources. The size of the files posed some problems, and would need to be considered in future studies. A large external hard drive was needed to store all the files. Further the videos were extremely challenging to work with and code. As noted by Keyton (2003), the interesting thing about groups is the rich interactions that naturally occur. Often there are overlapping conversations, and much happening through nonverbal communication. While the video captures all this, working with this

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complexity is time consuming, and requires decisions and consistency about what behaviours should be coded.

Unfortunately the log files, which were recorded through Morae, turned out to be problematic. Perhaps because of the type of tablet computers, or the length of some of the meetings, the Morae software did not reliably record all information. If this method was used again the tool for capturing all computer activities would need to be tested to ensure reliability over multiple hours. When the Morae files did work, it was useful to watch them simultaneously with the video, for a full picture of group activities.

To allow for the tracking of computer activities the groups were given tablet computers to use. It is possible that the use of an unfamiliar computer and lack of access to their own files and tools did influence and affect the behaviour of the groups. There was an effort to make any tools or technologies requested available, and to help the group use collaborative tools if requested. Ideally, to fix both the problems with Morae and the need to use lab computers, a tracking tool could be added to all the group members' computers. This would allow them to work with their own tool, but still provide the researcher with the data needed.

Built into the design was the ability to capture different types of data, to allow comparison. The diaries for example were originally designed to gain an understanding of the individual work on the group assignment between group meetings. The diary was electronic, and to prompt members to complete the diary the researcher made the decision to have members complete the diary at the beginning of their meetings. This proved problematic. Answering questions related to their information processes between sessions may have prompted them to think about information seeking and sharing and may have changed their behaviour in the session. Members did comment on the survey, and ask questions about how others were filling things out. Any additional effects cannot be known. The diary could still be an important part of the research design, but it would need to be integrated in a different way.

An interesting part of this method was also the ability to capture data from the groups on their reactions to being part of the study. All groups made some comments, most frequently in their first session about the "strangeness" of being recorded and watched. For the most part however, the groups worked without focusing on the cameras.

If the cameras moved, a member might comment, wondering what the researcher was trying to capture. In a couple of groups (D and G) groups members commented on being concerned in the beginning, but forgot all about it by their final sessions. The most interesting comment was from Group G, at a point where they were struggling to remember what they had just said. A member commented that they should just "Ask Sandra" for the video – this would be better than minutes of the meeting.

The relationship between the research and the groups was kept as separate as possible. The researcher's role could be best described as "Observer –as –Participant" (Pratt & Kim, 2012). Some interaction was necessary to coordinate the logistical details, but the direct intervention during meetings was minimal. In one or two cases the Researcher entered the room to deal with a technical issue. Other than those few instances, all communication happened prior to, or right after, meetings. Email was used to confirm details of meeting times and dates.

There is a long history of observational and ethnographic research in "the wild". In such studies the researcher will immerse themselves in the group, culture or organization for a long period of time, perhaps years (Pratt & Kim, 2012). This research also attempts to be "naturalistic", but is different in a couple of ways. In comparison to ethnographies, the groups in this study were observed over multiple hours, and for some multiple sessions. Yet all the groups were observed over the course of time it took them to complete their class assigned project. While the time might have been shorter, the researcher did in many ways become a silent partner in the projects. The researcher was included in all the group communication, was able to observe all meetings and received the final results.

Finally, while the process of analysis is a contribution of this research, the coding process could also be questioned, in terms of validity and rigor. This research employed a number of checks and balances to ensure quality. To ensure the reliability of the research, the coding proceeded through a series of iterative steps. Each group was considered a case, and was analyzed separately, but building on the one before, and also verifying prior findings. As noted above use of video and log files meant that the group interactions could be examined multiple times. The steps and stages of the coding process have been clearly identified, and the coding dictionary and thick descriptions have been included as

appendices. The researcher consulted with peers throughout the analysis phase (e.g. two PhD colloquiums) and after the analysis was complete a recent PhD graduate coded multiple sections to ensure findings could be replicated.

As noted in the Chapter 3, Section 3.6.8, Cresswell (2007) suggests that researchers use at least two accepted strategies in their research to ensure validity. This research incorporated four of the strategies Cresswell recommends: 1) Rich, thick description (Both Studies) 2) Triangulation (Study 2), 3) Negative Case Analysis (Both Studies) and 4) Peer review and debriefing (both studies).

7.2.4 Participants

Students were used for this research. The findings cannot be generalized beyond this population. The particular activities observed during this research may be specific to the tasks and the groups. It is interesting to note however, that groups in the workplace are becoming more similar to student groups, where members are brought together for shorter periods of time, to handle specific complex tasks, as noted by Edmondson (2012). This concept of "teaming" has more in common with student groups than the more traditional stable workplace groups.

The groups in this research were also examined in meetings, when they were collocated. The aim was to see natural behaviour in the optimal setting for communication – face to face. Whether the processes would change in a virtual mode cannot be known without further research.

7.2.5 Changes in Technology

An objective of this research was to examine both technology use, and the need for technology with within groups, to accomplish their information tasks. As such the study did not specifically introduce any technologies, but the groups were encouraged to identify any needs for tools that they had. A limitation of this aspect of the method, relates to the rapid changes in technology over the period of time the data was collected and analyzed.

The data analyzed in this study was gathered from 2007 to 2010. Technology, especially group collaborative and cloud based technologies have changed substantially over this time. It is possible, perhaps even likely, that if the same student groups were

observed today their use of tools might have substantially changed. The options for collaborative writing such as Google Docs have increased; group can share citations through tools such as RefWorks, and share documents through Google Drive, Dropbox, OneDrive or iCloud. The use and prevalence of social tools have also increased dramatically since 2007. For example Twitter was just emerging in 2007, but now is a key source of information.

Devices have also changed significantly. In addition to laptops, students frequently use iPads and tablet devices, as well as use of smart phones for email, search, and communication. In meetings, for example, group members today may be just as likely to search on their phone as on a laptop. The change in technology, combined with the fact the participants did not use their own computers may have affected the behaviours observed.

Looking at the technology related findings, it was suggested groups needed better tools to keep track of things. It is possible that groups, and group members might use Dropbox, Google Drive or One Drive, or even notes on their phones to better keep track of things. The logistical or scheduling challenges of groups might be better facilitated by tools such as Doodle polls, or better scheduling capabilities in Microsoft office. There are more tools to visualize information, although whether they are in popular use is debatable. Groups could more easily take a picture of artefacts created on a white board, and send to all members, reducing the need to type them into a document. Some groups and group members might have experience with smart boards. All these changes may limit the findings of this study with regards to technology use and needs.

As described in this research however, recent studies of collaboration (Morris, 2013) indicate that people are still not generally using collaborative tools for search. Further, recent research by Voida, Olson & Olson (2013) identifies that graduate students might be finding it *more* challenging to share and manage work in groups. While cloud based services such as Dropbox, Google Drive and iCloud are being used to collaborate, individuals still have challenges in keeping specific group folders separate from personal folders and work, agreeing on a platform that meets all group member`s needs, and dealing with different norms around document creation and editing.

7.3 Future Work

This research represented foundational work to better understand a particular phenomenon; group information process. The conceptual model and framework of GIP can be used to frame future research. Other types of groups and other modes (i.e. virtual groups) could be examined to test and refine the conceptual model, and to see if the elements of GIP are confirmed.

The aim of this research was to examine how the key information tasks (Need, Find, Use) were negotiated over the entire time needed by groups to complete complex projects. To accomplish this, *all* of the video and data were examined to see the broad patterns. This was a choice, guided by the research questions.

With such rich data it is also possible, and more common, to do a more fined grained or micro analysis of moments in time of each of the Phases. Through different methods such as discourse or conversation analysis, a rich understanding of each of the information activities could be gained, for example, or the shifts between phases or between activities.

Based on the findings in this research, the following is planned to further the understanding of information needs, seeking and use at the group level.

1. A deeper examination of the activities related to the information need task in groups (identify need; signal need; understand need), particularly when are needs accepted, and when are they ignored. What is the relationship between social aspects of groups and ignoring information needs? Needs represent an opportunity for groups to introduce new and different information. Understanding more about why this does, and does not happen, and interventions or tools that might enhance the need task might help groups move beyond the "common" information problem.

2. Examine the triggers at the information find task that shifts groups from sharing information to seeking experts or searching through databases. Prior work on these triggers (e.g., Fidel et al, 2004; Reddy & Jansen, 2008) has isolated specific triggers. The further analysis of the episodes in this research could add to this understanding.

3. An examination of the activities related to information use. In particular how the information activities during the use task are translated into changes in artefacts and documents, and the relationship between information use in groups and the building of shared understanding. This would contribute to the understanding of group cognition, and transactive memory systems.

4. A focus on the transitions between the phases of group activities (Planning, Doing and Monitoring) and how they can be better integrated and supported. This research would focus on looking at GIP across phases, and how the holistic process of groups can be better supported

5. Examination of the social phases of groups, to integrate the social into the model of GIP.

All of these research threads involve the examination of the relationship between group, information and task process. In addition it would be interesting and useful to examine the relationship between group information process, and the larger context, to integrate the middle of the model (Figure 3) back into the larger framework (Figure 2)

7.4 Concluding Remarks

> "(we) must rise to the challenge to move information seeking from search engine support that provided discrete items in response to simple queries to tools and services that support reflective and interactive search over time and in collaboration" (Marchionini et al, 2009, p. 6)

This examination of student group information process was designed to respond to this challenge. By examining how information needs emerge and are resolved in real motivated student groups, who worked on complex course projects over time our understanding and conceptualization of group information process has increased. The research examined a complex phenomenon in situ, and added to the understanding of a particular type of group, of their information process, and provided concrete suggestions for interventions and tools to enhance GIP and group effectiveness.

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APPENDIX 1 GLOSSARY

Artefact – a multi-authored document, diagram, chart or illustration created by the group, containing information integrated from multiple sources.

Awareness – a term used to represent for the need for consistent information about group members' progress. Different types of awareness needs have been identified including social awareness, presence awareness, action awareness, workspace awareness and situation awareness (i.e. Gutwin & Greenberg, 2001; Neale, Carroll & Rosson, 2004; Carroll, Rosson, Convertino, & Ganoe, 2006).

Course Project– The project assigned to the groups by their course Instructor. The assigned tasks were not controlled in this research, and the researcher did not participate in the creation of the assignments, or how the assignments were carried out. Their course projects formed the experimental task(s) for each group.

Collaboration - Collaboration is used as an all-encompassing term for any activities that are accomplished by more than one person. Collaboration can vary in terms of key factors such as degree of integration (formal vs. informal), location (co-located vs. distance) and time (synchronous vs. aschronous). For example individuals can be said to collaborate through the use of social tagging tools. Individual use the tags of others to help them, but there is not a joint task or formal agreement, and they do not need to be in the same space or time. Groups, working together on joint task are also said to collaborate. This research examines a particular type of collaboration, the collaboration of co-located synchronous formal student groups.

Collaborative Information Behaviour -"the study of collaboration with, through, and in relation to information; along with the systems and practices that support this" (Foster, 2010, p. xiii)

Collaborative Information Seeking and Retrieval -"The study of the systems and practices that enable individuals to collaborate during the seeking, searching, and retrieval of information". (Foster, 2006, p. 330)

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Collaborative Information Seeking - "information –seeking activities performed by actors to inform their collaborative work combined with the collaborative-grounding activities involved in making this information part of the actors' shared understanding of their work" (Hertzum, 2007, p.960)

Find - See information retrieval

Goal Specification – One of the transition phase processes, defined as "the identification and prioritization of goals and sub-goals for mission accomplishment". (Marks, Mathieu & Zaccaro, 2001)

Group /Team - These terms are used interchangeably within this work. Groups are "collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, maintain and manage boundaries, and are embedded in an organizational context that sets the boundaries, constrains the team, and influences exchanges with other units in the broader entity" (Kozlowski & Bell, 2003, p. 334)

Group information process (GIP) - involves members' interdependent acts involving information tasks and activities, tools and sources that enable groups to manage their work tasks and work together over time

Group Processes – Sometimes called group interactive processes or team processes. For clarity and to build on prior research, this research uses the following definition for this concept: "members' interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioural activities directed toward organizing taskwork to achieve collective goals. (Marks, Mathieu & Zaccaro, 2001).

Information Activity – the series of actions necessary to carry out information tasks (i.e. identify a need, extract information, synthesize) Toms, 2011.

Information Behaviour - "totality of human behaviour in relation to sources and channels of information, including both active and passive information seeking, and information use" (Wilson, 2000, p. 49).

Information Need (NEED) – a composite of activities related to recognizing a need for information and understanding the problem situation. One of the three key information tasks.

Information Retrieval (FIND) – composite of activities related to looking for information, either from information systems or from people.

Information Seeking and Retrieval Episode - Represents a compilation of needs, finding and using. Periods of time when the main activity of the group, or a group member was identifying a need, finding and using information.   Toze, McCay-Peet & Toms, 2011

Information Seeking Behaviour - "the purposive seeking for information as a consequence of a need to satisfy some goal." (Wilson, 2000, p. 49)

Information Sharing – the "voluntary act of making information available to others" (Davenport, 1997 p. 87).

Information Task –tasks with goals related to working with information (e.g., finding, needing, using) (Wilson, 1999, Choo, 2006). Information tasks provide the motivation for the information behaviour.

Information Task Goals – The motivation for information seeking behaviour.

Information Use (USE) – "consists of the physical and mental acts involved in incorporating the information found into the person's existing knowledge". (Wilson, 2000, p. 49). This definition has been extended to consider how groups integrate information into their shared understanding as observed by the changes in their joint artefacts. Information use is a core information task.

Interaction - see Group Processes

Interdependence – Group members are mutually dependent on each other to achieve their shared goals and manage their processes. To manage their interdependence groups need to share information, coordinate their activities, maintain awareness, monitor their progress and manage conflict.

Participation – active involvement in the process or task. Participation is determined by identifying through observation which members are engaged in the activity, by their verbal or non-verbal communication, gestures or

Phase – see stage

Role – a description of the particular responsibilities group members took on to accomplish the information tasks and activities.

Shared Understanding – shared mutual knowledge, beliefs and assumptions within groups as they work together over time (Clark & Brennan, 1991). Shared understanding is considered a critical part of team learning.

Source – a person, thing or digital object that is used to provide information.

Session – A single meeting of a group.

Stage –The period of time when a group was engaged in one particular activity. For example groups first start working members often go through a process of general greeting, and then move to focusing on a particular task. While group activities are fluid, there is generally a series of core activities or that can be identified and marked in terms of a start and stop time.

Tool - any electronic or physical objects used to assist in the manipulation of information; such as laptops, cell phones, databases or word processing packages.

APPENDIX 2 RECRUITMENT FLYER

Wanted for a Research Study

Have you ever wondered how you can work more effectively in groups? We are looking for interested groups to volunteer to be a part of our study.

We want you to have your group meetings in our Groupwork Lab on the second floor, while you work as you normally would on your class assignment.

Participation is voluntary and will be kept confidential.

An honorarium of $30.00 will be awarded

Time required: approximately 2 hours

Make an appointment by calling
494-8392
or e-mailing HCI@dal.ca
or dropping in to Suite 2010, 2nd Floor, Rowe Management Building

Sandra Toze
Principal Investigator

DR. ELAINE TOMS
PHD SUPERVISOR

Faculty of Management, Dalhousie University

APPENDIX 3 RECRUITMENT ANNOUNCEMENT

This script was read in selected classes which had significant group assignments

Have you ever wondered how you can work more effectively in groups? I am a PhD student who is are currently beginning a Research Study that will look at how groups search for, find, integrate use and share information while working collaboratively on projects. We are looking for interested groups to volunteer to be a part of this study.

We want you to meet in our Groupwork Lab on the second floor. The room has video cameras and microphones built into the room which we will use to record your meetings. Here, you can use our Tablet PCs which access the Internet to do your work. Over the rest of the term, you can book the GroupWork lab for the project.

We also have some special technologies that you can use to help when you are not together. These are meant to be time savers, and we will give you a tutorial on how to use them all.

Each week we will ask you to use a website to fill in a digital diary; this will take about 2-3 minutes and can be done anywhere in the world. In addition, we will ask you to fill out a couple of surveys, one at the beginning and one at the end, and participate in a group interview.

Overall, the time required will depend on how long it takes you to do your project. We expect participating in this study will require you to spend about two hours in addition to what you will spend on your project.

Participation is voluntary and confidential, and we will not inform anyone including your instructor about your participation.

For your efforts, we will supply a $30.00 honorarium. This will be given in two lump sums. Part-way through the completion of your class project, we will re-evaluate your participation as a group. We do not want this to be too onerous for you; on the other hand, we need valid research data. If you find that you cannot meet in our Lab or complete the diaries for example, then it may be best to discontinue the participation. If a group opts out at this point, we will provide $10 per person to acknowledge your contribution to the research.

If you would like to discuss this further, please contact us. Any groups interested in volunteering for this study can contact us by calling 494-8392, or emailing: hci@dal.ca. In addition, we will be available just before and just after class in room 2018 today.

If you have any questions I would be happy to answer them now.

Thank you for your time.

APPENDIX 4 DEMOGRAPHICS AND PRIOR EXPERIENCE QUESTIONNAIRE

Demographics and Prior Experience Questionnaire

Part I Individual Experience

People perform many tasks each day on an individual basis.

How many hours a week do you use the Web (other than e-mail)?
- ☐   I only use the Web for email
- ☐   Less than one hour
- ☐   1-5 hours
- ☐   6-10 hours
- ☐   More than 10 hours

How often do you use the following?

	Day	Week	Month	One or more times per Infrequently	Never
e-mail	☐	☐	☐	☐	☐
Web searching	☐	☐	☐	☐	☐
chat rooms	☐	☐	☐	☐	☐
instant messaging	☐	☐	☐	☐	☐
video or audio conference	☐	☐	☐	☐	☐
facebook (or other social tools)	☐	☐	☐	☐	☐
blogs	☐	☐	☐	☐	☐
other: _____	☐	☐	☐	☐	☐
other: _____	☐	☐	☐	☐	☐

Part II Group Experience

Group experiences can include a variety of activities from working with peers on academic assignments, producing a document for a business with colleagues, playing on a soccer team, or organizing an event with other student council representatives.

In what kind of group experiences have you participated?
- ☐   Student group to complete an assignment
- ☐   Team member – university activity
- ☐   Team member – high school or community activity
- ☐   School-related non-academic activity (e.g. yearbook)
- ☐   Trip-planning for a group
- ☐   Work-related activity (e.g. created a marketing brochure as a group

How much experience have you had working in groups
- ☐   I work in groups frequently (more than 10 times)
- ☐   5 to 10 times
- ☐   2 to 4 times
- ☐   I have only worked in groups once
- ☐   I have never worked in a group

5. Given an opportunity, to what degree would you rather work in groups or individually?

Individual   1   2   3   4   5 Groups

6. To date, has your work in groups involved working with:
- ☐ friends
- ☐ new colleagues
- ☐ both

7. Which do you prefer?
☐ friends
☐ new colleagues
☐ does not matter

8. Has your past experience with group work tended to be voluntary or imposed?
☐ voluntary
☐ imposed

9. How many people do you prefer to work with?
☐ no one; I prefer to work alone
☐ one other person
☐ two to four people
☐ five or more people?

Part III Personal

Which high school/college/university diplomas/degrees have you *completed*?
☐   high school
☐   college diploma: discipline(s): _____
☐   undergraduate: discipline(s): _____
☐   masters: discipline(s): _____
☐   doctorate: discipline: _____
☐   professional degree (e.g. M.D.): specify: _____
☐   other: specify: _____

Which high school/college/university diplomas/degrees if any, are you *currently working on*?
☐   high school
☐   college diploma: discipline(s): _____
☐   undergraduate: discipline(s): _____
☐   masters: discipline(s): _____
☐   doctorate: discipline: _____
☐   professional degree (e.g. M.D.): specify: _____
☐   other: specify: _____

What is your gender?
☐   Female
☐   Male
☐   Prefer not to respond

What is your age group?
☐   18-20
☐   21-23
☐   24-27
☐   28-30
☐   31-33
☐   34-36
☐   37-39
☐   40-49
☐   50 or more

APPENDIX 5 DIGITAL DIARY

Part A

1. Check any of the following activities which the represent your activities this week on your group Case Project:

A. Planning
- ☐ Identifying the problems in the case
- ☐ Planning how to complete the task
- ☐ Other (specify) _____

B. Gathering Material/Research
- ☐ Searching for pertinent information to support you analysis for the case
- ☐ Discussing with other group members any information you have found
- ☐ Discussing with group members any search strategies
- ☐ Planning for more searches for information
- ☐ Discussing potential sources of information
- ☐ Other (specify) _____

C. Writing
- ☐ Taking notes from the information you have found
- ☐ Writing a draft
- ☐ Revising the draft
- ☐ Other (specify) _____

D. Assessing
- ☐ Discussing the information you or others have found
- ☐ Discussing the draft copy of your assignment
- ☐ Determining whether you have sufficient information
- ☐ Other (specify) _____

E. Revising, Editing, Proofreading
- ☐ Evaluating your work
- ☐ Discussing the merits
- ☐ Rewriting
- ☐ Pulling parts together
- ☐ Other (specify) _____

F. Other   Please list any other work you did on the group project.

2.   Of the activities you selected above, what percentage of time did you spend on each?
- _____ Planning
- _____ Gathering/Materials
- _____ Writing
- _____ Assessing
- _____ Revising, Editing, Proofreading
- _____ Other

Part B

1. What were you biggest challenges this week in terms of working on your assignment? These could be personal (lack of trust, lack of motivation, lack of leadership, time management issues), technical issues, or even environmental (it was too nice outside to work!)

2. When you were looking for information for your assignment, and evaluating it, using it in your report or sharing it, did you do all these things alone? When did you interact with others?

3. Did you learn anything that was interesting or novel from other in your group this week, that would help you in other group projects?

4. How did the technology you used help in working on your group project this week? What other technologies might have helped you work more efficiently?

APPENDIX 6 POST STUDY INDIVIDUAL SURVEY

Part A

It was very easy for me to get information from other team members when I needed it.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

There were disagreements in my group about who should be doing what task.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

Each member of my group had a clear idea of the group's goals.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

I always received the information I needed from other group members on time.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

I often found myself duplicating work that other group members had done.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

People in this group were able to do their jobs without getting in each other's way.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

There were disagreements in my group on what plan to adopt for our project

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

My group knew exactly what things it had to get done.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

Tasks were clearly assigned. I knew what I was supposed to do.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

Schedules were clear. I knew when I needed to have tasks completed.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

It was expected that group members would provide information if it could help other group members.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

In this group, it is expected that any information that might help other team members would be provided to them.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

It was expected that we keep each other informed about events or changes that may have affected other group members.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

I often talked to people outside my group to obtain the information I needed.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

Sometimes members of my group talk about how we could have handled the project differently.

_____
1   2   3   4   5
Strongly disagree   Neutral   Strongly Agree

My group usually considers the different perspectives of various group members when deciding how to proceed with the group project.

_____

1	2	3	4	5
Strongly disagree		Neutral		Strongly Agree

My group often used ideas developed in group discussions to solve specific problems.

_____

1	2	3	4	5
Strongly disagree		Neutral		Strongly Agree

My group used ideas developed in discussions to set new project goals.

_____

1	2	3	4	5
Strongly disagree		Neutral		Strongly Agree

Part B

1. In your opinion, how would you rate your finished project?

2. What do you think contributed the most to the success (or lack of success) of the group?

3. Did you enjoy working with your group on this project?

4. What were the biggest barriers or issues (if any) you faced as a group?

5. How did this group experience compare to working with other groups?

6. Would you work with this group again?

7. What do you think you gained (if anything) as an individual during this project?

APPENDIX 7 SEMI STRUCTURED GROUP INTERVIEW

1. Tell me about what your group was trying to accomplish…

2. Did you stick to a plan, or did your task change as you moved through the stages?

3. If it changed, what caused the change?

4. How would you describe how you worked together?

5. Did you enjoy this group project?

6. How would you rate your end result?

7. What do you think contributed the most to your success (or lack of success)?
8. What were the biggest barriers or issues (if any) you faced as a group?

9. Do you think you were all motivated to do a great job?

10. Did you trust that the other group members would do their part to a level you would be happy with?

11. Did a leader emerge during the process? Was this consistent throughout?

12. Did you need to search for information? How did you do this?

13. How did you share information within the group?

14. Did you feel like you were all aware of what others were doing?

15. Did you end up duplicating work someone else had done?

16. What technologies did the group use? Did they help you work together? Was there a way technology could have helped more

17. What (if anything) did you personally gain from being a member of this group?

18. If you had to accomplish the same goals again, would you do anything differently?

19. How did this group experience compare to working with other groups?

20. Would you work with this group again?

APPENDIX 8 POST PARTICIPATION DE-BRIEFING EMAIL

Dear Participant;

Thank you for your participation in our research study. The purpose of this research is to understand the process of groupwork, particularly information flows, so we can design tools to support group processes, and enhance group learning. Your data, along with the data from other groups will be analyzed to identify and better understand such processes as the stages of groups over time, task related activities, information related activities, and use of technologies. All information that you provided directly, and that was captured during your group project will be kept both secure and confidential. The results of our analysis will be reported without any reference to you specifically.

Now that you are fully informed, we want to remind you that your participation is voluntary. Please let us know if you would like to like us to keep your data intact for the study or if you would like to have your data removed. If we do not hear back from you by January 10th, 2009, we will assume your continued participation. Your reply to this email will be kept confidential and will not be shared with your instructor.

If you have any questions, on this or any other matter pertaining to the study, please do not hesitate to contact me at Sandra.Toze@dal.ca or 494-2488.

Sincerely,

Sandra Toze
Principal Investigator
stoze@dal.ca; 494-2488

And

Dr. Elaine Toms
PhD Supervisor

APPENDIX 9 DESCRIPTION OF PROCEDURES AND CONSENT FORM

Exploring Information Processes in Groups

Sandra Toze, (494-2488); stoze@dal.ca)

Introduction
Thank you for participating in this research study. This research is affiliated with Dalhousie University. Your participation is voluntary. You may participate if you are 18 years or older and conversant in English. You may withdraw from participation at any time, and you may decline to answer any question. Please note that we are seeking participants who are willing to have their work on a group project be observed, and who will hold their group meetings in the iLab Groupwork Lab.

Purpose
The overall purpose of this research is to better understand how people work effectively to complete a project.

What you will be asked to do
In this study you will work within your class group to complete your class assignment, as you normally would with the following exceptions:
1. All physical meetings will take place in the iLab Groupwork room, which you will be able to book during the term for the purposes of completing this assignment. All activities in this room will be videotaped;
2. All communication between meetings will be through a collaborative technology (Email, Blackboard, Wikis, Blogs, Facebook), with the researchers present as observers; the choice of technology will depend on your group;
3. During your group meeting in the Lab, you will be assigned a tablet computer for your use in that lab; all actions will be recorded using special logging software;
4. From the week in which the assignment is assigned to the week in which your group submits the assignment, you will complete a diary entry once per week (approximately one page);
5. After you have submitted your assignment, you will complete a short questionnaire about the experience and participate in a thirty-minute semi-structured group interview, which will also be videotaped;
6. At the end of the study, each group will be asked to release its evaluation on the assignment to the researchers. A separate form will be given to request this permission. If any member of the group does not authorize the release of the grade, the group will still remain part of the study, and the researchers will assess the quality of the assignment;
7. The audio portion of the videotapes will be professionally transcribed. The transcription firm that we use has already signed a non-disclosure agreement, protecting the privacy of participants and the integrity of the data.

In addition to your group project which is required as part of your course, we anticipate that you will spend no more than two hours completing the other activities needed for our research.

We greatly appreciate your contribution to our research. We also understand that this is a long term commitment over a couple of weeks. Within two meetings of the group (or within two weeks of starting the class project), we will meet with your group to re-evaluate participation. If the group members feel the commitment is too much, or if the researchers feel that the group is not meeting the requirements (#1 to #4 listed above), the group will be withdrawn from the study.

After you have read this document, we will respond to any questions or concerns that you may have. After formally agreeing to participate, we will first ask you to complete a short questionnaire about your previous Web experience, your background and experience working in groups. Then, you will then be given a short tutorial on the technologies necessary for this study.

When completed, the results of this study will be posted on the iLab Website.

Risks/Benefits
There are no known risks to participation, but you will have a learning opportunity. You will learn something about working in groups, and may learn something about groupware software, and the use of tablet computers.

Compensation
While we cannot compensate you for your time commitment, we will provide an honorarium of $30.00 that will be given out according to the following schedule: $5.00 at the checkpoint (as described above) and $25.00 after the interview in the final session.

Confidentiality & Anonymity
Your participation in this study will not be shared with your instructor or anyone else. But, because this is a group activity, your participation and comments will be observed by other participants. We ask that participants respect the confidentiality of the session, but this cannot be guaranteed. The results of your participation in the group-work will be reported without any reference to you specifically. All information that you provide will be treated confidentially and your identity will not be revealed in reporting the study results. Your name will appear only on this sheet and this sheet will be stored separately from any data collected for this study. No names will be attached to the videotape or to the computer and/or paper files. The video tape will only be used by the researchers for the purposes of data analysis only. While reviewing and analyzing the data and materials, short quotations will be selected to include in the final report; however, the quotes will reflect the study's interests and not the identity of any of the participants.

Data Retention
All video and digital files will be retained in a locked cabinet in the research office for five years as per Dalhousie University's policy, after which the files will be deleted or destroyed.

I, _____, have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered to my satisfaction. I hereby consent to take part in this study knowing that short quotations will be selected from all the material in order to highlight topics of interest to the study, and that sessions will be video-taped. However, I realize that my participation is voluntary and that I am free to withdraw from the study at any time.

_____   _____
Participant's Signature   Date   Researcher's Signature   Date

In the event that you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, you may contact Patricia Lindley, Director of Dalhousie University's Office of Human Research Ethics Administration: (902) 494-1462.

Phase of Activity
After the group meetings had been described in terms of stages of activities, the stages were classified according to the following Group Activity classification scheme.

Phase	Definition	Example	Origin
Planning	Periods of time when the core activity of the group was related to discussing plans or strategizing how they would accomplish their overall project or a specific task.	The group could be observed to be reading the project guidelines and discussing their overall goals, and how they might achieve them. The group might also be observed to be discussing different strategies or ways of achieving their goals, or challenges with their goals.	Adapted from Marks et al. (2001) Transition phase which was defined as "periods of time when teams focus primarily on evaluation or planning activities to guide their accomplishment of a team goal or objective" (p. 360)
Monitoring	Periods of time when the group stopped their task activities to check their progress against their plans and goals, and made adjustments	The group could be observed to be coordinating their activities – for example a member might say "have we addressed all the factors"? Another example would be the group checking their progress against time, and adjusting the roles of different members to work more efficiently.	Adapted from Marks et al. (2001) Action phase which included the following dimensions: 1) Monitoring Progress; 2) Systems Monitoring; 3) Team Monitoring/Back up Behaviour; and 4) Coordination.
Doing	Periods of time when the group was working directly on their course project	The group could be observed to be working on tasks that were part of their group project. These varied by group but included working on the matrix, surveys, creating a flow chart, or creating a presentation. Doing was classified into the following work task goals. • Decision Making- Choosing between options • Generating- Creating or producing something new (Brainstorming) • Problem Solving - Course of action to resolve a specific problem.	Generated from the research
Social	When the group was socializing, or talking about events, hobbies or activities.	During these times the group might be talking about other courses, social events, or other things outside the scope of their work together.	Generated from the research. This classification included the Interpersonal processes identified by Marks et al., 2001.

INFORMATION TASKS

Definition: Information tasks are tasks with goals related to working with information

Note – in each phase a group might be engaged in multiple information tasks.

Information Tasks	Definition	Examples
Needing	Involves activities related to a group (or member) recognizing they need information, signaling that need to the group, and discussing the need to better understand it.	A member comments on a need to find information for a range of purposes. It could be they need information for the task, to coordinate activities with other members or for technical reasons (i.e. they cannot open a file, or edit a PDF). Other members might ask clarifying questions to better understand the need.
Finding	Any steps a group or member takes to resolve an information need by looking for information through any medium.	A group member might be observed to be flipping through their notes to locate information. A member might use the computer to access the internet, and type a query into Google, or might search through a database for information. Also included times a group member used a phone to call a friend or expert, or texted someone requesting information. The common thread is that there was an active search for information.
Using	Times when the groups were actively using information they had found or shared. Includes activities related to extracting information, clarifying, synthesizing or generating.	An example of a using task is when the Group members were actively working together to construct a group artefact (i.e. flow chart, matrix, document, presentation)

INFORMATION TASK GOALS

Information goals represent the motivation for the information tasks described above. The eight information goals identified were as follows:

Goal	Definition	Example	Origin
Confirm	Information is found and used to verify another piece of information.	A member or the group could be observed to be looking for information in response to a request to confirm information they are considering. This might be prompted by a member asking another to confirm, or by a member deciding directly.	Taylor (1991); Choo et al (2007)
Decision Support	Information is found and used by the group to balance information in order to make correct choices	In Group F for example, members searched for information to make a decision regarding the class trip they were planning. They collected information regarding specific species, distance, and chance of seeing the animals. This information helped them make a final decision.	Limberg (1999); Freund, 2008
Entertainment	Actively looking for and watching information for fun, to entertain group members.	A group member found a You Tube video and played for the group for fun.	New Goal – Generated from this research
Fact Finding	Information is found and used to determine the facts of a phenomenon or event, to describe reality.	For example in Group F there were multiple times when a member looked for information to answer a fact based question Examples included - Is that an International organization? When was it founded?	Choo (2007); Taylor (1991), Limberg (1999) and Freund (2008) Find Facts
How to	Information is found and used to answer questions such as *How do we?* Or *What do we need to do?*	The group or members needed to find information to determine how to complete the matrix for example. They would read the coding instructions, then discuss, and then ask and expert to make sure they were on track.	(Freund, 2008; similar to Instrumental Taylor (1991)

Goal	Definition	Example	Origin
Keep Track	The group works with information to ensure information is not lost, but that it is saved somewhere to be used again.	A group or a group member comments on the need to keep track of a specific fact they found or decision they made. This code was used for times when the goal of keeping track was specifically articulated in some way. For example comment were made using words like "let's keep track of this", or "we can't lose this", or "write this down".	New Goal - Generated from research
Make Sense	Find or use information to better understand or make sense.	Relates to times when the group had commented that they did not understand something. For example Group F in particular had to locate background information on specific topics to ensure they had enough contextual information. Information tasks related to "make sense" involved looking for more general, broad information rather than a specific fact.	Like problem understanding (Taylor, 1991); Sense-Making, (Devin, 1998; Choo, 2006)
Re-Find	Information needs to be re-found, as it has been lost.	A group member might re-search for something they had located earlier, or in another meeting.	New Goal - Generated from Research

INFORMATION ACTIVITIES

Information activities are the series of actions necessary to carry out information tasks. 19 Information Activities were identified associated with the key information tasks.

Task	Activity	Definition	Example	Origin
Need	Need Recognized	When at least one member of the group realizes they need information to complete their task work, or to manage the process of working together. Cannot observe this until the need is signaled.	The moment prior to a member signaling the need for information. Relates to a situation where a need for information emerges. To find this you need to look for the discussion of the need, and then find the situation that prompted it.	Marchionini 1999

Task	Activity	Definition	Example	Origin
	Signal Need	Group member(s) asks a question or prompts the group to for information.	Member asks a question, or highlights that they need to know something.	Emerged from research
	Understand need	The group, or part of the group has a discussion centred on clarifying the need for information... for example what would help - where they could find it etc.	A member specifically refers to a book, website, article, news story where information could be found. Or a member might ask more questions to help refine the need.	Marchionini, 1995
Find	Formulate Query	Activities related to determining what to type into the search box	A member opens a search box and prepares to enter a query.	Marchionini, 1995
	Execute Query	execution of a query by clicking on the "search" button, following links within results, webpage, or information object, or clinking back or forth function and following links from within an information object	The member hits search.	Marchionini, 1995
	Examine Results	Examination of results or surrogates.	Member or members can be seen to be actively scanning the results of a search.	Marchionini, 1995
	Reformulate Query	Modification of an existing query or composition of second and subsequent queries	Member goes back to a search box and changes their query.	Toze, McCay-Peet & Toms, 2011
	Select Search System	Group or member determines the best route to find information (i.e. notes, computer, cell phone)	Members choose to flip through notes, open a book, read an article or turn to a computer.	Adapted from Marchionini, 1995
	System Set-up	Logistical steps to prepare the system that will be used to search for information	The physical activities related to ensuring the computer is plugged in and working.	Toze, McCay-Peet & Toms, 2011
	Request for Assistance	Group needs to consult with Instructor, or a key person external to the Group to move forward with their task	Group is seen emailing, texting, calling or leaving the room to meet with an "expert"	Emerged from this Research

Task	Activity	Definition	Example	Origin
	Reflect and Iterate	Summary evaluation or assessment of information found and not found.	Members are actively discussing or debating the information they have found –either through a search or though sharing. Relates to sufficiency – is the information found enough.	Marchionini, 1995
	Share	Times when ta group member voluntarily made information available to others, in response to a need	Times when information was made available within the group, member to member based on their prior experience or knowledge.	Davenport, 1997, p. 87
Use	Analysis	Group needs to examine information and assess its usefulness to help make a decision, solve a problem etc.	Group is assessing the information not in terms of what is missing, but in terms of its usefulness to complete their task, to plan or to monitor. Relates to relevance.	Blake & Pratt, 2006a
	Extract Information	The process of extracting information by reading, scanning, listening to information found in information object. In a group situation includes discussion. Refers to not only extracting information from found information, but also from shared information.	A member might specifically read out a piece of information – and another might add it to a group artefact.	Marchionini, 1995; Blake and Pratt, 2006
	Generate	Group members use different pieces of information to create something new	Group members can be seen to create something new, based on multiple sources of information.	Emerged from this Research
	Negotiation	Activities related to group members discussing and debating the relevance of information	Negotiation involves a difference of opinion. For example a member might say –"I don't agree …" and provide information to support a different point of view.	Emerged from this research

Task	Activity	Definition	Example	Origin
	Questioning or Clarifying	Actions related to group understanding. To make sure all members have the same understanding of the information being discussed individual members asks questions, restate or clarify (Did you mean…?). Different from verification, which was used to code times when the group wanted to confirm an external fact or decision.	Members probe or ask questions to ensure everyone has the same understanding. An example might be that a member asks "what do you mean by x" or asks "so you mean that…"	Emerged from Research
	Synthesize	Process by which a group assesses information (both found and shared) and attempts to fit things together, and assess patterns.	Members can be observed to be working with information from multiple sources, and attempt to synthesize into a common artefact.	Talja & Hanson, 2006
	Verification	Actions related to confirming a fact or decision that the group had made	Members ask a question related to a decision previously made – to ensure that they still agree	Blake & Pratt, 2006a

TECHNOLOGY NEED

Related to times when the group articulated the need for a specific feature or technology that would aid their work. Members might specifically ask for a piece of software for their analysis, or might have more generally commented on a problem they were having working with information.

Technology Need	Definition	Example
Bucket for Valuables	The group sometimes commented on the "value" of a thought - and wanted to make sure it was "noted" or "kept track of" for use later. The need expressed was for a safe place where they could put something precious, that they did not want lost. This is related to the "keeping track" code, but relates to the need for a "space" to solve the problem.	A member specifically comments that "this is important" and that "we need to keep track of this".

Technology Need	Definition	Example
Group Space	Times when the group talked about the need to have a "group" space to keep things. Groups commented on options with course systems such as BbLearn or Google docs, but did not use them. Wanted a simple, seamless way to keep work coordinated, and remain aware of what others were doing.	A member or the group discusses that they need a common space to share information, drafts, and keep up to date with what others are doing. A mix of sharing and awareness related features wanted.
Group Visualization Tool	Times when the group commented specifically on needing a tool to help them "see" all their information together.	A member or the group comments on the difficulty synthesizing information and the need to see it integrated in a different format.
Technology Problems	When an individual or a group has problems with technology. Not when they need something they don't have (that would be technology need), but when they can't use what they have. For example the computers were slow - problems with wireless etc.	A group or a member specifically comments that something is not working. Examples included the internet not working, computers being slow or frozen, or the Dal network not being available.

1. ROLES

The Roles reflect points in time when individual group members took on a specific role or part relating to the group's Information Tasks. Ten different roles were identified.

Role	Definition	Example
Analyst	The analyst examined the information found to determine its meaning or relevance for their project.	Group member(s) were observed to take on a role related to analyzing the information collected. Related to the Information Use task.
Data Analyst	The data analyst performed statistical analysis using SPSS.	Group member(s) were observed analyzing data using SPSS. Related to the Information USE task.
Director	The Director coordinated activities or tasks to help with planning and efficiency.	A group member was observed to coordinate activities by assigning tasks or activities. Different from the leader as the role was focused on coordination rather than planning or leading.
Editor	The editor proofread and made content changes to a document.	A group member was observed to take on the job of editing an artefact within the session.

Role	Definition	Example
Integrator	The integrator accepted files or updates from members and integrated the information into a single file.	A group member was observed to take the responsibility for pulling information from multiple people. This was mechanical – they merged files from group members into a single document.
Leader	The leader set the agenda, strategy or course for the group.	A Group member was observed to make comments related to changing or setting goals, or motivating others. For example a member might take work that was done and link it back to the project description. Or they might help motivate the group by goals and timelines.
Reader	The reader took on the role of directly reading specific information for the group to hear. This may be something they just wrote (as the scribe) or the writer.	A group member was observed to read definitions out loud to ensure shared understanding within the group.
Scribe	The scribe took on the role of writing things down in a range of formats. They were recording, but not necessarily generating the material.	A member was observed to take on the physical act of writing on a flip chart, on the white board, or typing on the computer. They were not necessarily generating the content, but physically recording it.
Searcher	The searcher actively looked for information through any channel. They took responsibility for the finding of information.	Member was observed to actively search for information through the internet, external databases or physical notes, books or articles.
Writer	The writer took on the role of creating new information.	Member took on the primary role of creating new content in a group meeting. Others are passively observing, but one member is generating the content.

Participation

Participation was classified as one of three levels:

1. Individual (student was working independently with no observable interaction with others);
2. Sub-group (some members of the group working together, but not all);
3. Group (three or more members all observed to be involved in the same activity)

Group A

Stage 1 Beginning
Before they started the course project work the group took five minutes to take stock, and confirm their understanding of what they were to accomplish. This involved checking with each, questioning and clarifying, asking questions like "*do you know what is going on?*" One member asked if the others had read the simulation, and the sample case study (Sources). Not all had. One member was concerned that they had missed the previous class, where the exercise had been explained. Members tried to reassure one another – "*No. You did not miss much in the last class*". They had not started work on the course project yet, but they did identify some particular expertise; for example Participant 2 was identified as – "*you are the lawyer - law type*" (Role) This initial stage ended as the group began to start working on their project. No artefacts were created during this stage, and there was no information seeking from external sources or databases. Members shared information, and assessed information held in common. They worked together as a group during this stage. The goal was to assess who knew what, and what resources they needed to work with.

Stage 2 Identify Challenges/Risks – Beginning
The group then moved directly to the first part of their project without discussing or reviewing all they had to do. As they were actively working on Identifying Challenges and Risks (1a), patterns emerged in their processes. Participant 1 volunteered to be the scribe (role- scribe) - to write things down. The group determined they would go through the case study and identify the information they needed to assess. The main information source for the group was the case study provided in the project materials. Some members were reading this in hard copy; others pulled it up on their own computers (multiple copies of the same source).

During this stage the group alternated between working individually and collectively. For example one person would mention a key point or factor (information sharing), and then other members would jump in to question or clarify. Once information had been shared they would work at the group level, making sure all agreed with what they were deciding. To help the group "see" together –they used the map of the case study location, provided with the project materials. Participant 5 asked – "*where is the map?*" Participant 1 pulled it out and put it in the centre so all could see. The group actively worked to achieve shared understanding and consensus by discussing the facts and visualizing things on the map. To record the information they were creating, an artefact was created by Participant 1 using a pen and paper, which reflected the group discussion. The group's information activities were to assess their need for information, to find information in the case study to support their decisions, and to solve problems. They were using multiple computers and pen and paper.

Stage 3 Checking Resources
As they worked on this task, the group required times of reflection. The main activity during Stage Three was to monitor their progress. Members commented that their progress seemed slow, and they questioned how they were using their resources. To combat the feeling of information overload they asked themselves - What information did they need at this part of the project, and what they should save for later? There was laughter, but also some disagreement during this phase over how to label some of the factors. They worked as a group during this stage. Their information tasks related to "how to". They shared and synthesized information.

Stage 4 Division of Labour
This process of monitoring led the group to review their strategy. Participant 4 voiced concern that the group was off track, becoming unfocused. This prompted the group to stop to discuss their goals, and determine the best way to achieve them. The group made a decision that it would be more efficient to divide the task - Participant 1 would look for challenges; Participant 2 would keep track of risks. They used the case study and the project guidelines as their source, as well as prior knowledge. The goal of their information tasks were related to determining how to do their course project. Members were extracting information from their assignment guidelines and analyzing this information collectively. Tools used included pen and paper, and the computer.

Stage 5 Identify Challenges/Risks – Revised Process; Stage 7 Back to Challenges and Risks and Stage 9 Finishing Challenges and Risks
During these stages the group worked directly on task; identifying the challenges and risks according to their revised plan. The group continued to work by sharing information from the case. Participant 1 took on the role of reader, sharing information which was discussed and analyzed by the group, to agree on what was important to record. The group worked to actively create consensus, through questioning, clarifying and agreeing. The information sources used were the case study, and prior knowledge.

There were problems related to the group being able to collectively see the artefact that was being created. Participant 1 was writing on paper. Participant 4 was concerned about this, as others could not see what had been decided, and was worried about the duplicated effort. They would need to make this electronic at some point. Participants 2 and 3 were using their own computers. At one point Participant 2 showed the computer to Participant 4 to confirm that they had written down key points - Participant 2 commented "*you can look at it here*". Multiple artefacts were being created.

Both Participants 3 and 5 contributed information based on other assignments and presentations they had completed individually for this class, demonstrating their prior knowledge, and Participant 2 used her legal knowledge. Participant 5 left the table and used the iLab computer - but did not discuss what he was doing, or contribute anything to the group based on what he was doing. It appeared he was checking email. When he came back he commented "what did I miss".

The group was continuously identifying the need for information – but then answering the need through conversation, identifying facts from the case study and prior knowledge, rather than searching for answers through electronic resources. Participant 4 did move to the iLab computer and try and search for something – she mentioned Google. She shared some information from her searching - referring to what another country was doing: "Listen"… and gave an external example (Jamaica). This information was discussed briefly by the group, but not really but not really picked up or included in any of the artefacts. Some task based conflict was observed with Participant 4. She was not sure all the group decisions were on track, and more than once brought up a dissenting point. The Group acknowledged and discussed, but did not change what had been written.

Over these stages how the group worked shifted. At the beginning all members were looking at their own papers/computers - and took turns suggesting things. As they completed the Challenges and Risks, they had moved to a more collective or collaborative model. Participant 1 would read things out, and they would all discuss. The group continued to use the map to help the group see together.

Stages 6 - How are we Doing? and 8 Almost there?
Interspersed with working on their project there were mini-stages (less than a minute) where the group would assess their progress. Participant 1 commented at about 30 minutes; "*great list- good progress, slow though, but good thorough job*" **(Stage 6).** They briefly examined what they had done, and what they still had to do, and then went back to task work (Stage 7).

Members checked themselves again at 56 minutes, **(Stage 8)** using this time check as a prompt to set goals: "Check again at …it is 10:30 now, by 11:00 we should have started the matrix" (Participant 1). The group also speculated about the other group, and how they were progressing. They seemed to think the mix in the two groups was different, and that they might be doing different things. They described the other group as a "big enforcement group". The group then went back to course project work **(Stage 9)** and completed the subtask in 20 minutes. During this these stages the group members shared information to confirm decisions, and to keep track of important facts and decisions.

Stage 10 Examining the Matrix
Once the group had completed Part 1a, they moved on the task of filling out the Matrix. Participant 3 volunteered to take on the role of scribe this time - "*You guys tell me what to write down*." The first few minutes were spent figuring out what they were supposed to be doing. The group discussed which matrix they were to fill out –there were three with their materials, but they only needed to complete one. Once they decided it was the requirements one, they also discussed the instructions. They were starting to work, but some members were still not convinced about what they should be doing. They only needed to fill out one matrix, but they did not feel confident with their decision regarding which one. As their anxiety increased, Participant 2 left the room to ask the other group. The other group confirmed that it was the requirements matrix. They needed to confirm information from an external source to continue their work.

Stage 11 Beginning the Matrix

The group worked on the matrix, through asking questions, then discussing. The matrix was a tool to support decision making. Each box on the matrix, which needed to be given a score, represented a complex group decision about the level of requirements that were needed. To determine the score the group assessed the information found in the case study, and debated - extracting, synthesizing and evaluating the information being shared. The main sources were the case study and prior knowledge. The group used pens and paper, computers, and needed to jointly use a computer. Information was found in the case study to confirm, to support a particular decision, and to locate a particular fact. The matrix was a group artefact which recorded a group decision, and was then used in the next stages of their course project.

Stage 12 Wait…is this Right?

As they worked on the task the group made comments about their progress, and passing time. Members discussed the fact the other group was half through their matrix. "*But this is not a competition*" commented Participant 2. The group was still not feeling they were really getting the matrix. At one hour and forty five minutes one of the instructors entered the room, and the members discussed their concerns with him for about five minutes. The term on the matrix was requirements, but the group decided what made more sense to them was to think in terms of priorities. During this stage the group confirmed information to assure themselves they were filling out the matrix correctly (information goal – how to). They worked at the group level, and needed to consult an "expert".

Stage 13 Working on the Matrix

This discussion created a greater sense of shared understanding of how they should assess things, as observed by their quick progress through the rest of the Matrix. Participant 3 continued the role of official "scribe". Participant 2 also filled out the matrix on her computer, and Participant 5 filled out another on his paper copy. Because of this the group experienced problems with a lack of shared view, they needed to keep asking others/confirming their decisions (is that a 0, 1 or 2?) as they couldn't all see the same matrix. They shared information to confirm and to make decisions. For most of this stage they worked as a group, but with individuals recording things separately. The used the case study, their notes, and prior knowledge.

Stage 14 More advice

This work was interrupted briefly at the two hour point, as the external guest, who was observing the exercise entered the room. He advised the group not to overthink – just to make a quick decision. Based on this, the group decided they needed to set a firm goal. They would finish the matrix in twenty minutes.

Stage 15 Finish the Matrix

The rest of this stage was quite animated. All members were involved in the discussions. There were differing opinions which they had to talk through. They were sharing and analyzing information from the case study and individual notes, to support their decision making. Even with the differences of opinion, the group commented that they felt they

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were productive – they were getting things done. They were still using a mix of pen and paper and computers, and generating multiple copies of the matrix. The group finished the matrix at 2:20 and decided to have a short break for lunch.

Stage 16 What Next?
After their lunch break the group identified the tasks left and jumped into a stage of assessment. First they needed to identify shortcoming and overcapacity. But they were confused; were shortcomings the same as challenges? They spent a few minutes struggling to understand what they should be doing. The group couldn't move forward without external help. The external guest talked to them and provided direction. During this phase they needed to seek information to determine how to accomplish the next part of their course project, and to make a decision regarding planning.

Stage 17 Requirements & Capabilities
The group worked together as a group to determine the requirements and capabilities. The main sources were the case and their prior knowledge as well as their individual notes and the group artefacts created, especially the matrix. They used the matrix to help identify and make decisions regarding which aspects of the case study were most critical and where additional capacity was needed. To work together they used computers, pen and paper. Participant 1 played the role of scribe – writing things down for the group, and asking questions for the group to discuss and comment. Participant 2 was using material she collected earlier to confirm recommendations with Participant 1 and the group. The group was very aware of time, and the need to make decisions and move on.

Stage 18 Assessing
As they completed the requirements and capabilities, the group assessed their goals. Members reread the instructions, and reminded themselves that they only had to focus on one area, and that they only had 10 minutes for the presentation. This helped them counteract the feeling of being overwhelmed with information. They looked for information to determine how to do their task, and to confirm facts. They used their project guidelines as a source.

Stage 19 Policy Recommendations
During the next stage the group determined their policy recommendations. All group members were involved, conversation was animated; there was conflict, disagreement, frustration but also laughter. To help with their recommendations Participant 4 suggested they use a flow chart (group artefact). Participant 1 tried to create one, as the others looked on, and provided comments and suggestions. This artefact was on paper, so it was not easy for all to see or manipulate. Participant 2 acted as the time keeper - "*we only have one hour left*". At one point the group was laughing about their problems all getting on the same page, and Participant 2 commented "*I will be having nightmares about this tonight*"...*and "maybe this is why they have us do this exercise to realize how frustrating it is*".

Stage 20 Creating Slides
As they finished the recommendations Participant 1 steered the group directly to the slides (outcome) and - "volunteered" Participant 3 - who had a computer and was great with charts, to be the slide creator. The key players during this stage were Participant 1 who read from the notes created jointly during the assessment and Participant 3 who created the slides. Participant 2 jumped in and out - helping when needed. Participants 4 and 5 for the most part were not directly engaged in the process, but were chatting about other courses, plans etc.

It is not clear in the end that what went on the slides was a "Group" view, or mainly Participant 1's interpretation of the "group view". Participant 1 was the key person throughout the session- she managed, directed others, took notes, and prompted the group the most. Participant's 2 and 3 were active making notes etc. on their computers. Participant 5 was very engaged at some points, making lots of notes, but his participation was uneven. Participant 4 played varied roles, from encouraging the group to think broadly, through to information seeking, and clarifying. There was one information-seeking episode during this stage, Participant 2 searched for an appropriate background for the slides - then emailed this to Participant 3. Tools used included computers, email, and pen and paper.

Stage 21 Finishing
The group rushed to finish as the other group entered the room and set up to present. The group finished their project without a clear plan for presenting, or time to confirm they were ready.

Group B

Stage 1 Taking Stock
As the group moved from the Group Lab into the Usability Lab room, they discussed the fact that they were not certain about their project. All members took out materials, and Participant 4 brought out lots of pens, pencils, erasers, and highlighters. All members had blank paper as well as the actual case study. Some members had other articles, and notes. Members started by trying to summarize the main parts of the case, to help the group ensure they were all on the same page.

Stage 2 Individual Re-read
Participant 1 suggested that they should all take a few minutes and reread. This stage for the group was an individual one; each member took about fifteen minutes to review the case. There was limited communication during this time. Members individually highlighted, made notes, but did share some documents.

Stage 3 Let's get started… Challenges & Risks
At about twenty minutes, Participant 3 suggested "*I think we should just start going through this*", pointing to the assignment. Participants 1 and 4 agreed, and traded some papers back and forth. The group started working on identifying the challenges and risks, but had some challenges. They needed to keep reconfirming what they should be doing.

Participant 3 for example commented, "*But we can't look at it in terms of capacity - just need to look at vital interests*." The group was organizing itself as it worked. To be able to "see" the information together, the group pulled out the map, using it as a common artefact to orient themselves. There was a mix of individual and group level work. There was some group creation, but also individual generation of ideas.

Stage 4 Monitoring our work
As they worked on this first part of the project, the group also monitored their progress. Initially Participant 1 and 2 made notes on their own copies of the assignment, but Participant 3 noticed this and decided it would make more sense to do this on the computer as they worked. Participant 3 took on the role of scribe. Additionally she often typed without consulting, or without telling others what she is writing, taking on the role of creator. The group made these adjustments to work more efficiently.

Stage 5 Vital Interests
The group had focused first on the challenges and risks, and then moved to determining the vital interests. During this stage there was animated discussion, and task based conflict. Humour was used to diffuse some of the tension. Participants 1 and 3 didn't seem to agree on what the vital interests were. They shared information to increase their understanding of the problem. The group continued to use the map to confirm things, and to think through the problem together. This seemed to be a circular process. By the end all were happy with what they had written, and Participant 4 commented "*I thought this was what I said from the beginning*". At the end Participant 3 prompted "*are we happy with these vital interests?*" and added one more point. Members referred to the case study, their own notes, and referenced some other articles members had brought with them. There was no external searching for information online. The computer was used to type notes. They worked mainly as a group during this phase.

Stage 6 Confirm what we have done
Before moving on to the Matrix the group reviewed the risks and challenges, and the vital interests they had just determined. The group spent ten minutes discussing and debating to ensure there was agreement and shared understanding. They had some challenges separating what should be considered a "risk" vs. what was a "challenge" and discussed the differences as a group. Participant 2 took notes on a notepad, but Participant 3, again commenting on efficiency, took the pad and typed the notes into the computer. There were some issues with the tablet computer, and her lack of familiarity with it. Individual members were flipping through their individual copies of the case, and their notes, and sharing information at the group level. All were participating, but Participant 3 had "control", as she is was writing, and was the only one who could see the computer screen. She recorded what they have said, but also determined how the ideas were formalized into the official record. It was a group artefact, but created by one member.

Stage 7 Which Matrix? And how do we score?
At about the one hour mark, the group moved to the Matrix. The group first needed a few minutes to determine which of the matrices they needed to complete, and how to use this tool. Participant 3 read the instructions and definitions out loud, and the other members

confirmed understanding; "*So 2 means….no capacity*"? They shared information to ensure they knew how to complete the matrix.

Stage 8 Starting the Matrix
As they started the task, the group began to fill out the matrix on paper, so all could see. Before they could actually complete it – they still needed to agree on a strategy. Members discussed exactly how they should complete it – for example should they go down the columns or across the rows. They made a decision to go across.

Stage 9 But wait?
The group began filling in the matrix according to this plan, but did not get far. The group was unsure that they were using the tool correctly, and questioned themselves. Participant 1 for example asked "*We are doing requirements*?" Participant 3 was obviously frustrated, and decided they need to confirm what they were doing with the instructor (expert source). Participant 3 brought the instructor into the room and commented "Ok, so we are very confused…" The discussion with the professor was helpful and the group was able to work through the matrix with a clearer focus. They worked as a group to resolve their problem.

Stage 10 Back to the Matrix
The group shifted some of the numbers they had previously recorded, based on their new understanding. As they worked through the matrix, one member read from the manual, to share the exact definitions they needed to consider. The group systematically worked through each box in the matrix. They needed to agree on a number, forcing the group to come to a consensus. They are aware of time, and the need to work quickly. Comments such as "*Let's leave that as a 2 - Don't think about it too much otherwise we will be here all day*" were made. All members seemed focused - working closely together looking at the paper copy of the matrix. The group needed to reuse material they already created. For example Participant 1 asked "*what did we say*" – prompting Participant 3 to go to the computer and refer to the Risks/Challenges they had identified. They did not search for information using the internet or databases, but shared from the case, the project manual, from their notes, and from prior knowledge. They worked collectively as a group, with Participant 2 recording their decisions on the matrix.

Stage 11 So how are we doing?
Their work was interrupted at times, to allow the group to assess their progress and decisions. For example after filling out a box members would comment: "*Ok so we are good*"; and "*cool - we are getting there*". When a member from the other group entered to ask about the right matrix they realized they were ahead, and were happy.

Stage 12 Completing the Matrix
After these mini breaks they resumed work. Participant 1 took on the role of "reader" - looking for definitions in the manual. Participant 2 made notes on the Matrix. Participant 3 volunteered to retype this on the computer when they finished. At 1:45 they finished the matrix and Participant 3 commented "*I think we are doing well...got a roll going*". They decided they could take a coffee break.

Stage 13 Determining next steps
When they returned from their break, the group started working on identifying the overcapacities and shortfalls. They were not really sure how to start. One member suggested using another matrix – it was not required but might help. No one responded; all were working individually flipping through their own notes. Participant 3 decided she would start filling out the matrix electronically – she had an electronic copy (searches email for this). The others worked together on the next task.

Stage 14 Parallel work Over Capacity/Recopy Matrix
The group seemed to be running out of steam as they were not as focused or efficient during this phase. There was much more off topic conversations for example. There were frequent comments about how tired they were, plans for the rest of the weekend, and their other courses. Participant 3 mainly worked individually, typing the matrix into the computer. The other members shared information from their notes, the case study, and the matrix (group artefact) to generate a list of the shortfalls and over capacity. Individuals were flipping through the pages, and evaluating the information that was being shared, and synthesizing information to make decisions. Tools used included the computer, email (to retrieve the matrix), and a USB stick to share information as well as pen and paper. They needed to keep track of earlier decisions, referring back to the matrix or their notes.

Stage 15 Policy Objectives & Slides
During the next stage the group also worked in parallel; simultaneously working on the policy objectives and their slides for the presentation. During this time the group continued to lack their earlier focus, spending much time off task. Participant 3 was at the computer, creating the slides. At the same time Participant 4 was reading the policy requirements aloud to all. They jumped from discussing the slides and how they should do the presentation, back and forth to the policy recommendations. There was some discussion of different views, and they commented on the different backgrounds (3 Science, 1 Political Science). During this stage Participant 4 referred to the extra articles she had brought with her. She was reading those as well as the case study, and occasionally shared some facts and ideas.

Stage 16 Finalizing Content
Participant 3 has finished the electronic copy of the matrix, and added their policy objectives to the slides, changing some of the wording. She read them out to confirm the final text. The others listened and asked some questions, but there was not the same level of group engagement as before the break. There were some issues related to the group not being able to easily see the computer screen. Participant 4 kept moving to see. The instructor entered and they shared what they had done, which helped give them the sense they were on the right track.

Stage 17 Quick Practice
During the final stage the group organized themselves for the presentation. To accommodate this the members all gathered around the computer – jointly looking at the

screen. Members claimed the slides they wanted to present, all taking a section. Members worked individually, looking at their slides and making notes. Participant 2 voiced some concern; "*I hate presentations like this...on the fly...don't know what I am talking about*." Participant 4 read through her slides carefully and asked several times "*what did you mean by....*" indicating that she did not immediately identify with the words chosen. The group ended by commenting they wanted to get through this quickly, as they wanted to get home.

Group C

Stage 1   Getting Situated
During the first stage, the two group members went through a process of trying to organize and orient themselves and the project. Initially both members organized their papers, and started reading independently. Both were reading, and throwing out comments to each other, but they were not working in sync. They were trying to determine what information they needed to work from, the original simulation materials, or the updated memo received in class.

Stage 2 Discussing the Problem
The pair moved from planning to a discussion of the overall objective of the assignment. Both were flipping through papers, looking at the map, asking questions and sharing information. They were working mainly independently, each looking at the materials. They would share some information, reading sections they thought were important aloud to each other. They had not started creating anything yet, but were discussing the overall problem. Participant 1 had signed on to the computer, but did not use it at this time. They felt they had assessed the key information they needed in class prior, so were ready to start the matrix. They discussed which matrix they should use, and reviewed the process of scoring.

Stage 3 Ok let's start
The pair started working through the matrix. Participant 2 started recording scores on her copy of the matrix, as they discussed the information from the case and came to decisions. But neither felt confident they were approaching things in the right way.

Stage 4 But wait
Feeling frustrated, Participant 2 went to find their instructor to ask for some advice. They confirmed which version of the scenario they were to use, to base their decisions on.

Stage 5 Drawing it out
Based on this conversation the pair realized they did need to summarize their resources before they could fill out the matrix. Participant 2 decided to use the space around them to help list the key information they needed to consider when making decisions. She moved to one white board and started listing all the assets so they both could "see", and be sure they were referring to the same info. She asked some questions of Participant 1, but was working through this largely independently. Participant 1 had a military background, and Participant 2 asked questions that draw on his expertise and deferred to

his decisions on those topics. The pair also used the map to help orient themselves, and to understand the problem. Once Participant 2 had recorded the information she felt she needed, they went back to the matrix.

Stage 6 Matrix
The pair began work on the matrix by saying ""*Yeah well you have to really see if they are as overtaxed as they say they are...*"(Participant 1). To complete the matrix they flipped between the matrix itself, the guideline documents for definitions, and the case study to confirm facts. For example Participant 2 would say "*monitoring*" - then Participant 1 would read the definition, and they would start discussing how they should score. They worked through the matrix systematically confirming their process, and going back to earlier boxes to re-evaluate at times.
Participant 1 started using the computer during this process, but did not always comment on what he was doing. He used Google to search for UNCTAD, and then clicked on a link to the "Oceans & Law of the Sea" site. This is not used at this time, but the pair came back to it later. They were mainly working together during this stage.

Stage 7 Are we doing this right?
The instructor entered once again as they were working through the matrix and confirmed that they were completing the matrix appropriately. They discussed what was meant by "requirements", and confirmed the scores (0, 1 & 2). Participant 2 also asked if they were making good progress.

Stage 8 Finishing the Matrix
Participant 2 works alone for some time. Participant 1 left for coffee. When he returned Participant 1 tried to bring in external information (another class) and information from websites (Intergovernmental organization site) to help with the process. He executed a series of different searches for information, only sharing at times. Participant 2 was filling out the matrix, at times they worked together through discussion. Participant 2 also monitoring their results and their process, concerned about the number of 2's they have, and the passing of time. Participant 1 continued to search for external sites, and used some information he found to support their decisions; "*This reinforces the 0*".

As they worked Participant 2 walked over to the white board, and added notes. They were working on the matrix, but she also noted things they will want to think about for their policy recommendations. They were often negotiating with each other. *Ok, you win this one* (comment by Participant 1). Participant 2 was using the list of assets on the board as a memory aid, and as a way of examining the problem together. Participant 2 for example walked to the 2nd white board she created during this stage and commented "*this is what I am thinking*" adding to the white board. Participant 1 walked over so he could look closely at what they were creating. Participant 1 was consistently bringing in external resources. "*Remember that article by Albert Cherkov...it's all about national sea*". They finish with the Matrix at 2:51. Participant 2 sketches out a diagram which represents what their ideal solution would look like. It involves policy recommendations, but it was really a new system, the creation of a "watchtower". To finish the matrix they integrated information from external sources, prior knowledge, and the case study

provided. They utilized the information on the white board, and used the computer, pens and paper as well. They oscillated between working separately and as a pair. The seeking of external information was to clarify points, and aid decision making.

Stage 9 What Next?
As they moved to the next stage, Participant 1 suggested dividing their work. "*I am just going to run through natural law because I think we have to make sure we know - we can quote (Solace) as he (the instructor) was pretty key on saying we had to know law of the sea*" He continues searching, suggesting Participant 2 start drafting their policy recommendations, and he will find information to support their decisions. As they work the pair starts commenting on how they are feeling.... - "*starting to feel the burn*" (Participant 1) "*starting to think we have done this - we have talked about it - do we really have to prove to you what we have learned*? (Participant 2).
They continued to generate their policy recommendations, or how they are going to do what they want to do. Participant 2 moved between the two white boards, using one to help determine what needed to be changed on the second. Participant 1 joins her at the second white board, bringing their matrix along. They try and simplify their diagram of their solution, which is their overall recommendation. Participant 1 brings the map over to help them. They are actively using the space, whiteboards, their group artefact and the map to help them generate their recommendations.

Stage 10 Parallel work- Policy Recommendations and Finding Evidence
After working with the diagram Participant 2 moved to a computer to summarize what they have decided. Participant 1 started utilizing external websites again; clicking through a site and reading he comments - "*We have sovereign rights for the purpose of exploring*"…*so we were right".*

As they work Participant 2 shows frustration. "*This class already assumes you are working at a level? Need more time...this is complicated - doesn't go quickly for me".* Participant 2 kept typing up their notes, and discusses what she is writing with Participant 1. At times Participant 1 tells Participant 2 what to type. They go back and forth between writing and clarifying things.

Stage 11 Confirming last facts
The instructor comes in to check on their process, and they confirm the deliverables. Participant 1 decides to recopy the Matrix so their decisions are clearer. Participant 2 finished their recommendations. Participant 2 is not happy at the end and comments "I *need more time to square this away*". P1 tries to reassure her. End is prompted by the time, rather than the successful completion of all the tasks. They do not have any time at the end to reflect or plan their presentation – they just finish the actual project itself.

Group D

Stage 1 Getting Organized
At the beginning the group is having problems with the tablet computers, as one appeared to keep freezing and crashing. The group decided to rely more on the white boards in the

room because of this difficulty. They joke, "*I am thinking that is part of the challenge - how do you deal with ...malfunctioning*".

Stage 2 How will we work?
Deciding the white board is the way to go, the members moved to the white board and started writing headings (Risks, Challenges etc.). They agree that they will generate the necessary information through this process.

Stage 3 Challenges & Risks
As they started working on the actual project Participant 1 was reading from the case study on the computer as Participant 2 and Participant 3 filled out content in the chart on the white board. Participant 3 had a copy of case study in her hands. They worked through interactive questioning and answering,
"*Is that a risk or a threat - and what is the difference?*" (Participant 2)
"*It's a threat until it happens.*"(Participant 1)
They negotiated, and then settled on this. They did not look at case study or definitions – they worked from their own knowledge. They progressed through the identification of the principal threats, risks, and challenges systematically for each category then noticed some risks fit across all categories. Participant 2 suggested they needed to add another category off to the side for "all". The rest of the group agreed. Participant 2 and 3 worked at the board, Participant 1 was at the computer, typing what they were doing into a document. He confirmed the computer was now working. At times Participant 2 was generating more of the ideas, with Participant 3 recording them on the board, but this switched over time. Participant 1 picked up a paper on the desk of Participant 2, and asks him about it. Participant 2 replies it was strategy, making it clear he had not only read the case but had brought some ideas with him. They finished the first subtask quickly with no real conflict. They used a computer, and the whiteboard, and integrated information from the case study and their discussion. The chart created on the white board became a key group artefact, which helped them during other parts of their project.

Stage 4 What Next?
The group determined that next they needed to identify the vital interests. They discussed briefly how to do this, and determined that they will add a column to the table they have already created on the white board. This short planning stage allowed the group to transition effectively from one part of their project to the next.

Stage 5 Vital Interests
During this stage the group continued to work with the white board along the wall, but also moved over the portable white board to use it as well. There was more debate during this stage, and they wrote things down, changed their minds, and wiped things out. It was a very dynamic stage.

Members decided they needed to create a flow chart to organize the vital interests on the portable white board. The group required a great deal of common space to look at information together, and to organize their thoughts. Participant 1's role was largely writing, with some interjections into the discussion. Participant 2 was thinking and

generating, and Participant 3 was thinking, writing on the board and generating. The group reviewed their progress as they finished, ensuring they were in agreement. They used multiple coloured markers, making links and highlighting things in their chart. It was a very active process of integrating and manipulating information. Members' reflected that this would help them determine what their policy framework should look like.

Stage 6 So Now?
Finishing the vital interests, the group wanted to start the matrix, but needed a few minutes to assess how they would do this. They flipped through the documents confirming the right matrix, and referred to the memo they had been given in class. They needed to incorporate information from the specific incident that was added to the simulation. The group considered the memo, and commented on feeling overloaded. *"Sorry this is where my brain stops…this is brutal, so much stuff?"* (Participant 3). Participant 2 tried to translate the new information, and focus and simply their task. *"So the big thing right now is protection…and getting rid of pirates and terrorism"*. *"We need guns!"* Participant 2 joked. This joking made them realize that they needed to list their resources, so they had a clear list to help with the matrix.

Stage 7 Assessing our Resources
Participant 2 started making notes on the legal pad. For the next period of time they worked in sub groups. Participant 1 was working to reproduce the chart from the white board on the computer. Participants 2 & 3 were working on a list of resources. They did this by summarizing key information from the memo onto the legal pad.

Stage 8 Confirming the Matrix Process
As they moved to the matrix itself, they needed a few minutes to assess. They looked at the requirement matrix, and tried to interpret. *"Is this a wish list?* - Participant 3 asked. They debated this, coming to a common understanding of what they were supposed to be assessing.

Stage 9 Matrix
To work together on the matrix, they decided to work in stages – asking what they (the case study site) needed; what they had; and then mapped the two together. The general pattern for completing the matrix was that Participant 2 read out the category, and made suggestions, then the other members commented and debated. They needed to keep confirming what the scores meant. They kept going back to the definitions, to talk through things and arrive at a shared understanding. During this time Participant 3 joked about the difficulty of working with two economists, identifying a difference of perspective within the group. They did not use any external databases, but used the white board, as well as the project materials, and their prior knowledge.

Stage 10 Transitioning
After finishing the Matrix, the group took a few minutes to refocus. They had finished the matrix but were still processing, and deciding what they would do next.

Stage 11 Off task
The group had a break from the project for a few minutes. They commented about the camera and decided they were not acting differently. Participant 2 commented "I *am just as bitter a person as I always was"* and compared this experience to being on a reality TV show. They had an off task discussion of different reality TV shows.

Stage 12 Overall Policy Formulation
Participant 2 refocused the group on the task, and moved them on to Policy Formulation. He provided a recap, *"this whole meeting has been convened because of a ship spill and terrorism events"*, summarizing from memory and providing a common reference for all. During their policy discussions the members commented on their backgrounds in terms of their different perspectives (Participant 1 was a Canadian, from Alberta, Participant 2 was an American, Participant 3 was from St. Lucia. Participants 1 & 2 had Economics undergraduate degrees). In addition to the white boards, the group also used a flip chart to organize their policies. They had some disagreements during this stage regarding their project, but worked through them by discussion. They were also very physically active during this stage. They moved around the room, referred to the white board, wrote on the flip chart and motioned to things. At one point Participant 1 walked to the board and sketched a map of the island, and the surrounding areas, to help them assess what the priorities should be.

They asked questions such as "do you think there are any other countries that have this problem? (Participant 2), identifying a clear need for information, but they did not attempt to search for supporting information. Instead they answered from their own knowledge. They did not look up or seek any agreements or treaties. They also compared their case study to the US/Canada/Indigenous Peoples situation, but just discussed this and did not seek out any documents. Instead they used their collective knowledge, and discussed situations they knew. The Group was very much working at the group level - all three trying to come to a common understanding of the problem. It was an iterative process of systematically discussing ideas, evaluating and synthesizing; topics emerged and reemerged during their conversation. Humour was used throughout.

Stage 13 Review
As they worked directly on the project, generating their overall policy objectives, the group needed moments where they stopped work to assess. During this stage they referred back to the assignment guidelines, and looked at what they had created, to ensure they were on target. They determined that they had identified the high level objectives, but still needed to come up with specific objectives for each area.

Stages 14 Specific Policy Objectives and 16 Finalizing Policies
Based on this, the group worked to determine their specific policy objectives. To accomplish this they used the matrix, the charts on the white board, the case study and their prior knowledge. Their discussion was animated, and continued to be active. Participant 2 was doing the actual recording in a document on the computer, and the others commented – You will present this, as it is in your words. All members were actively participating, and they worked at the group level during these stages.

Stage 15 Making Sure
Similar to Stage 13, the group needed to stop for minute to assess their progress. They pulled out the assignment guidelines, and discussed if they were doing what they should be doing.

Stage 17 Reflection
As they finished the group reflected on their process, commenting, "*We haven't reached that point yet with technology - where everyone is coming to a meeting - flipping out their computer" (Participant 3).* As they end the group assessed their progress. They double checked on what they have done, and worry that they have missed some things. They conclude that they have a "*great plan*" but that it's "*never going to fly though*", indicating this is a theoretical solution but maybe not a realistic one. As the other group had not finished, they took a break for a few minutes.

Group E

Session 1
The first session of Group E was primarily a planning or organizing meeting. The group started *(Stage 1 Getting Started)* by generally chatting, making comments about a discussion that had been on Facebook before moving to a discussion of their project, prompted by a comment about the key source - "Ok who's read the case" (Participant 3). There was some direction, where a member took on a role of directing another- "you ARE going to read it?" (Participant 3 to Participant 5), and one member (Participant 2) left the room to copy the case for another member (Participant 5), who did not own a copy of the text. The mood of the group appeared light, there was laughter and joking. During this time members were observed to work individually more than as a group.

After this initial stage the group moved directly to dividing the work *(Stage 2 Planning and Dividing).* The group members used humour to deal with the recognition that some members had done preparatory work and some had not. They group did not really spend any time discussing or analyzing the work task itself; they jumped directly to how they were going to do it (Information task – how to). The dividing of the work proceeded without conflict. Members identified what they would like to do. The group worked mainly as a group during this time, and used email to confirm details of what they needed to do. They identified their need for information collectively, and shared information.

After dividing their work, the group debated the timing of their next meeting *(Stage 3 Logistics and Goals)*, which involved trying to coordinate five schedules. They assessed what the goals or deliverables for the next meeting should be, how they should share information (use email), and what they should "write up". Some members tried to initiate a more substantive discussion by asking questions, identifying more need for information. These needs were not met, as the other members were packing their things and commenting on the time.

As the group adjourned *(Stage 4 Adjourning)* members confirmed a meeting time, updating their schedules, and packed their books and notes. There was off task discussion of other courses and jobs.

Session 2

The group began the second session *(Stage 1 Getting Organized)* with general talk about other courses, and job opportunities. They quickly transitioned to the project, and discussed organizational activities. There was concern voiced about the time they had left to complete their project and frustration with the problem of finding convenient times to meet, due to conflicting schedules.

The group then moved on to a discussion of how best to present the material, which involved negotiation and debate and brainstorming *(Stage 2 Brainstorming)*. The group spent most of the meeting in this stage. Need for information was identified through questions. Members shared information from their interpretation of the case (main source), aggregating and integrating from the individual to the group level. Members asked questions to ensure comprehension and to discuss interpretation of the case, and their process (how they should be proceeding). They discussed the key information source (the case study), shared information from individual course notes, and discussed what their presentation (group artefact) should look like. Members referred to the case study (source), and to how other groups in the class had organized their presentations. The group jumped from discussing content, to process, to format. Tools used included pen and paper, and emails.

The group did not have a systematic approach to sharing thoughts and opinions. For example they did not go around the table and ensure everyone gave their opinion. Not all members actively participated in the discussion; some members did not make any comments, or look at any sources. Some members talked more than the others, and one participant talked very little (Participant 3), but appeared to be attentively listening, based on body language and non-verbal gestures (i.e. nodding). There appeared to be a feeling of uncertainty, based on their expressions, comments (frustration) and body language (shifting) about what they should be doing.

The trigger for the next phase was the group agreeing on a way forward. The group made a decision about how they were going to organize themselves *(Stage 3 Outline & Division of Labour)*. During this stage Participant 1 took on the role of leader. Based on a suggestion from Participant 1 for example, the group decided to split the members into two groups, one focused on the internal issues (Participants 3 and 4) and one focused on external (Participants 1, 2 & 5). Within each of these groups however, they would still be working independently. Participant 1 also recommended that all members should try and work their "concepts" (from their course notes) into their section. Members made individual notes (tool – pen and paper). The group adjourned.

Session 3

Only four members were present for the third meeting (Participants 2, 3, 4 & 5). There was little general talking and their expressions appeared anxious. This meeting could not

easily be divided into different stages. After the filling out of the diaries *(Stage 1 Diaries and Greetings)* and waiting for members to arrive the group began to work together *(Stage 2 Scheduling & Adjourning)*. The main activities were planning what they still needed to do, and monitoring who was doing what. Members set goals for the next meeting, to ensure they were splitting the work appropriately, based on the disparate schedules and workloads of members. There was an increased sense of time pressure, and it was also clear from their comments that most members (Participants 2, 4 & 5) still had the bulk of their work to do. Because of this, there was more discussion about when and how, than the what.

During this session members referred to the case study, and to other groups' presentations. Members talked about the need for slides for their presentation, and use of email. There was some directing, for example Participant 2 encouraged Participants 3 and 4 to work together, as participant 4 would not be there for the final meeting. Participant 3 resisted, he had his section completed, and did not want to spend more time. The group mainly worked with information through discussing, negotiating, and clarifying. Even though individuals had not done their work the group did not seem concerned. One member commented "*I think we are on a good track here*" (Participant 5). But then another joked – "*individuals will likely still be adding their content to the PowerPoint on Sunday night*" (Participant 4). The group was planning collectively, deciding things like "*we will start putting together the PowerPoint on Friday*", while work on the actual project (task work) was to be done individually outside of the meeting. Participant 3 referred to his notes during the meeting, but others did not directly use any sources. Email was used.

Session 4
The session started (*Stage 1 Greeting & Off Task*) with each member filling out the diary individually, and waiting for the others to finish. There were general greetings and non-task related information was exchanged.

As with Session 3, there was little actual progress at this meeting, as most of the group members still had not completed their individual pieces. In Stage 2 *(Update & Re-Division of Labour)* the members continued their discussion about how best to organize things, started during the previous session.

There was some discussion of the actual problems in the case study, but more around organization and logistics. The main activities were dividing the project among members. There were some technical issues with one of the computers. Members used email to send draft information to each other.

The group then moved to discussing the external section *(Stage 3)*. The discussion involved the three members responsible for this section (Participants 1, 2 & 5). The other two members (Participant 3 & 4) worked independently. Participant 5 shared what he had written by reading out loud, and the other two members added their thoughts. The three attempted to brainstorm directly about the key challenge. They needed to confirm specific details (confirm facts) from the source (the case study) and to share ideas.

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Participant 1 asked for the syllabus to confirm project details and Participant 5 produced it. The group then noticed what Participant 4 was doing on his computer.

Participant 4 had started the slides for the presentation (***Stage 4 Presentation Draft & Plan***). Members walked over to look at Participant 4's computer (joint computer use). Members spent a few minutes discussing this artefact, and making suggestions, which Participant 4 implemented. There was some conflict about how the presentation should work, and frustration and confusion. Participant 1 commented "*what is the point of today* (the meeting)? *We are not going to get it done*"; recognizing that as members did not have their sections done, they could not move forward.

There was a long discussion, with members expressing both frustration and confusion about how they could bring the sections together for the presentation. Participant 1 commented "I *still don't get it – explain it to me again*". To deal with this confusion Participant's 1 and 4 used the white board to try and draw an outline of their presentation plans, so they could "see" it together. Participant 3 joined the conversation to help bridge the gap in understanding. It was not resolved. Members (particularly Participants 1 and 4) did not agree on how they should be re-integrating the divided work into a final group product. The session ended due to time pressure, with no sense of agreement (***Stage 5 Adjourning***).

Session 5
The final session was the only time the group really attempted to integrate their work, and to think through their presentation as a whole, although this was hampered by one member not being present, and by another being persistent in wanting their section to remain intact, as they created it.

The session began with the Group completing their digital diaries and talking about how they are going to put their presentation together (***Stage 1 Diaries and Organization***). Some members (Participants 1 & 2) complained about this project "*Don't know why but I really don't know how we are going to do this*? *I don't really want to* (Participant 2).

Members discovered that different members had done things in different ways (Stage 2 Logistics). Some had slides ready and shared them with the group (Participants 3 & 5). Some had written them, and emailed them to themselves, but the email didn't come through, so they needed to redo. Through their conversation it was revealed that no one had any understanding of what the missing participant (Participant 4) was planning on saying. He had not shared slides or notes. There was a discussion about how they could be more efficient. The group decided that they should work on slides together - the "shell" of the presentation. Then they would divide up who will say what, and everyone could work on their own part.

At this point in their workflow, the group appeared to have little shared understanding of their project. This was identified through their conversation. For example Participant 1 commented "*What are we going to talk about*"? Group members were not clear about the suggested text already on the slide. Participant 1 asked "*disconnect - what does that*

mean anyway?" The group decided to start with Participant 3's section as he was finished. Participant 3 moved to Participant 1's computer, the others gathered around. The group was working with a shared group artefact (the slide deck) and jointly using a computer**.**

During this second stage of this session, the group tried to begin task related work, but remained still stuck in logistics. Participants 1, 2 & 5, who were the "external" team needed to figure out together what they wanted to say in their section. But 1 and 2 had not created, or did not have their text. Because of this there was much independent work. Participant 3 (the internal team) tried to start on his section, but seemed unsure of what the others wanted him to do. Looking at the activity during this stage, it could be described as disorganized and fragmented. Members were not working together, they frequently needed to clarify things with each other, and they commented that they did not have a clear sense of what they were trying to accomplish. In addition the group members were trying to determine the best way to deal with the content from the missing member. They discussed options; should they let him fit something in at the last moment, or should they create something for him?

The group moved from this fragmented stage, to more focused work (***Stage 3 Focus on PR Issues***), and on the PR or external issues (Participants 1, 2, & 5). These three members started collecting all their ideas. Participant 1 was typing (scribe). The three were discussing, negotiating, questioning and at times brainstorming. There were issues reaching shared understanding, some technical, and some cognitive. Participant 1 was typing the communal notes on her computer, but the others could not easily see what she was writing. Participant 5 was not as involved. Participants 1 and 2 asked questions to confirm what he covered, and he offered his opinion. They were getting things done, but it was taking a long time, which was noted by several members. This concern over time prompted Participant 5, taking on a role as leader, to suggest a new strategy. Participant 1 and 2 should continue to work on the external section. Participants 3 and 5 would work on updating the presentation.

During Stage 4 (***Multi-task – PR & Slides***) each pair worked together sharing a computer. Participant 5 used a pen and paper at some points. After a while Participant 1 floated between the groups and eventually took over the presentation. She searched the internet using Google images and YouTube for pictures to add, and formatted the slides. Participants 3 and 5 moved away and appeared to both work individually. Participant 5 showed frustration at times; he needed to remain aware of what Participants 1 & 2 were writing about the PR/External section, as this was his part as well. They ignored his questions, but he persisted. From constant references to time, there was a clear sense that the group was concerned. They were getting things done, but their work was inefficient (as voiced by some members and observable from their body language) and slow.

The group did veer off topic at times. Participant 1, who took on the role of "searcher" searched for and shared a YouTube video with participant 2, for example, for fun. There was some information seeking to find supporting materials and pictures for the PowerPoint. Participant 2 shared a funny/sad zoo animal story she found on YouTube.

She had found it looking for task related information, but the story did not have anything to do with their project. This stage ended with a break for lunch.

After their lunch break Participant 1 continued working on the PR/External section *(Stage 5 Continue PR)*. Participant 2 was sometimes helping, and sometimes reading a novel. Participant 5 was trying to join in at times, but also wanted them to get moving, and tried to focus and reorganize things. He left for a while. Participant 3 was doing his own thing for much of this, as his section was done. The group was observed to move in and out of focused attention on the task. There were also some technical problems with the computer. Updates were being loaded so its processing was very slow. This caused some concern.

As the group finished with the PR/External word document they moved on to finalizing the slides *(Stage 6)*. Participant 1 rearranged the computers and took charge of the slides. Using the two computers side by side, she integrated information from the word document into the PowerPoint document. Participant 1 directed the others, but Participant 5 was more the leader, focusing on logistics, and finishing things. The group came back to the issue of the missing participant. They were still concerned that they did not know what he would say, or how it would fit. Participant 2 had been reading but rejoined the group at this point. Participant 3 stayed in his seat, away from the shared computers, but did participate. There is more searching for zoo animals (Participant 1). They also needed to fact check and verify information from case study in the text (source). There was some humour. During this stage the group continued to move in and out of focused work. Finally *(Stage 7 Adjourning & Logistics)* Participants 1 and 2 saved the group artefacts and sent them by email to all. They confirmed that each member knew what they were responsible for presenting. The group determined how they would coordinate with the missing member, and made plans to meet quickly before class the next day.

By the end the group did have a completed presentation, and a plan for solving the problem that all members present endorsed. The activities of the members between meetings were mainly procedural in nature. There was no sharing of substantive thoughts, or information resources. Individuals mainly worked as individuals.

Group F

Session 1
As the researcher left the room to allow the group to begin their meeting, the members made the space their own (*Stage 1 Greetings & Organizing the Room*). Members moved the furniture, and discussed how they should work during this session. They agreed that they did not want to use the computers (no tools), but just wanted to talk. Comments were made regarding the cameras and being watched. Judging from these comments it appeared some members were uncomfortable with the space and the idea of being watched. The group then began project *work (Stage 2 Problem/Task Assessment)*.

Group F came to their first meeting prepared to work, with one member (Participant 3) bringing an outline (artefact), related to the literature review and class presentation,

which was used to help organize their workflow. A range of sources were brought to this meeting. A couple of members (Participants 1 and 2) brought books, one member shared an article (Participant 3), and all members referred to, and flipped through course notes. During the second stage, which lasted about 30 minutes, the group began to assess their topic (the project) and to identify the sub-tasks they would need to complete. They began by sharing; individuals within the group started to contribute their thoughts. During this process the group started editing the outline; it became a key group artefact. The categories and sections in this outline served to prompt and organize their thoughts. They looked at this collectively, but individually took notes on their own papers.

The group tried collectively to determine the relevant legislation and acts related to their topic, working to define the scope and understand their problem. They were questioning each other, and clarifying the scope of their project, including things like geographic regions they should cover, topic areas, and what might be good discussion questions. The group was trying to collectively learn about their topic, and to confirm and keep track of specific facts. Listening to their conversation, members seemed hesitant. Sentences included phrases such as: "I know"; as well as "I think". Members were sharing information they were sure of, and more speculative knowledge.

They needed to clarify both the topic and their group deliverables (e.g. questions such as "Do we have to do a paper as well"?). Storytelling was used by individual members quite a bit in this session. There was a leader through much of this section; one member who the others seemed to be confirming things with (Participant 4). Most of the discussion was relaxed, with much use of humour.

The group initiated a discussion about the best ways to share information over the course of the project. They would use PowerPoint for the presentation, but wondered whether the course management system (Blackboard) had space that groups could use to collaborate. The trigger to end this stage and start dividing the topic was affective - one member commented that the topic was "*almost overwhelming*" (Participant 4). The group was trying to understand their project by pulling information from multiple sources including books, articles and individual notes. They mainly worked as a group during this phase.

During the third stage *(Stage 3 Dividing & Refining*) the group continued to work on defining the problem, but also began the process of the division of labour. To deal with their sense of being overwhelmed and swamped by the topic, the group decided each member should pick areas of interest from the list and research them individually between meetings. The group thought this would work – "*as long as we share, to ensure we will not be duplicating work*" (Participant 3). As part of this process, the group continued to learn about their topic and initiated searching to find specific facts. To accomplish this, the group began to use the computer, contrary to their initial plan.

The group collectively tried to determine their information needs, and used government web sites (sources) and Google as a tool. The group was learning about each other, and members were individually demonstrating their skills and prior knowledge, by telling

stories, and providing examples. They discovered that one member had a social sciences background. The other three members had science undergraduate degrees. The member with the social sciences background (Participant 4) acted as the "leader" in the discussion for much of this meeting. Members used their prior experience and interest to select the sections of the project they wanted to research.

Commenting on the time, the group concluded their meeting (**Stage 4 Adjourning**). They established a list of objectives and goals for the next meeting, and organized their process. All members would independently research their topics, and bring a summary to the next meeting. Members continued their discussion of how best to communicate**.** They debated if they could they post things to a group space on the Blackboard site? Or should they begin to put things in a PowerPoint? Should they alert other members by next meeting of any changes that should be made to the planned outline based on their readings? Also any overlaps? These questions were discussed by the group, without any final answers being determined. Members agreed that they should bring to the next meeting any contacts or thoughts on the field trip or guests to invite to class. Work during this whole meeting was concentrated on understanding their topic.

Three individual information seeking episodes (needing, finding, using) were observed to arise spontaneously from the conversation during this meeting. As noted the group had originally decided to move the computers to the side, thinking they would not need or use them, members brought one laptop back when they realized it would aid them in finding information (tool). The information seeking episodes emerged from their discussion, and different members took on different roles, with one member doing most of the searching (find), and another editing the outline (use). One information seeking episode revolved around locating a news clip on a recent change in Government policy which related directly to their topic. Participant 4 set up the computer and tried to locate the clip. All members watched the news clip.

Session 2
During Session 2 the group focused on integrating their individual work on the literature review into a group presentation. The group was still determining the scope of their topic; they had not yet reached a shared understanding of their topic. The group members were aware and concerned about overlaps between their topic and other groups' in the class. They needed to search, find and use information, and used a range of tools (as will be discussed below) to facilitate a shared or collective understanding of their topic, and to determine how they would organize the presentation. Illustrating the information intensive nature of their tasks, there were eight separate information seeking episodes identified during this meeting. The session ended with a sense they had begun feeling overwhelmed and worried, but that they had made good progress.

At the beginning of the session members filled out the Digital Diary, and had a general discussion *(Stage 1 Diaries & Chat)*. Stage 2 (*Updates & Scoping out the Tasks*) began as one member (Participant 2) updated the others on activities between the meetings. The group systematically went around the table sharing their conversations, activities, and findings since the last meeting. The discussion centred on the field trip and guest

speakers. They were confirming the details of their project still – did they have to organize a field trip? Yes - the group determined through discussion– this was mandatory. But did they also have to bring in guest speakers. There was less certainty and less agreement on this point. They also discussed at a high level what they needed to cover in the presentation. Most of the discussion was at the level of negotiating the boundaries of their project, and ensuring they had a shared understanding of what they needed to do, and how they could accomplish their tasks. There was also some conflict over expectations of how they should work. Two members (Participants 1 and 2) came to this meeting with draft PowerPoint slides already created, while two did not. There was confusion about what they had promised to do for this meeting. Participants 1 and 2 merged their slides. There were some issues with the computers at this point, one was slow and non-responsive.

The group then moved to a new stage (***Stage 3 Understanding the Topic***) where they discussed the presentation in greater depth. During this stage there was joint computer use (tool), and use of materials prepared individually and brought to the meeting (sources). The pattern of communication was one member to all, followed by a process of analysis. Members checked expectations "Are "*we*" going to…?" to ensure the group was aware of what the requirements were. The group also commented frequently on the need to "*keep track*" or "" (information activity – keeping track). There was a clear sense they did not want to lose track of any of their "gems" – good ideas they might forget. During this stage the group was working directly on their literature review, but the discussion lacked focus. Participant 4 for example asked - "*So do you think we should do it that way – International then national*? "*It's going to be tough to break it down like that – it is so…intertwined*", was Participant 2's reply. Comments such as these indicated members were struggling to figure out how to organize their material. They did not have a clear sense of what aspect they should start with, and how the different sections should logically flow. They were using the outline as a common group artefact, but that was not sufficient to allow them to solve their information overload problems.

There was not a big break between Stage 3 and 4 (***Establishing the Boundaries of Their Topic***). The group shifted focus from defining their topic, to differentiating their topic from other groups' in the course. Members tried to clarify their boundaries by discussing what other groups in the course were doing. They were trying to decide what was core to their topic versus what aspects would be covered in other presentations. The decided they should talk to other groups to ensure there was not too much overlap. The group worked together, but also sub-groups formed during this time. There were problems with the internet access of one computer, and frustration around this.

To help determine the boundaries of the project group members searched and shared information from multiple sources. A member (Participant 1) searched for an association, another (Participant 4) "Googled" an international convention to clarify details, and another participant read from an article (Participant 1). There was frustration with all members trying to see one computer, and issues with slow computers. Mid stage the group requested (Participant 4) and was given a flip chart to help with the process of working collectively with information (Tool). This was a very information intensive

session. There were a range of sources being used simultaneously; notes of individual members, the draft presentation, articles, books, as well as the information found on the internet. The group was looking for information to help them understand their topic, and to confirm specific facts. They were also trying to organize the information they had found. Members also discussed the usefulness of having the outline (group artefact) to keep them on track. They could just "plot things in as they moved forward".

In an effort to move forward, the group decided to try and work on a redraft of the outline (***Stage 5 Re-Draft Outline).*** There were parallel processes going on. One member was using the flip chart (Participant 1, then 4, then 2). Another was updating on the computer (Participant 3). They were working with two copies of the outline, one a communally constructed one on the flip chart, the other created from editing the original outline. This was also a very active part of the meeting. There was frequent moving of chairs, members physically changed places and roles and tasks. The group was working to analyze and synthesize the information found to date, and were still dividing the overall labour. There was some conflict related to decisions re the task. Members made comments like "we need to get a grip" (Participant 4), and that the topic was all over the place, overwhelming and unwieldy. There were moments of clarity – for example one participant (Participant 1) noted - "We just had a moment"; a flash of insight. Then members commented on the need to ensure they had captured these "moments". There was a sense they had to keep track or would lose something important.

During this stage the group looked for information collaboratively, continuing to learn about the topic and confirm facts. In addition they group acted to keep track of the information and ideas they found. They were using the flip chart, computers, Google, pen and paper. Participation shifted from working as a group, to completing some activities in pairs.

The group moved to the final stage of adjourning (***Stage 6***) as they noted the time. Members commented on their progress. "We started slow but good progress" (Participant 4). There was agreement that they needed to finish the new draft of the outline. There was some subgroup activities, two members working online, two on the flip chart. This final stage focused on logistics. There was discussion of how people work, and a recognition that they needed to understand each other's processes as well as the work task. Two members wanted to start finalizing the slides (Participants 1 & 2). Two members felt it was too soon for this, they would be changing them, so the slides should not be collected until later. There was clear division on this topic. In terms of their project, the group was still struggling to organize their topic. Members used colored markers to help organize the outline and keep track of changes. There was some discussion of the fact they were part of a study, and a mention of the fact they were being recorded (Participant 3). Summarizing their own sense of the meeting one member commented "I was worried in the beginning…but this is coming together" *(Participant 4).*

Session 3
During the third session the group branched out to discuss the guest speakers they should invite and the class activity they needed to organize as well as continuing to work on the

literature review and their presentation. In addition to the outline the group also continued to create a flow chart, the second key group artefact. This played a critical role in the process of synthesizing information.

As the meeting started (***Stage 1 Diaries and Greeting***) the group was largely chatting about other things. The group appeared to be were building relationships, using humour and teasing each other. The group quickly moved from this initial phase to a systematic process of updating and confirming progress made between meetings (***Stage 2 Updating & Clarifying***). Each member provided updates. This was a very active stage. There was both joint and individual computer use, use of sources including books and websites. One member (Participant 3) received a phone call (tool- cell phone) from an "expert" who might be a potential speaker and who had ideas about the field trip. There was discussion of citations, and key articles (sources) a member felt all should read (this had been shared by email).The group reflected on their process and decisions – "*what did we decide again*?" (Participant 3).

The start of this stage involved an individual to group mode of communication. Then they moved to group discussion. The group discussed the need to talk to a key human source (information source – expert). Two members had identified a person within the Faculty who was an "expert" in the area (Participants 3 & 4). They felt they should organize a meeting with this expert to ensure the group hadn't missed critical information, and to confirm other key resources they should be using. There was collaborative searching to confirm facts, and help clarify and make sense of the scope of the topic. The trigger for the end of this stage was comments about being overwhelmed by the layers of the topic. This led to the decision to go back to the flow chart (group artefact) to better see how the pieces fit together.

During the next (***Stage 3 Creating a Flow Chart***) the group used two tools, the flip chart and computer to create a flow chart. The group stated that this would not only help them see how things fit, but would be a great tool during the presentation to illustrate the topic to the class. They spent quite a while trying to organize the stakeholders/legislation on the flow chart on the flip chart. One member took on the role of scribe, consistently writing, as well as providing leadership (Participant 4). There was joint and individual computer use, and joint and individual searching. The group needed to search the internet for legislation, government sites and NGO sites. The role of searcher was most frequently Participant 3. In their conversation the participants concluded that although their flow chart wasn't working perfectly - it was a good start. Creating the flow chart helped the group move forward - "*this is how we are going to get through this*" (Participant 4). The group moved to adjourning (***Stage 4***) and recapped what they had done, and what they needed to do next.

Session 4
In session 4 the group discussed potential articles to assign the class, continued to identify potential guest speakers, and to discuss options for the class activity. Members increasingly commented on their awareness of time, and that they really had to make a decision on the location for the class activity and the number and potential topics for the

guest speakers. The group continued to work on the flow chart and outline related to the literature review and the presentation.

The session began with the filling out of the diaries, and general greetings *(Stage 1 Diaries and Greeting)*. The group members chatted about things not involving their project. The group then moved to updates (***Stage 2 Updates and Discussion***). Members took turns reporting on updates on calls made to potential speakers and experts for the field trip. One member would speak, all would respond to that idea. There were no decisions, only negotiation and discussion. Members commented on feeling "scattered" and the need to "nail down" (Participant 4). This is seen as the end of this phase.

During the third stage (***Decision Making***) of this session the group trying to assess options and make decisions. They struggled and debated over their class field trip choice in particular. They debated between several options, and made phone calls to confirm options. They were concerned about the time for the class trip, and questioned if in fact this task was necessary for the project. They searched the internet to provide background information to help make decisions, for example they found and assessed details including distance and travel time to choose between options. This phase "ended" when some members left to discuss their concerns/frustrations with the course Professor. Participant 1 stayed to continue work on the flow chart.

During the fourth stage (***Sub Meeting & Individual Work***) of this meeting work was split. The group felt they did not have the full information to make a decision so they took steps to gain that information. Participant 1 remained behind to work on publisher using the flow chart on the flip chart as an information source. The other 3 met with the course Professor to confirm plans, receive feedback and assistance and to relieve their increasing anxiety and frustration.

The members returned. The group determined they did need to organize the class trip. All members resumed work on the outline and flow chart for the presentation (***Stage 5 Outline & Flow Chart Re-Design)***. This involved sharing, analysis and synthesis. There was mention of particular sources such as the "*book*"- a core resource two participants were urging all to read (Participants 3 & 4). Members referred to notes, websites of regulatory bodies, and legislation.

Due to time pressure the group transitioned to adjourning (***Stage 6***). During this stage the group made goals and plans for the next meeting(s), and confirmed what they had done/decided in this meeting. Specific follow ups were promised for the next day or so – and they would plan to meet the following week.

There was reflection about their flow chart. They group recognized that had made a start collectively, but it wasn't working out perfectly. The group assessed technologies they could use for the flow chart. They also discussed the feasibility of using two computers for their presentation; one with the flow chart - that would highlight what they were talking about, and the other with their slides. There was a discussion of how they might have a flow chart with automated features, to guide the class through the topic. As some

members left and two remained (Participants 3 and 4) there was an indication of discomfort. One commented; "*I really need to get my head more into this*" (Participant 3). They reassessed the idea that the group, or some members, should speak to an expert, because "*sometimes you just get so stuck in your own view*" (Participant 4). As the meeting ended each member was going off to work on their individual parts.

Session 5
During this session the emphasis shifted from collectively examining and assessing information to working with information they had already collected, and combining individual sections into their final draft of the group presentation. Members discussed and identified a style and template for their digital presentation and worked to ensure they were all on track for finalizing the content and timing of the presentation.

A very different tone could be observed from the members during this session. For example there was very little idle chat. Observing their body language and their voices, there appeared to be an atmosphere of stress. Group members commented not just about this project, but work for all courses. Participants mentioned that this was a tough time of the year. Different patterns in body language were observed, more shifting and nail biting.

The group discussed logistics (Stage 1 Greetings & Logistics). When should they do a dry run? What should they have ready for the next week? They continued to discuss the format choice for their slides. The group also debated how they were going to meet with the field trip person. When and how could they all get there? Because of this it took longer than normal to fill out their Diaries. The trigger to move to the next stage was task and time pressure. "Can we set some goals for today (Participant 2)?

Members all seemed tired – there were yawns and rubbing of the eyes. The group moved from discussing logistical details to trying to focus what they needed to do this session (***Stage 2 Goals for the Session***). They discussed the number of slides they should have in total, and the timing for the presentation. This was a brief discussion. The group then began discussing how their class session should be organized.

For the bulk of this meeting the group tried to decide how all the parts of the project would be organized within the timeframe they had for their class session. They discussed the number of guests, the time to allocate for them, and how long would be left for the group's presentation. They determined how long each member should talk and the time to leave for questions. They also had to finalize the field trip details including the time to get to the field trip and back, and the length of the field trip activity.

The group used the flip chart as a tool to try and plot the time line. There was much sharing, synthesis and verifying, and comments that indicated uncertainty, anxiety and worry. They seemed to be struggling with not having a full sense of the topic - that each only knew their piece, and did not know how the whole was coming together. Members commented that they "*trusted*" that the other members knew their sections. But at the same time members needed to keep clarifying and checking. Some members (Participant

3 in particular) seemed uncomfortable that they did not yet really "know" what the others knew.

Some members had done more work, or were further ahead in terms of their part of the presentation - this created an asymmetry in terms of the group. One member stated he felt comfortable (Participant 2), two clearly stated they were concerned (Participant 3 and 4), and one did not voice any strong opinion regarding their confidence level (Participant 1). There did not appear to be a sense of shared understanding. The group was making some decisions, but mainly clarifying, questioning and negotiating. There was conflict, and comments such as "I need to know"…what the others would be saying. There was also concern about knowing exactly what the guest speakers would talk about. One member (Participant 4) commented, "I kind of want to put a speaker phone in here and call him".

During Stage 3 (***Organize the Tasks***) there was joint use of the computer. The group was moving between their slides, the flip chart, email, and notes. The discussion revolved around processes, how and when to put the final presentation together, and what kind of a style to use. The group did not have shared understanding. A member commented - "I'm picky like that" (Participant 4) - and wanted very standardized, uniform slides. Two were quite vocal on this, one member was much more flexible (Participant 2), and the other member did not voice a strong opinion (Participant 1).

Information sources including Google Map and people were used. Members referred to books and articles read. The group also need to "re-find" questions they had written down before – "where are our questions? I think we jotted them down on a loose leaf?" They also referred back to the video (source) they watched in the first session – should they show this to the class and have a discussion question from it?

Members made comments on how "hard" this was - to work together on such a large project (Participant 4). There was multi-tasking within the group - group, individual and pair activities. There were periods when the group was quiet – engaged in individual tasks.
The group then moved to a stage of summarizing and finalizing the results of their discussion (***Stage 4 Concluding Recommendations***). The group did one more "task" after this, but this was the summary of the discussions of the meeting to date. The group created a timeline based on their negotiations.

One member commented on how much he had learned through this group project, and the amount of time they each had spent (Participant 2). Commented "*no reason why we can't do well*" (Participant 1) but the rest of group seemed uncertain. Another member mentioned that they were not sure what would make an "awesome" presentation rather than just good? (Participant 3) Members stated that they did not have a clear understanding of how their project would be evaluated.

One member commented that they knew they had two weeks, and that things would come together - but that they "*feel like it is not there yet*" (Participant 4). Three members commented on how they don't have a grasp of the whole (Participants 1, 3 & 4). Two

commented on feeling somewhat terrified (Participants 3 & 4). Participant 2, who felt more confident tried to reassure the group. Then they moved on to their last goal for the meeting, picking a "style" for their slides.

During Stage 5(*PowerPoint Slide Design*) the group tried to agree on a basic template for their PowerPoint slides. They worked in pairs on this, examining Google images, government websites as well as PowerPoint templates.

As the group adjourned (*Stage 6*) most of the conversation was off task. They made comments about the Master's program, the amount of work, and specific projects in other courses. There was a general agreement that all felt overloaded, and some indication of frustration.

Session 6
During Session 6 the group spent much of their time integrating each member's slides into one presentation. This session ended due to time pressures, and with a feeling the presentation was almost, but not quite ready. Members were to individually examine and review slides given the whole presentation, and they would quickly run through things before class.

As with Session 5, this session began (***Stage 1 Diaries and Discussion***) with a high level of stress. Group members were discussing issues with other courses as they filled out their digital diaries. Issues and problems they were having were discussed. There was little discussion of their project.

As the group moved on task (***Stage 2 Getting Ready***), the first thing they attempted to do was to merge their individual slides into one deck. They experienced a number of technical issues just sending the slides and combining them - some of which related to slow internet speed. They also had to "format" the slides once they were combined. There was a bit of difficulty getting the slides to show on the projector, which they had requested be available for this meeting.

During this time they continued to have both on task and off task discussions, to discuss other classes, the number of slides needed, and how they should control timing. One member suggested that they could try to record time cues in the presentation. Individual members discussed their slides, highlighting what they had tried to capture. The mood was anxious, frustrated and fairly tense, they were very aware of how long this was taking and the passing of time. There were some technical issues with the slide format - not what the member had done. Updating the format would have to be redone. Members used sarcasm to control their frustration - "*I love technology - makes our lives sooo much faster*" (Participant 3). Members used email and a memory stick to combine slides. One member (Participant 1) was working on the "Schedule" for the day". Finally all slides were combined and they were "Ready to go". There was a mix of individual, sub group and group work during this phase.

During *Stage 3 (Dry Run)* the group viewed the integrated presentation for the first time. There was tension as members did not all agree on how individual sections flowed with

the whole. Members questioned and clarified content on each other's slides, and the information presented by each member. Members questioned and confirmed the information, the sources, and the order; trying to develop a "group" view of the topic. There were examples of divergent prior knowledge, discussion of prior experiences, and discussion of how language is used differently in different spheres (science vs. policy). There were gaps in their shared understanding at times. At times members directed each other – "*you should*". One member was more crunched for time than the others and had to leave early (Participant 2). There was task related conflict, and a clash between individual and group understanding. The meeting ended based on time, with members commenting on not quite feeling prepared.

Group G

Activities by Stage
Session 1
The group began with general chitchat (***Stage 1 General Chatting***), but quickly moved into work mode (***Stage 2 Getting Situated***). The transition was prompted by a member (Participant 4) directing the group to what they had completed, and what needed to be accomplished that day. "*So the consent form is looking really good, the next thing we need to do is the interview guide*", (Participant 4). Members discussed whether they had been given a copy of a sample interview guide, and checked the course website. During this activity, one participant (3) commented that they did not want to sign in with their password, as there was tracking software on the computers as part of the study. Participant 3 questioned - "*so they can track everything? They can see my passwords*?"

After determining that they did not have a sample guide the group decided to not worry about the format for now, but to brainstorm about potential questions (***Stage 3 Interview Guides Draft 1***). The group established different roles for different members. Participant 2 was told he had a "free pass" as he took a lead on the literature review. Participants 5 and 6 went to the white board wall and started writing with markers. They both took a different section of the board, and concentrated on a different audience for the guide. Participant 1 started to copy what was on the white board onto paper, until Participant 4 suggested it should be done on computer so it could be emailed and edited later. The group worked in the following manner, individual members would contribute an idea, which the group would collectively assess and debate. They worked through question and answer – "*What do we need to know*", and members would suggest ideas. Members were very supportive of others' ideas and the process, for example comments like "*those are good questions*" were made.

The process during this stage was both structured and productive. There was a great deal of humour and laughter, and the tone was "light". The group remained focused mainly on their project, but would occasionally spin off into side conversations as well. At some points there was much overlapping conversation. They mainly worked as a group.

Participant 4 took on a "leader" role. Noting the time, he suggested that they should be able to complete their work by 6:30. The conversation was active and dynamic, and

covered potentially controversial topics, the group seemed happy to work with information shared by members. They did not use the computer to search for information, or even notes to look things up. This seemed to be a conscious decision. For example at one point someone asked if they should confirm a fact by examining the policy. The group decided to - "*just write it down now, and check later*" (Participant 4). The commented that their goal was to surface ideas, not confirm facts. This stage ended as Participant 4 noted the time – "*it is 6:30 – is there anything critical missing?*"

This prompted the group to assess their progress (***Stage 4 Adjourning***). They had covered demographics, prior knowledge and barriers. The group determined that they could not finalize the guide until they had a copy of the template. Participant 2 emailed (tool) the Teaching Assistant to see if they could get the template. The other members confirmed they achieved what they could at this meeting. Participant 4, monitoring the group's progress, checked to see if everything on the white board has been typed into the computer. Participant 1 confirmed this, and committed to emailing the notes to all. Members agreed that once they looked at things on paper they would likely all have more ideas. The meeting ended. The group used the white board and laptops, and email, and there was some use of pen and paper. The only shared information, there was no information seeking episodes. They did request assistance from an "expert" (Course TA), to obtain the template as soon as possible. They worked as a group for most of the meeting.

Session 2
At the beginning of the second session four members arrived early, and had to wait for two members who were coming from another class (***Stage 1 Diaries and Waiting***). There was general chatting about common social events, and general news. Members seemed to know each other quite well; they told stories about common events and acquaintances. The talked about social interactions outside this course project. Participant 3 was a part time student, and asked for clarification about some of their jokes. As all members arrived the group swiftly moved into work mode.

Stage 2 (***Getting Organized***) began with praise for the work done to date - "*Good job, again*". Participant 2 had a hard copy of their artefact from the last session, which they needed to share to work with in this meeting. They used a flash drive (tool) to pass this artefact around as there were issues with the laptops. To work more effectively as a group they decided to use the large monitor as a common interface. Once documents had been shared they looked at the sample template, and concluded it would be straightforward to make the necessary changes. Participant 4 stepped in as a leader asking - "*what are our goals for this meeting*?

The group decided to work on one interview guide (***Stage 3 Revising Interview Guides***). Members collectively and systematically edited the document, which took the bulk of the meeting. They worked largely as a group, with occasional side conversations about other courses and projects. They were all motivated, but it was difficult to keep all six members engaged for the whole time.

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Work was distributed in different ways among the members. Starting with this meeting, and continuing through the next, Participant 6 controlled the computer and the large monitor, doing all data input (editor). At times he was also the content creator, and other members actively watched. Other times he incorporated suggestions from others. The majority of the time the work progressed through the same process; members made suggestions, the suggestions were considered and analyzed by the group, and changes in the group artefact were implemented by Participant 6. All members participated, as observed by their gaze and their comments. Members followed their progress collectively, by observing the changes in the document on the large monitor.

Participant 4 continued to lead their process, making suggestions such as -"*let's not waste too much time "wordsmithing"* to ensure efficiency with the group time. He commented that the group time should be used to ensure they were surfacing all the best ideas. Fine tuning could be done by an individual outside the meeting.

Some members were also following the unedited version of the document on their computer. Some looked at notes or print copies (sources). Participant 4 passed around physical copies of templates they were given in last class. Participant 6 accessed their literature review (source) to confirm their Research Questions, accessing the marked copy through his email. Members also moved their seats to gain a clearer view of the monitor. When Participant 6 noticed attention was wandering he would ask a question to bring their focus back to the monitor. Participant 4 had to leave early, but the others remained to work through to the end of their document.

As they finished the group assessed their progress (***Stage 4 Adjourning***). Should they go through it again? Several members said no point - Participant 4 (who had left) would edit and rip it apart - "*but in a good way*" commented Participant 3. They congratulated themselves on their work to date - "*Fantastic document*". Participant 2 moved over to help Participant 6 create a linked table of contents, as the group finalized the document and moves to adjourning (Stage 4). They congratulated themselves – "Good work" and "ok team take care".

Session 3
The first part of the meeting was about organizing who they could interview and who would talk to the government and policy contacts (***Stage 1 Diaries and Organizing***). Participant 6 was back at the computer attached to the large monitor. He was typing a form email - which all members would use to contact participants. Other members, particularly Participant 4 suggested a few grammatical changes. This email was saved and sent to all. There were some things the groups still felt unsure about related to Assignment 2. They needed to confirm a couple things with their professor regarding who they could interview. Participant 2 texted his sister (cell phone as tool) during the conversation to confirm the contact information of some potential interviewees. They determined they had done as much as they can about the interviews, and moved on to their next goal.

During the next stage (***Stage 2 Incorporating Feedback***) the group systematically worked through the comments from their professor regarding the Information Guide, making revisions collectively. Participant 6 typed (scribe). All the group members provided suggestions and comments. They used the large monitor, and expanded the comments field so all could see the feedback.

As they worked they did need to confirm facts and details; members consulted sources including emails, course materials and individual notes. They did not actively search for information though the internet though. The group communicated by email with the professor during the session to clarify a detail related to their project. As they finished the revisions there was a sense of progress being made– "*good work guys*" (Participant 4). They reviewed their "to do" list which had been created by Participant 4 and took a vote on whether they should start the questionnaire (subtask 3). The group decided yes –they should brainstorm for ten minutes or so.

The group started to brainstorm (***Questionnaire Draft 1***), but were not as organized. They thought about using the whiteboard, but ended up with Participant 1 typing their notes into a computer. There was an issue with the connection to the large monitor, so they could not share the common monitor. They spent 20 minutes suggesting and negotiating potential questions, and finished a rough draft. They discussed that these questions might need to change to ensure they would get the right data for analysis. The goal of the survey was to generate mainly quantitative data, that they could analyze using SPSS (statistical analysis software).

The group moved to adjourning (***Stage 4).*** They concluded that they had done as much as they could, and comment that they had accomplished a lot. They confirmed a schedule for their next meeting, and discussed who would email the new group artefacts to all members.

Session 4
The first stage of this meeting was fairly long, not due to work, but because the group members arrived at different times (***Stage 1 Diaries & Updates***). There was some general discussion of the timing of their project, and assignments for other courses. One member (Participant 3) commented that he felt this was "*last minute*" –no choice with the way project deadlines were stacked - but he was not comfortable about it. While they were waiting they confirmed who had completed interviews (***Stage 2 Interview Debriefs***). Two of the participants (1 and 5) would not be coming to the session today as they were conducting an interview. The other members provided updates on the results of their interviews, as they were unpacking and filling out the diary. They compared notes on who had contacted potential "interviewees", and leads that needed to be contacted.

During this stage there was an information-seeking episode involving participants 4 and 6. The two were discussing a potential group they should interview, and realized they needed more information. Participant 6 checked the website, and read some information aloud. They did not make a decision about the interview and the conversation moved on. There was a gap between the identification of the need, and the sharing of the information

found. This stage ended as they begin to focus and Participant 3 volunteered to take notes from the meeting. Instead of moving forward however, the group moved back to discussing the interviews, with Participant Three sharing her reflections. This led to a group discussion on the emerging findings, especially the key barriers. The group moved to the next stage of the meeting as Part 4 drew their attention back to the questionnaire.

In stage 3 (*Questionnaire Take 2*) the group continued their work on the questionnaire. They did not have the notes from the last meeting. Participant 1 didn't send after the meeting - and was away this meeting. So they decided to brainstorm a second time - members did remember some of their prior discussion and decisions. Participant 6 worked at the whiteboard, Participant 3 recorded their work in Word on a laptop. This was necessary because the connection between the laptop and the large screen was not working. For this part of the session they were working as a group, and really brainstorming. Members provided feedback to each other each (i.e. "*that's really a good point*") throughout this phase.

There was information seeking related to a discussion over what was considered "mainstream" vs. "alternative" medicine. This led to an animated discussion, but the information discussed was not used to change the draft questionnaire. Participant 4 ended the searching with the comment - "let's get back to the project". They re-examined the questions - clarified a few points, and then agreed they have covered all the bases.

The group started to pack up and organize (*Stage 4 Adjourning*). They confirmed deadlines and schedules - and who would do what. Participant 3 found the missing notes from last week on the computer - and sent them to all by email. They checked this draft, but felt like they did cover everything in the new questionnaire. As they prepared to leave there was continued discussion related to their information searching. Participant 3 showed them all the YouTube video she found, just for entertainment. There was some duplication of work on the questionnaire. The group took a picture of the white board with a cell phone - just in case. During this session the group tried to re-find information (questionnaire started the prior week), used information sources including individual notes, people, and websites, and tools including email, computers, Word, the white board, Google, and cell phones.

Session 5
The members who arrived first checked email, and searched for and watched funny videos' on the large monitor (information seeking for fun) (*Stage 1Diaries and Organizing*). There was some discussion of their project tasks, but mainly just waiting. The mood seemed fine; there was no observable sense of panic or pressure.
Stage 2 *(Transitioning)* was initiated as Participant 1 announced that the Professor had just sent an email with updates and reminders about the questionnaire. The group needed to add open ended questions. Participant 6 started talking about his interview - sharing with the group and updating them. Mix of chatting generally and individual work. At the end of this transition phase the group moved to focusing on the questionnaire - question by question.

For the third time the group revisited the questionnaire (***Stage 3 Questionnaire Take 3***). Participant 6 had put the questionnaire up on the large screen so all could see -as they worked through it. Participant 2 had formatted the questionnaire on his computer (a Mac) - so he was making the changes in parallel, as required. The copy on the shared screen was a PDF and is not editable. Participant 6 highlighted the question/words they were discussing to help all keep track. During this session they worked consistently at the group level - debating words and concepts, and generated the final copy. They analyzed each question in the questionnaire in a systematic way. They discussed everything from the content, specific words, the scale, and how it looked on the page. The discussion was quite animated, members had strong feelings about how to present some information (i.e. age, education, how to refer to alternative/traditional medicine). In addition members were incorporating feedback from the class on their draft questionnaire. Towards the end of this stage they confirmed the decisions they had made earlier.

All members participated. There were some differences of opinion, but the group worked through this. For example, at one point Participant 4 made a decision, and commented "*it's on my head if it is wrong*". The group consistently shared information and constructed new content- generating a shared understanding and agreement for the questionnaire. There was no external information seeking during this stage, members referred to the literature review (prior group artefact), but no one looked at the actual document, or confirmed any facts.

As the group finished the questionnaire they examined their "to do" list (***Stage 4 Other Tasks & Adjourning***). They discussed ideas for upcoming assignments as they packed up and left. Participant 2 confirmed he has made all the changes necessary for the questionnaire. Sources used included individual notes, feedback from the professor, and the interview transcripts. A range of tools were used including the laptop, large monitor, a Mac, the white board, word, email and cell phones.

Session 6
Session 6 started off with focus (***Stage 1 Goal Setting & Interviews***). The group identified that they needed to finalize the questionnaire, and that they would like to be finished by 6:30. Before they started this, members discussed other aspects of the project. One member (Participant 4) commented that he had some free time this week, so would start on the introduction to the report. Members chatted generally as Participant 6 brought the questionnaire up on the monitor (***Stage 2 Finalizing Questionnaire).***

The group needed to merge updates from multiple sources into the questionnaire. Each member had collected feedback from beta testing, and they had received feedback from the course Professor. They needed to assess and discuss all the feedback collectively, and make a decision regarding what they should change. This was a complicated process involving the large monitor, individual notes, and emailed notes from the professor.

The group worked by sharing and analyzing, at the group level for the most part. Participant 6 was consistently the editor, and also contributed content. There was information seeking, done individually and then shared - to provide synonyms

(Participant 1). There was some laughter; members were in a good mood. Working hard, but happy with their progress. Even with the shared view the group used the white board to brainstorm around how to format some sections of the survey – they needed to be able to sketch free hand to show what they wanted to say.

There was a systematic process to work through the entire questionnaire. At the end of the session members prompted each other– "are you happy with this"? The questionnaire was sent back to Participant 2 to finalize the formatting on the Mac.

The group was very focused this meeting, with all the work being done in this second stage. The group moved to adjourn (*Stage 3 Adjourning & Logistics*) confirming that Participant 2 would send the final copy to the Professor, and referring back to their subtask list. Should they start the presentation? Participant 4 volunteered for a second time to start writing the introduction to their report. The group decided they should do the introduction, and analyze the data before starting the presentation. They took a team picture with a camera brought by Participant 5. The group had looked for information to find fact, and to keep track. They mainly worked as a group.

Session 7
The group chatted as they filled out their diaries (*Stage 1 Diaries and Getting Organized*). One member commented they had been doing more activities between meetings than any time prior. Several expressed how helpful the large monitor had been. "Love that thing". There was a greater sense of anxiety, comments related to the amount of work they had to do, and the fact they needed to get going. Participants 2 and 4 started to move to the computers and began working (*Stage 2 Multitask*). Participant 3 was missing from this meeting

Participant 4 and 6 worked together, using 2 computers, the MAC for the questionnaire, and a tablet computer with the email with the feedback from the professor. The others joined in as the questionnaire and email were displayed on the large monitor. They worked through the questionnaire feedback systematically, discussing the comments. The group didn't always agree with the suggested changes, and at times decided to stick to their original text. There was some pair and sub group communication and work. There was a technical issue with computer attached to large monitor. It was rebooted.

Moving into the next stage *(Stage 3 Planning)* Participants 2 and 4 continued with the Questionnaire, while Participant 5 started organizing how they would recruit participants to complete the questionnaire. Using the white board they tracked the numbers and locations where they would try and recruit participants.

As they adjourned (*Stage 4 Logistics & Adjourning*) the group confirmed timelines, deadlines, and who would do what. Participant 4 asked Participant 6 to pull up calendar, and the syllabus - so they could see the due dates, and confirm what needed to be delivered. They discussed logistics including how they would get the survey printed. A member called the Teaching Assistant (Information seeking – external to the group) and

confirmed she would assist with the printing. The meeting ended with the group searching and watching a You Tube video for fun.

Session 8
Group members arrived at different times. As they waited the group worked on integrating the survey results into one SPSS file (***Diaries and Collecting Survey Data***). This proved difficult, as members had emailed their files, but the DalMail server was down. Members left the room to go to the computer lab with a memory stick to transfer the data.

During this process Participant 3 laughed and commented how in the beginning said she would never put her passwords in the computer – and now she doesn't care. They all commented on how they thought they would watch their behaviour but they haven't. Once all the data had been located, the group moved to the next stage.

The process of data integration (***Stage 2***) was mainly carried out by Participant 6. He took the data from the memory stick and integrated it into the SPSS data file. Part 2 asked everyone how many surveys they had - so they could insure all were included. All members provided their numbers, and they discussed how many have been completed, how many they needed, and if some were missing. The other members watched, but generally chatted off topic. Participant 2 walked over to Participant 6 to help. He provided suggestions. They checked the descriptive statistics to ensure all the data was there.

Once the data was integrated, all members were involved in the analysis. The descriptive data from SPSS was shown on the large monitor (***Stage 3 Examining & Cleaning Data***). The key people were Participant 6 who worked with SPSS directly (data analyst role), and Participant 2 who made notes about the key statistics in the hard copy of the survey. The group noticed there were some issues with the data, and started to clean it up. Participants 4 and 2 worked together at the monitor gesturing, and helping Participant 6 delete the bad files. They moved between paper copies and the large monitor integrating comments from all. At the end the group felt that data was in good shape. To clean the data collectively the group required multiple computers, print copies of the survey, email, SPSS and input from all.

Once they were happy with the data the group moved to organizing (***Stage 4 Division of Labour & Adjourn***). They discussed what still needed to be done, and agreed on a workable schedule. They couldn't finish some things until the data analysis was complete. More time was needed to work with the survey data. The interviews and appendices could be standardized. Participant 4 reminded the group he already volunteered to start the introduction. Participant 3 offered to standardize things for the report. All members volunteered for something. All members had a common task - they were to think about what they might need to compare in the data. They would learn how to code the qualitative data in class, and could continue with the data analysis next meeting.

Session 9
The members arrived at different times. Participant 6 moved directly to the computer and large monitor, and opened emails and files - displaying the document that had the statistical analysis. As members arrived they were chatting (***Stage 1 Greetings & Organization***).

Once everyone was there Participant 6 started reading some of the findings, and other members started to discuss (***Stage 2 Discussion of Statistical Trends***). The Group discussed the significance of the data, linking back to what they predicted in their literature review. They discussed how the statistics were calculated - and how data categories had to be collapsed to find anything with statistical significance. They assessed as a group how they might write the section of the final report. The stage ended when Participant 4 (role of leader) said "*I think we should figure out what we need to do to finish this*".

The group took a few minutes to 'regroup" and confirm what they still needed to do (***Stage 3 Planning***). They discussed what needed to go into their presentation. Participant 3 mentioned that she had started a PowerPoint and sent to all. People claimed sections and suggested they had already, or could update them for final report. To help organize members' commented that they needed to get this on some sort of timetable. They used tools including the large monitor to display a calendar and the outline of the report, as well as the draft PowerPoint.

During the next hour the group went through a very complex process of generating the PowerPoint (***Stage 4***). They used the draft presentation started by Participant 3, and incorporated information from the following: the standard report template given to the class, their data analysis, their literature review, and other documents (group artefacts) that they had created to date. Email was used to share documents, and then they were displayed on the large monitor. At times the group was working at the group level. A member would comment, and all would assess. They were also integrating information from memory – "*oh we need this*"…or "*what about this form*". Individual group members' waxed and waned in attention during this process. At times all were engaged, at times there was much off topic chat, at times there was good debate. Participant 6 consistently took on the roles of integrator and scribe. All participants were involved in giving some suggestions. All gathered around another computer to look at a form at one point. They shifted between programs on the computer - Data/Email/Presentation. At times members were doing things individually on their computers. As they discussed the presentation they were also talking about what was needed for the report. The group worked actively, until the combination of time and technical problems prompted them to stop. "*Ok is that good for now*? (Participant 4)

Group members moved to packing up (***Stage 5 Adjourning & Division of Labour***). Participant 4 volunteered to work with the data analysis section. He will add to the qualitative data, and rework the results section. Participant 5 volunteered to help. The group reviewed deadlines and deliverables. They decided to book one more meeting to go over the PowerPoint. The group moved off task and chatted generally as they left.

Session 10
Three members arrived and Participant 6 linked the computer to the large monitor *(Stage 1 Greetings & Waiting)*. There was general chatting and Participant 1 searched and showed a video of his nursery school class, others watched and laughed. Another member arrived and they opened the PowerPoint to start work.

The group started reviewing the slides (*Stage 2 Slide Review & Update*), discussing the overall content of the slides, making suggestions and generating new content. They were working both on changing the content and editing the format. They also were determining what would be said in the presentation vs. what was written on the slide. There was a great deal of overlapping conversations. They broke into pairs (2 groups of 2) at one point. Participant 5 arrived. Participant 3 was not able to make the meeting. Participant 6 was consistently the editor. All members took turns explaining and questioning. Participant 4 was consistently concerned about time. He wanted them to be efficient as possible as he needed to leave at a specific time. Tools used included the common monitor, the laptop and the Mac. This stage ended when the group was satisfied with the presentation and decided to do a dry-run.

The group did a full run through (*Stage 3 Dry Run Presentation*). The three presenters did their sections, and one member timed them. There were interruptions, and the group still made some changes as they went through. Members flipped through sources including books and notes to confirm facts. They alternated between "presenting" and asking for feedback from others. At other times member's volunteered comments. Their process was informal in some ways – members did the presentation from where they were sitting, but they did run through the whole presentation.

As they finished the presentation and moved to leave, the group confirmed the timing was ok (**Stage 4 Adjourn & Logistics**). They made one more slide for the presentation, for questions from the class. Participant 6 agreed to save and email the presentation to all members. The final report was discussed – members reviewed what still needed to be done. Each member commented on their availability and what they would take on over the weekend. All were observed to be fairly relaxed and happy with process.