Summer 2014

More than a game: Examining sensemaking and self-organisation in alternate reality games

Yeo Yun Ting Alanna
Purdue University

PURDUE UNIVERSITY
GRADUATE SCHOOL
Thesis/Dissertation Acceptance

This is to certify that the thesis/dissertation prepared

By Yeo Yun Ting Alanna

Entitled

More than a Game: Examining Sensemaking and Self-Organisation in Alternate Reality Games

For the degree of   Master of Arts

Is approved by the final examining committee:

Sorin Matei

Brian G. Smith

William B. Collins

To the best of my knowledge and as understood by the student in the *Thesis/Dissertation Agreement. Publication Delay, and Certification/Disclaimer (Graduate School Form 32)*, this thesis/dissertation adheres to the provisions of Purdue University's "Policy on Integrity in Research" and the use of copyrighted material.

Sorin Matei

Approved by Major Professor(s): _____

Approved by: Melanie Morgan   07/08/2014

Head of the Department Graduate Program   Date

MORE THAN A GAME: EXAMINING SENSEMAKING AND

SELF-ORGANISATION IN ALTERNATE REALITY GAMES

A Thesis

Submitted to the Faculty

of

Purdue University

by

Yeo Yun Ting Alanna

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Arts

August 2014

Purdue University

West Lafayette, Indiana

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Yeo Yun Ting Alanna, M.A., Purdue University, August 2014. More Than a Game: Examining Sensemaking and Self-organisation in Alternate Reality Games. Major Professor: Sorin Adam Matei.

Alternate Reality Games (ARGs) are an emerging brand of online role-playing games, immersive and highly interactive. This genre of games pioneered an effective and efficient form of collective play and problem-solving in loosely-defined situations, showcasing powerful and efficient sensemaking and self-organisation at work. In this thesis, an ARG titled "We Are Earthborne" was studied in order to understand the processes of communication, sensemaking, and self-organisation that occurs in the course of an ARG. Using the structure of Weick's organisational sensemaking and Latour's Actor-Network Theory as a lens, this study intends to break down how distributed groups of people can come together to create meaning, self-organise and use technology to problem-solve. Understanding these processes have positive implications for organisations to create optimal environments for effective problem-solving.

CHAPTER 1. INTRODUCTION

One evening in 2001, a group of people received a strange phone call. It was a recorded message made by a slowed-down voice that said:

"Good evening, meat. The year is 2142, and we are done with you. When the Mann Act passes, and the machines take over, we'll be watching. People like you are the easiest to track down. When the machines take over, our brave soldiers will delete you.".

While some people would dismiss this as a prank call, the group of people who received this call took this message very seriously instead. After all, they had been living in an alternate reality for the past three months where machines were sentient, and things in that reality were getting very serious indeed.

1.1 Alternate Reality Games

2001 was the year that heralded the arrival of a new brand of immersive, role-playing games that have come to be known as Alternate Reality Games (ARG). The above scenario happened in the climax of the first-ever ARG, which had been conceptualised as a marketing vehicle for Steven Spielberg's 2001 movie, *Artificial Intelligence: A.I.* Spanning four months, the game created a new form of storytelling in the information age; an interactive, immersive experience that provided players with game information through everyday network devices such as their phones, their browsers and even their mail when game artifacts were sent to them via the United States Postal System (McGonigal 2003).

Alternate Reality Games (ARGs) are an emerging brand of role-playing games, which combine online instructions with offline activities. For example, users are invited

to visit a site, where they get clues for finding a location or instructions to perform activities in the real world. Once completed, sometimes in the company of other players, the game continues online, where a new quest or challenge is proposed. Due to the "high touch" capabilities (Naisbitt, 1999) of the game medium, ARGs provide the user a heightened level of presence and involvement. Furthermore, such games enhance the immediacy and tangibility of game-playing, creating new, stimulating activities that engage the player at a deeper level.

More importantly, the game pioneered an effective and efficient form of collective play and problem-solving. Typical gameplay in an ARG consists of tracking and interpreting plot developments within the game narrative through evidence that circulated mostly through websites and emails, but occasionally phone calls, faxes and offline events. Players also had to crack complicated puzzles which "variously required programming, translating and hacking skills, obscure knowledge of literature, history and the arts, and brute computing force" (McGonigal 2003: 2). The myriad skill and knowledge base required to solve these problems thus made it necessary for players to group together and cooperate. Such games, with their unique style of platformless, collaborative gameplay, can pave the way for new types of social involvement in the post-digital era, especially in the areas of learning, training and collaborative task completion.

Yet, the manner in which collaboration takes place within ARGs is yet to be fully understood. A closer look at the processes of collaboration within ARGs show that the players are piecing together information in a very loosely-defined scenario. Collaboration between players takes place via the co-construction of their knowledge of the given game situation, and on a more meta-level the understanding of the rules and customs of playing an ARG.

A central component to understanding how collaboration in ARGs take place is thus to examine how people understand and learn the culture and the contexts of the games, as well as how players make sense of the rules, boundaries and contexts of scenarios, which are not often clearly defined. In other words, researchers should seek to understand how *sensemaking* occurs at multiple levels in ARGs.

1.2 Sensemaking in ARGs

Prior research has shown that sensemaking is a core component in the process of understanding the rules, learning from, and interacting in ARG. Understanding how sensemaking facilitates complex task completion is also an important research goal.

Sensemaking, literally, is the *making of sense*. In sensemaking, sensible meaning is constructed by active agents (Huber & Daft 1987: 154). Students of sensemaking try to understand what the subjects construct, why they construct, and what effects these constructs produce (Weick, 1995). In organizations, the process of sensemaking is an important and vital way of viewing the manner in which organizations function. Researchers of sensemaking in organizations thus put across that the sensemaking process is highly valuable for organizational members; using sensemaking, organizational members can understand and also share their understanding of the organization to which they belong (Feldman 1989: 19), and in the process presumably generating agency and personal investment.

While there has been research done in the outcomes of the sensemaking process, especially in organizational research, there is little done with regards to the social interactions in sensemaking. As such, with a focus on *processes* in mind, this study focussed on the processes and mechanisms of sensemaking evident in ARGs, and how the players involved are able to make sense of their situation in the unique environment of the ARGs. In order to understand the nature of social construction of knowledge in sensemaking, we can turn to the Actor-Network Theory to give us some insight.

1.3 The Actor-Network Theory and Sensemaking

By using Latour's Actor-Network Theory, we may have a little more insight into the manner in which knowledge is constructed within sensemaking. The Actor-Network Theory (ANT) takes a social constructionist approach that argues that understanding, meaning and significance are not developed within just the individual, but instead co-constructed with other human beings and other non-human artifacts, known as actants. When we consider that sensemaking entails the construction of the problem situation by

agents within their environment, we find that the ANT can thus provide significant ways in which to examine the social aspects of sensemaking.

The Actor-Network Theory posits that these actants form relationships with each other and thus create a complex system, or a "network". These networks may not be permanent, and instead the relationships formed between the different actants will shape and re-shape the "whole", or meaning and understanding of a situation. The theory thus assumes that relationships are constantly "in process", and that without such interactions, meaning cannot be formed. Similarly in sensemaking, shared understanding through communication and interaction is vital to understanding the problem and situation, and as such, ANT will provide a method of viewing the networks in which the meaning-making takes place.

1.4 ANT, Sensemaking and ARGs

The Actor-Network Theory seems especially apt for the study sensemaking in ARGs, as not only are there many immediately identifiable human and non-human actants in the network, the nature of gameplay in an ARG itself dictates that meaning has to be co-created with other players. By exploring the manner in which relational ties shift between these actants and how sensemaking takes place in ARGs with the help of technology, we will be able to gain some insight on how distributed teams can self-organise and work together efficiently.

CHAPTER 2. LITERATURE REVIEW

In real world practice, tasks and problem situations are often loosely-defined. Contexts and boundaries must instead be constructed from the situational cues and events that result from the environment. In this fashion, a practitioner must thus "make sense of an uncertain situation that initially makes no sense" (Schön, 1983).

For the most part, organisational analyses were centered around decision-making, but these have met with some dissatisfaction. Analysts felt that these decision-making preferences were inconsistent and did not take into account environmental factors surrounding a problem situation such as political and "symbolic considerations" (Reed, 1991: 561).

One of the responses to this situation was proposed by Orasanu and Connolly (1993), examining naturalistic decision making. Klein (1993) expanded this with exploration of situational assessment and sensemaking in his model of recognition-primed decision making, which couches decision-making around past experiences. For this study, the research is based on the sensemaking framework proposed by Weick (1995).

2.1 Sensemaking

Sensemaking, literally, is the *making of sense*. "The basic idea of sensemaking is that reality is an ongoing accomplishment that emerges from efforts to create order and make retrospective sense of what occurs" (Weick 1993: 635). In other words, people go through sensemaking to make things rational and accountable to themselves and others.

These people are known as "agents" (Huber & Daft 1987: 154). In this manner, we can see that sensemaking is both a subjective and intersubjective process.

In organizations however, the process of sensemaking is an important and vital way of viewing the manner in which organizations function. Weick defines organizations as social structures that "... combine the generic subjectivity of interlocking routines, the intersubjectivity of mutually reinforcing interpretations and the movement back and forth between these two forms by means of continuous communication' (Weick 1995: 170). This implies that sensemaking is predominantly cued by others. Sensemaking, Weick says, is thus a social-psychological process in which definition and context of any given situation are inferred based on "social-emotional ties rooted in mutual respect and trust shaped through interaction" (Manning 1997: 143). The aspects of these problems (such as the boundaries, elements of the problem, and such) are thus constructed by the agent himself to form a "clear and adequate formulation of what the problem situation is", and most importantly not alone, but through discussion and sharing with all the others who are involved (Shotter, 1993). The study of organisational sensemaking is thus not focussed on the subjective processes, but instead the intersubjective processes and how meaning is made through communication between a group of people.

In other words, sensemaking is the creation of *shared meaning and understanding* of a given context or situation based on *communication and interaction* with others.

As can be seen, the very act of sensemaking is a social and collaborative process on several levels. Understanding the cognitive processes of sharing and meaning ascription in sensemaking can assist organisations in quickly overcoming uncertain or ambiguous situations.

However, there is little literature that discusses the social aspect of sensemaking and the interactions involved in sensemaking that lead to a shared understanding of the problem. In order to understand further the social aspects of sensemaking, we can use the Actor-Network Theory as a lens in which to view the processes of sensemaking.

2.2 The Actor-Network Theory and Sensemaking

The Actor-Network Theory (ANT) is a well-established theory in the science and technology field that takes a social constructionist approach towards the influence of technology on society. Developed by Callon, Latour and Law in the 1980s, the Actor-Network Theory proposes that understanding, meaning and significance of any situation are not developed within just the human individual, but instead co-constructed with other human beings and other actants. In this manner, it proposes that the word "actor" (or an "actant) should be extended to include non-human, non-individual entities (Latour, 1996). Latour goes on to say that "an actant can literally be anything provided it is granted to be the source of an action".

One of the main significances of ANT is that with its focus on heterogeneous relations, the theory avoids technologically-deterministic perspectives with regards to the effects on organization and society. While machines and technology continue to play an important part in the Actor-Network Theory, they are also part of the network that is shaped and reshaped by the interplay of other forces within the network (Stanforth 2007).

There are two main aspects of the ANT that will be of much importance when studying sensemaking in organizations in general and within the area of interest of this study in particular, namely ARGs. They are: the Network and the Translation of Power.

2.2.1 Networks in the Actor-Network Theory

The Actor-Network Theory posits that actants form relationships with each other and thus create a complex system, or a "network". These networks may not be permanent, and instead the relationships formed between the different actants will shape and re-shape the "whole", or meaning and understanding of a situation.

In addition, because each actant is a heterogeneous piece, they have no social order. The networks formed help to create some form of order. It thus follows that the process of building and changing networks is "political" in nature. In a process that is extremely similar to that of sensemaking, actors mobilise resources, put forth favoured

solutions and contest others to build networks and enroll allies to form new networks (Stanforth 2007).

The theory thus assumes that relationships are constantly "in process", and that without such interactions, meaning cannot be formed. Similarly in sensemaking, shared understanding through communication and interaction is vital to understanding the problem and situation, and as such, ANT can provide a way of understanding the mechanisms within the networks in which sensemaking and problem-solving takes place.

2.2.2 Power, Translation and Sensemaking

While dictionary definitions of "power" describe it as an authority, ANT theorists argue that "power" must be understood instead as a consequence rather than a cause of collective action. Latour (1986) describes the power of paradox as follows: when you have power - *in potentia* - nothing happens, and hence you are powerless; however when you exert power - *in actu* - others, rather than you, are performing the action. In this model, power over something is thus an action that is made by many, yet attributed to one. As such, Latour argues that the traditional notion of "power" merely summarizes the consequences of a collective action, but does not explain what exactly created the collective action in the first place.

The idea that power is an *effect* rather than a *cause* of collective action is an important aspect of the Actor-Network Theory when used to analyze organizational networks and structure. To provide an alternative view of power, Callon conceptualized the *translation model of power*, which suggests that successful commands of power are a result of the actions of not one, but *chains of actants*, each of whom have shaped and defined the command to their own objectives. In this model, powerful agents are thus those who define and redefine what holds everyone together within the network. As such, powerful agents in this network are those who have managed to enlist allies successfully through a process of relationship-building and convincing. In this manner, the translation model of power is the mechanism by which networks take form and order themselves.

The translation of power in ANT is important in our study for two reasons. First, in the process of translation of power, we see that there are a group of agents who have a

particular interest that they wish to forward to the rest of the network. In order to do so, they have to recruit and gain more allies towards their particular interest alignment. During this process, they thus have to convince the other actors towards their cause, using various methods. Throughout this process, they are *sharing information* about a given situation. What this results in is thus a *shared meaning* that will generate a collective action. In other words, the interest alignment process of translation of power results in sensemaking. As such, understanding the manner in which interest alignment takes place is vital to our further understanding of the processes of sensemaking.

As such, this brings us to our first research question for the study. RQ1: How does *translation of power* affect the relational ties and *self-organization* in an actor-network of an ARG?

Second, this movement of relational ties via interest-alignment and sensemaking, and the consequential shift in power create self-organization and role structure within the heterogeneous network of the ANT. As actants assert their interests and recruit allies to their cause, they gain power and in the process, a *role structure* naturally emerges. By studying how power translates itself through the network and how relational ties shift through the course of the game, we can examine how self-organization within a given network emerges.

This in turn leads us to our second research question. RQ2: How does *sensemaking* within an actor-network foster role emergence and create *self-organization* in an ARG?

When we consider that sensemaking entails the construction of the problem situation by agents within their environment, we find that the Actor-Network Theory can thus provide significant ways in which to examine the social aspects of sensemaking. The Actor-Network Theory also can help us to explore and understand the processes of "patterning, social orchestration, ordering and resistance" (Law 1999). By using the ANT to view sensemaking and network-building, we can see how actors and organizations mobilize, juxtapose, connect, and manage bits to form a coherent, effective network.

2.3 ANT, Sensemaking and ARGs

In order to study the processes of sensemaking in action, we now turn to an emerging form of games called Alternate Reality Games (ARGs). These games, which emerged in 2001, combine a fictional narrative and real-world elements to present a unique and pervasive game style that blurs the lines between fiction and reality. Players of such games self-coordinate to complete a series of tasks in order to make sense of a fictional storyline.

2.3.1 Why ARGs?

Game studies scholars argue that games provide a visible context for the study of cognition and social interaction. Games can also provide a representation of both individual and collective activity and the processes of these activities over time, enabling the researcher see the manner in which society and the individual interact and influence each other (Steinkuehler 2006). Games are a new form of networked community (Williams, 2006), and ARGs, a game genre that relies heavily on problem-solving and communications, is thus an excellent platform to study the cognition process of sensemaking.

Although Massively Multiplayer Online Role Playing Games (MMORPGs) and other online gaming environments are, to a large extent, structurally similar to ARGs, there are several aspects in which ARGs are distinctly different from MMORPGs and other collaborative games; these make them a unique environment in which to study sensemaking and collaboration.

2.4 Understanding the ARG

McGonigal (2004: 9) defines an ARG as "an interactive drama played out in online and real spaces, taking place over several weeks or months, in which dozens, hundreds or thousands of players come together online, form collaborative social networks, and work together to solve a mystery or problem … that would be absolutely impossible to solve alone".

While the ARG has a narrative storyline outlined by game masters in advance, for the most part, this narrative is kept secret from the players. Players are also not allowed to directly communicate with the game masters, and all information has to be put together by the players themselves. The game space is thus *constructed by the players*, a distinct difference from MMORPGs where the platform and environment is inherent via the software that players use. In addition, communities self-organize into groups of players, using communications systems that are also designed by them.

ARGs are designed to be impossible to solve without the combined intelligence and activity of many different players with different expertise (McGonigal, 2003). As such, one of the key features of such games noted in existing research is the collective participation of the players in assembling the knowledge necessary to make up the story (O'Hara, Grian, & Williams, 2008). For instance, in *The Beast*, the ARG set in the universe of the 2001 Steven Spielberg film *Artificial Intelligence: A.I.*, clues required to access important game files. These clues were distributed separately at live events in multiple cities, and players in each region were assigned to attend these events and retrieve clues. They would then communicate in real-time with players who were unable to attend in order to piece together the necessary data (McGonigal, 2003). The immense difficulty and spread of ARGs thus means that there has to be many players actively participating and problem-solving in order to for the game to move on. In addition, these players all require a sustained, complete understanding of the game in order to be a contributing, active player.

In addition, gameplay in ARGs takes place in the form of rapid exchange of ideas and information, usually over a digital platform. Players are obliged to interact and work together to construct the story, combining and sharing their own interpretations, skills, knowledge and experiences in order to make sense of the narrative and progress through to the game's conclusion (Kim, Allen, & Lee, 2008). The level of collaboration over the distributed network of an ARG is shockingly efficient. Producers of "The Beast" had created puzzles upon puzzles of varying difficulties to be spread across a 3-month period. Within the first day of them releasing the string of puzzles, the community had banded together and solved the entire schedule worth of puzzles (McGonigal 2003).

A quick comparison of ARGs and workplace settings shows that there are many similarities between the challenges faced by ARG players, as well as those faced by workers within complex organizations. Both deal with the challenges of navigating unstructured content, operating with limited time frames to accomplish goals, defining and managing tasks, as well as coordinating potentially geographically distributed teams . Also, both teams engage in social knowledge construction, evaluative collaboration, and systems-based learning (Gurzick et al. 2011).

From the above characteristics, it is evident that ARGs are uniquely positioned for us to study the processes of sensemaking, as we can review how players in an ARG work together to create s*hared meaning and understanding* of the ARG game context via *communication and interaction* with each other.

2.5 Technology use in ARGs

Gurzick (2011) discusses how collaboration in ARGs is rooted in sensemaking and the thought processes within sensemaking provide distinct benefits to knowledge compilation, management and information discovery. In this manner, we can observe that knowledge compilation, knowledge management and information discovery are thus mechanisms within the sensemaking process. Within the ARG community, knowledge management and information distribution is achieved by accessing a variety of media systems such as forums, mapping applications, multimedia systems, and by supporting a culture of rapid idea diffusion (Gurzick, 2011). For example, the use of databases, forums and wikis can provide such idea diffusion and a space for the construction and testing of theories.

By studying the use of collaborative technology in ARGs, we can shed some light on how technology and the online environment can support and help consolidate emergent and distributed contributions in order to further the sensemaking and self-organization processes.

This leads us to research question 3. RQ3: What role do *collaborative, crowd-sourcing techniques* play in sensemaking and self-organization?

2.6 Theoretical and operationalized models
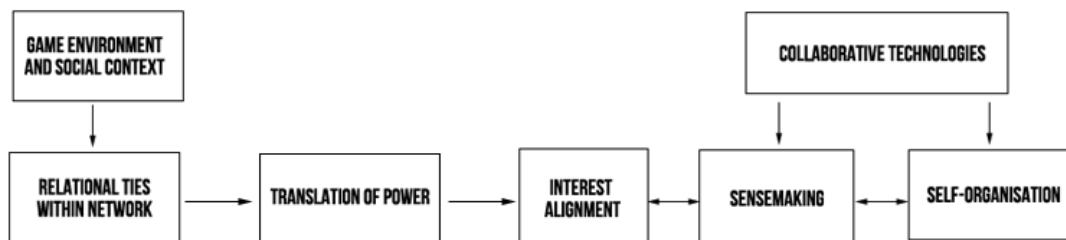
Figure 1: Theoretical Model

After reviewing the literature regarding ANT and sensemaking, I have created a theoretical model for my study. Figure 1 shows the relationship between actors, sensemaking and self-organization. By blending our knowledge of sensemaking and ANT, we can make initial hypotheses that there are relationships between the different aspects of the model that result in self-organisation.
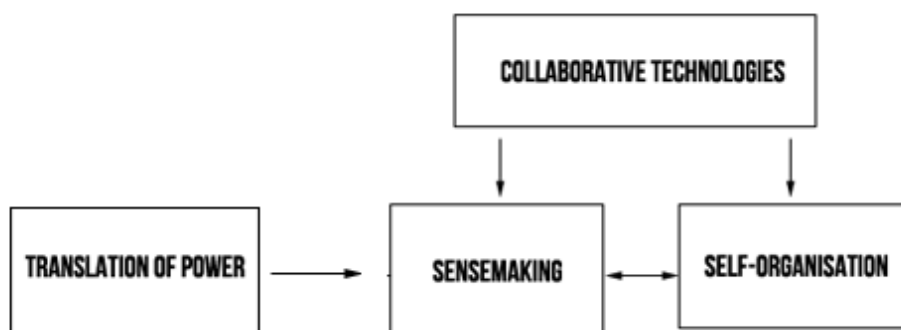
Figure 2: Operationalised Model

Figure 2 shows an operationalised model of the different variables that this study will examine, although it is possible that the relationships are also potentially affected by

other variables. For this study, I am interested in the way self-organisation emerges as a result of user interactions in the processes of sensemaking, and the use of collaborative technology. As such, in this study I examined the relationships between translation of power and self-organisation, sensemaking and self-organisation and collaborative technology and self-organisation.

To sum up, my research questions in this study are as follows:

RQ1: How does *translation of power* affect the relational ties and *self-organization* in an actor-network of an ARG?

RQ2: How does *sensemaking* within an actor-network foster role emergence and create *self-organization* in an ARG?

RQ3: What role do *collaborative, crowd-sourcing techniques* play in sensemaking and self-organization?

2.7 Variables

In the following section, I explain the variables that I intend to study and how they have been broken down into measurable units in previous literature. I will elaborate on how they will be specifically measured in this study in Chapter 3.

2.7.1 Translation of Power and Relational Ties

Using ANT to view sensemaking gives us codable units that we can use to measure relationships. In his 1986 seminal paper "Some Elements of a Sociology of Translation: Domestication of the scallops and the fishermen of St Brieuc Bay", Callon describes an environmental situation where there was a decline of scallops in Saint Brieuc Bay. Three marine biologists developed a conservation strategy. They then proceeded to insert themselves into the network in order to transform the power relations of the network, enroll the fishermen and other actants to become their allies, and became their spokespersons. Callon mapped relational ties in the network and the manner in which power was translated through the process of resolving the environmental situation.

Callon identifies four "moments of translation" in this story:

- "Problemization" - the principal actors (the researchers) make themselves indispensable to the other actants in the network (fishermen, scallops) by defining the nature of problem and encouraging others to accept a way forward (the research program).

- "Interessement" - the principal actors lock others into place by putting themselves into the network and defining the linkages between the other actants (the research program becomes the recognized obligatory point of passage between the global and the local networks.

- "Enrollment" - the principal actors define the roles that are to be played and the way in which the others will relate to one another within these networks.

- "Mobilization" - the principal actors borrow the force of their passive agent allies and turn themselves into their representatives or spokespeople.

For the purposes of this study, we will not be analyzing these four moments of translation of power in much depth, but the description of these moments will help coders to recognize occurrences of translation of power.

2.7.2 Sensemaking

Most studies that have been done on collaborative nature of sensemaking revolve around very time-sensitive and information-intensive domains; such as the military (Ntuen et al, 2006; Jensen, 2007) and healthcare (Albolino et al, 2007). Ntuen et al (2006) in particular define collaborative sensemaking as a situation where "multiple agents with different thoughts about the world engage in the process of making sense of 'messy' data or information with a high degree of uncertainty" (p7). The authors also defines four crucial elements of the sensemaking process - communication, knowledge management, developing shared situation awareness and developing collaborative knowledge. Ntuen et al. also propose a framework to understand sensemaking, laid out in five abstract steps (p. 10):

- Identification and definition of the contextual information setting.

- Identification of the processes involved in ascribing meanings to contextual information.

- Identification of the processes involved in interpreting contextual information.

- Identification of the processes involved in understanding contextual information.

- Identification of the processes involved in tacit knowledge transfer.

Similarly, Albolino et al (2007), who reviewed sensemaking in the hospital, divided the sensemaking process up into phases, namely the Sharing, Building and Consolidating phases. Jensen (2009) also broke sensemaking in military operations down into several different "functions" which fall loosely into the previous three phases. These phases were namely "understand the mission", "understand the preconditions" (Sharing), "find a way to accomplish the mission" (Building), "decide on course of action" and "evaluate the situation" (Consolidating).

For the purposes of this study, I identified processes of sensemaking largely according to Albolino's phases of Sharing, Building and Consolidating. Ntuen's framework will provide a definition of the processes that fall within each of these phases.

2.7.3 Self-Organization

In the simplest sense of the word, self-organization refers to the "arrangement of parts in a system to be non-random" (Serugendo et. al, 2004). Self-organization refers to the fact that a system's structure or organization can appear without any explicit control from outside the system. That is to say, self-organization occurs when the organization of a system is *intrinsic*, and results from internal mechanisms due to *local interactions* between its components (Camazine et. al, 2001). It is important to note that the dynamics of the system can also modify its environment, and in turn, these modifications can again influence the system. In this manner, self-organization is a dynamic process that is dependent on first, internal mechanisms and second, environmental context.

The process of self-organization and what it is dependent on is mirrored in Weick's "The Collapse of Sensemaking in Organizations: The Mann Gulch Disaster" (1993), based on Norman Macleans's *Young Men and Fire* (1992). Weick analyzes how the situation was a clear example of how role structure and sensemaking disintegrated in the face of a crisis situation, and discusses the importance of structuration within the process of sensemaking. He says that structures and frameworks are important to bolster

meaning and understanding in an organization and vice versa; in other words, self-organization is vital to the efficiency of sensemaking.

Structuring in this context, according to Weick, refers to two patterns and their relationships between them. The first pattern, described by Ranson, Hinings and Greenwood (1980) as *informal structure* or agency, refers to the interaction patterns that occur to create shared meaning. This first pattern is very similar to the internal mechanisms required for self-organization as defined by Camazine. The second pattern refers to the framework of roles and other *contextual constraints* that the organization has to adhere to, or the environmental contexts in self-organization.

In order to study self-organization in ARGs, we must thus identify within the data, the two key patterns identified, and examine the self-organization that emerges from them. First, the pattern of local interactions and internal mechanisms; second, the contextual constraints of the game narrative and other environmental constraints such as the platform on which the game is played.

2.7.4 Collaborative Technology

Collaborative technology or collaborative software refers to a co-process of human and communication technology where the human component provides a shared purpose and process, with the technology used to support the human processes. The computer software should thus reflect and support a group's purpose, process, and culture (Johnson-Lenz and Johnson-Lenz, 1990).

Originally conceived as "groupware", software that enabled corporations to conduct remote collaboration, collaborative software has since developed and migrated into the Internet into the generation of Web 2.0. Features such as document sharing (including group editing), group calendars and instant messaging contribute towards today's culture of collaboration.

The definition of "groupware" however is still relevant today. Types of groupware, and thus collaborative technologies, can be divided into three categories depending on the level of collaboration (Lotus Development Corporation, 1995):

1. **Communication applications:** unstructured interchange of information, such as conversations via instant messaging or phone calls

2. **Conferencing/Collaboration applications:** interactive work toward a shared goal, such as brainstorming or voting.

3. **Co-ordination applications:** complex interdependent work toward a shared goal, such as calendars that facilitate and manage group tasks.

As such, to study collaborative technologies within ARGs, we must identify the usage of software and application that aids the players' purposes and processes. As all conversation between the distributed group of players takes place on a single forum, I am considering it as the most basic form of communication between them, and did not include such basic communication within my coding.

CHAPTER 3. METHOD

Like several other studies revolving around ARGs (McGonigal 2008; Gurzick et al. 2011), I have adopted a case study approach to investigate my research questions.

The study takes place over the course of a single ARG from start to finish, and has taken the form of content coding followed by quantitative analysis of the coded data. The raw data of the study comes from a public, online forum described below, observing the interactions and behaviours that took place around the unfolding of the game narrative. These interactions, in accordance with the Actor-Network Theory that actants can be human or non-human, also included players' interactions with in-game websites and other in-game artifacts.

3.1 Research site

The Unfiction online forums (http://forums.unfiction.com/forums/, also known as Unforums) is a community hub for all ARG-related news and events. It was created by moderators of the early ARG *Lockjaw* as a central communication space, and now boasts over 38,000 members.

The forums are a valuable arena for studying community and culture in ARG gaming. As the Unforums are a well-known hub for ARGs, it draws both new and experienced players. Game masters have been known to place "rabbit holes" (a clue that leads players into the game) in this forum, and both current and potential ARG players also join the forum to discuss other rabbit holes and seek games to join. As a result, the

Unforums has emerged as the main English-language platform for geographically-distributed players to coordinate and compare gameplay efforts, thanks to its history in hosting the main English-language discussions for many major and famous ARGs such as *I Love Bees* and *Metacortechs*.

The forums are completely public and open, as a login name is required only for posting comments. This means that as a researcher, I am able to collect nonreactive data as the community naturally interacts with each other as they would usually.

3.1.1 We are Earthborne

For the purposes of the study, I have chosen the game *We are Earthborne*. This 2012 game was designed by Immersive Fiction, a transmedia production studio that has prior experience in producing ARGs. The game ran for about 4 months, generating 129 pages in its own forum thread on the Unforums. In addition, information on *We are Earthborne* is readily available, both via the Unforums and game wikis created by players and Immersive Fiction.

The game is set in a dystopian universe in the year 2276, where participants were tasked with joining a band of revolutionaries called the Earthborne United. Participants banded with in-game characters to try to overcome the tyrannical rule of Horizon Industries over planet Earth. Players also interacted with characters via email, phone, physical mailings and a set of in-story websites, following two major storylines over 140 days of gameplay.

3.2 Data Analysis and Coding

The preliminary analysis was based on a quasi-qualitative, grounded theory investigation of the main themes of discourse. The literature on sensemaking has an established history and there are several models that successfully map the sensemaking process. There is also sufficient literature to suggest that ARGs are a good ground to

study collaboration and collective action (Gurzick 2011, O'Hara 2008). The preliminary analysis resulted in a set of variables for use in the analysis of the data, which are further discussed below.

Analysis was based on the focused content coding of the 129-page thread that unfolded over the course of the game. Thus, the entire data corpus to be used is contained within a single thread on the forums, which is split again into manageable units of user posts. There are 90 unique users who commented in the thread, with a total of 1931 posts through the entire thread, making an average of about 22 posts per user. As the purpose of my study is to observe social behaviours recorded at the individual level, I have used as unit of observation the post, and as unit of analysis the individual.

3.2.1 Variables

The coding process will help us to codify and measure the core variables of our study, namely discover the following:

1) *translation of power*

2) *sensemaking behaviours*

3) *self-organization*

4) *use of collaborative technologies*

One coding theme was developed for each core variable: translation of power, sensemaking, self-organization, and use of collaborative technologies. For the variables of sensemaking and translation of power, there are several sub-variables that allow us to identify and code for stages within these processes. Doing so allowed us to review in further depth the relationships between each variable.

Although there are no code books available from previous research, the initial conceptual coding categories may be inferred, based on previous works and models on sensemaking (Ntuen 2009; Jensen 2009; Albolino 2007) and ANT (Callon 1986; Gao 2005). They are as follows.

Table 1: Coding Categories of Variables

Themes	Description	Examples of statements
Sensemaking: Sharing phase	- Identification and definition of the contextual information setting - Processes in ascribing meanings to contextual information	- "I ran an audio Morse code test on the music file and here are the results." - "I got an email from a character last night."
Sensemaking: Building phase	- Processes in interpreting contextual information - Processes in understanding contextual information	- "Maybe this means that A and B were working together?" - "Based on these pieces of evidence, I feel that this must have happened."
Sensemaking: Consolidation phase	- Processes in tacit knowledge transfer	- "Here's a summary of what has happened so far." - "The answer is this, and here is why."

Translation of Power: Problemization	- Principal actors define the problem	- "What we need to do is to find out who this came from."
Translation of Power: Interessement	- Defining a network structure; communications structure	- "We will be updating the wiki to ensure even newcomers will know what's up"
Translation of Power: Enrollment	- Defining roles of other actors	- "X, it might be a good idea to contact the NPC again and say..."
Translation of Power: Mobilization	- Recruiting allies to the cause; spreading information and convincing others that your theory is correct	- "Don't you think that it had happened because of XXX?"
Self-organization	- Pattern 1: local interactions and internal mechanisms - Pattern 2: contextual constraints: such as game narratives or game platform - Self-organization that emerges as a result of pattern 1 and 2	- "I'm hoping that X can take the lead on this because I'm not caught up." - "It seems like Character X has decided to trust you the most, so you'll have to be the point person for interaction with him."

Collaborative Technologies	- References to other platforms for information	- "Check the wiki for the story up to now." - "Just read the previous posts and caught up"

It is also important to note that it is possible that there could be overlaps in the different processes, especially in occurrences of translation of power and self-organization.

3.2.2 Coder Reliability

To assess the reliability of the measurement, two independent coders were trained and requested to code a data sample of 60 forum posts for the 9 different variables, using a dichotomous coding system. The author also coded the same sample units for calibration purposes. The author was also available to answer questions concerning the coding, which were then used to refine the codebook accordingly.

The initial data was then compiled by the author and run through the online application ReCal[1] to determine reliability of the measurement.

One of the issues that occurred during the reliability calculation is that that for binary data where one of the values (1 or 0) is very rare, Scott's Pi, KAPPA and KALPHA will return low coefficients, even with very few mistakes. In particular,

---

[1] ReCal ("Reliability Calculator") is an online utility that computes intercoder/interrater reliability coefficients for nominal, ordinal, interval, or ratio-level data. ReCal calculates a variety of coefficients including percentage agreement, Scott's Pi, Fleiss' Kappa, Cohen's Kappa, and Krippendorff's Alpha. It is available at http://dfreelon.org/utils/recalfront/.

Krippendorf (2004) says that "in the calculation of reliability, large numbers of absences should not overwhelm the small number of occurrences".

For instance, let us observe the calculation for the variable "Translation of Power: Problemization", shortened to "TP1" in my codebook.

Table 2: Average Pairwise Percent Agreements for TP1 (pre-adjustment)

Average pairwise percent agr.	Pairwise pct. agr. coder 1 & 3	Pairwise pct. agr. coder 1 & 2	Pairwise pct. agr. coder 2 & 3
96.67%	95.00%	96.67%	98.33%

Table 3: Fleiss' Kappa for TP1 (pre-adjustment)

Fleiss' Kappa	Observed Agreement	Expected Agreement
-0.017	0.967	0.967

As can be seen, although there was an extremely high pairwise percentage agreement, Fleiss' Kappa reflected a negative value, signifying that the reliability was worse than random chance (or that coders were systematically disagreeing with each other).

After an adjustment where the last 6 '0'-code agreements were changed to '1'-code agreements, the new reliability calculations were as follows.

Table 4:Average Pairwise Percent Agreements for TP1 (post-adjustment)

Average pairwise percent agr.	Pairwise pct. agr. coder 1 & 3	Pairwise pct. agr. coder 1 & 2	Pairwise pct. agr. coder 2 & 3
96.67%	95.00%	96.67%	98.33%

Table 5: Fleiss' Kappa for TP1 (post-adjustment)

Fleiss' Kappa	Observed Agreement	Expected Agreement
0.838	0.967	0.794

The percentage agreements were still the same, while Fleiss' Kappa has improved tremendously. In order to overcome this problem, I have decided to recode the sensemaking (Share, Build, Consolidate) and the Translation of Power variables (TP1, TP2, TP3, TP4) into two new categories, "Sensemaking" and "Translation of Power". As long as there was a presence of any of the variables, each process was subsequently marked as "1", or present. In addition, I also reviewed pairwise agreement and Fleiss' Kappa/Scott's Pi in tandem. The new reliability results are as follows.

Table 6: Sensemaking Coefficients (3 coders)

Coefficients	Results
Average Pairwise Agreement	82.22%
Fleiss' Kappa	0.49
Observed Agreement	0.82
Expected Agreement	0.65

Table 7: Translation of Power Coefficients (3 coders)

Coefficients	Results
Average Pairwise Agreement	78.89%
Fleiss' Kappa	0.28
Observed Agreement	0.79
Expected Agreement	0.71

In order to determine if percent agreement coefficients were acceptable, Neuendorf says, "Coefficients of .90 or greater are nearly always acceptable, .80 or greater is acceptable in most situations, and .70 may be appropriate in some exploratory studies for some indices" (Neuendorf 2002, p. 145).

Fleiss' coefficients are slightly lower, and gives the following guidance for interpreting his statistic (1981):

"Figure 6: Interpreting Fleiss' Kappa

- < 0.40 = Poor agreement
- 0.60 – 0.74 = Intermediate to good agreement
- ≥ .75 = Excellent agreement"

From this, we can see that the Sensemaking coefficients were satisfactory, but not the Translation of Power coefficients. On further analysis, it was noted that by removing a particular independent coder's data, the coefficients improved significantly. After a discussion with the coder on her data, she realised that she had completely misread several coding categories, and as such her data was not usable. The final coefficients with 2 coders for all variables within the sample are as follows:

Table 8: Intercoder reliability coefficients (2 coders)

Coefficient	Percent Agreement	Scott's Pi
Sensemaking	86.7%	0.52
Translation of Power	93.3%	0.71
Self-Organisation	100%	1
Collaborative Technology	93.3%	0.56

Because satisfactory intercoder reliability was obtained within the sample, the principal investigator continued the coding alone.

After each post had been coded, the data was compiled in order for the investigation to take place at the individual user level. Posts were reorganised in order to determine the number of posts each user had, and in which variables. The data however was skewed and not normally distributed.
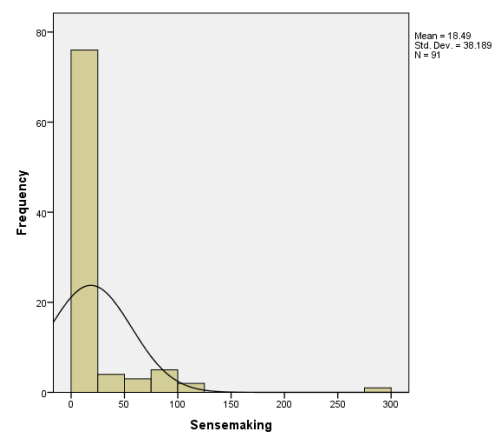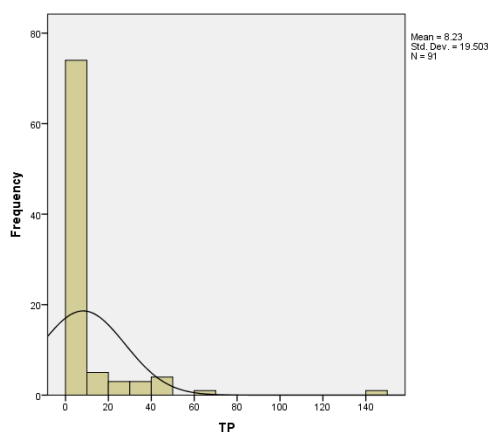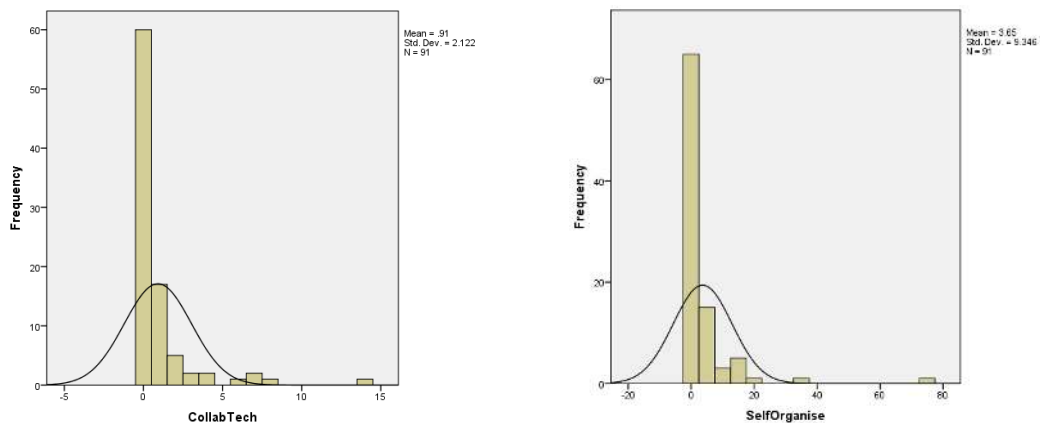
Figure 3: Skewness Charts

Table 9: Skewness (pre-transformation)

	Skewness	**Std Deviation**	**Kurtosis**	**Std Deviation**
Sensemaking	4.264	.253	23.922	.500
Translation of Power	4.606	.253	27.351	.500
Self-Organisation	5.652	.253	39.077	.500
Collaborative Technology	3.827	.253	17.719	.500

As such, it was imperative to reduce the skewness of the data before proceeding. As the data is right-skewed, I have transformed the data by square root. The new skewness values are as follows.

Table 10: Skewness (post-transformation)

	Skewness	**Std Deviation**	**Kurtosis**	**Std Deviation**
Sensemaking	1.901	.253	4.399	.500
Translation of Power	1.940	.253	4.556	.500
Self-Organisation	2.095	.253	6.441	.500
Collaborative Technology	1.718	.253	2.754	.500

CHAPTER 4: RESULTS

The transformed variables were included in several regression models that predicted the chains of effects that connect translation of power to sensemaking and sensemaking to self-organization through the mediation of collaborative technology use.

First, it was hypothesized that translation of power would affect self-organization in an actor-network of an ARG. To test this hypothesis, self-organisation was regressed against translation of power and the other core variables. Consistent with the hypothesis, it was seen that translation of power significantly predicted self-organisation, $\beta = 0.327$, $t(89) = 2.39$, $p < .001$

Second, it was hypothesised that sensemaking would also positively affect self-organisation. The results of the same regression model showed that sensemaking also positively affected self-organisation, $\beta = 0.463$, $t(89) = 3.36$, $p < .001$. See Table 9 for results.

Table 11: Effect of independent variables on self-organisation

	B	*SE* B	β	*p*
Constant (Self-Organisation)	-0.128	0.088		0.152
Sensemaking	0.233	0.069	0.463	0.001
Translation of Power	0.219	0.092	0.327	0.019
Collaborative Tech	0.386	0.094	0.208	0.000

Notes: $R^2 = .887$, $p < .001$.

Sensemaking, Translation of Power and Collaborative Technology explained a significant proportion of variance in occurrences of Self-Organisation, $R^2 = .887$, $F(3, 87)$ = 227.25, $p < .001$. The results above suggest that the more we observe ARG players sharing their thoughts on the forums to piece together information and create sense out of their situation, the more they displayed self-organisation behaviours. In the process, references to collaborative technologies positively impacted participants attempts to self-organize.

It was also hypothesised that collaborative technology would affect sensemaking processes. A second regression analysis was run for collaborative technology against sensemaking . The results presented in Table 10 show that contrary to expectations, the use of collaborative technology did not significantly predict sensemaking, $\beta = -0.11$, $t(89)$ = -.070, $p> .05$. The model explained a significant proportion of variance in sensemaking, $R^2 = .94$, $F(1, 89) = 448.94$, $p < .001$. Refer to Table 10 for more details.

Table 12: Effect of independent variables on sensemaking

	B	*SE* B	β	*p*
Constant (Sensemaking)	.758	.101		.000
Translation of Power	.983	.089	.738	.000
Collaborative Technology	-.011	.150	-.003	.944
Self-organisation	.493	.147	.248	.001

Notes: $R^2 = .94$, $p < .001$.

A Pearson product-moment correlation coefficient and Spearson's Rho were computed to assess the relationship between all the variables. There were significant, positive correlations between all the variables. Table 13 and 14 summarise the results. These indicate that sensemaking is most closely associated with translation of power and the weakest with collaborative technologies. Also, given that collaborative technologies are associated with sensemaking in a bivariate context but not in a multivariate context, it looks like we are witnessing a process of redundancy, where the effect of collaborative technologies is subsumed within that of the other variables. Better and more distinct

operationalization of collaborative technologies might be needed, as suggested in the discussion section.

Table 13: Pearson's correlations between four variables

Measure	1	2	3	4
1. Sensemaking	-			
2. Translation of Power	0.96*	-		
3. Self-Organisation	0.92*	0.92*	-	
4. Collaborative Technology	0.70*	0.70*	0.76*	-

*Notes: N=91. *p<0.01, two-tailed.*

Table 14: Spearman's Rho correlations between four variables

Measure	1	2	3	4
1. Sensemaking	-			
2. Translation of Power	0.89*	-		
3. Self-Organisation	0.80*	0.80*	-	
4. Collaborative Technology	0.59*	0.57*	0.65*	-

*Notes: N=92. *p<0.01, two-tailed.*

CHAPTER 5: DISCUSSION

The present study tested the hypotheses that there were positive relationships between translation of power, sensemaking, the use of collaborative technology and self-organisation. Results support two of the hypotheses, showing overall strong support that self-organisation in ARGs is aided by sensemaking and translation of power. However, use of collaborative technology did not impact sensemaking, as was originally expected.

Self-organisation in this ARG mostly took place in two patterns. Firstly, self-organisation occurred when there were geographical and environmental constraints. As players came from all over the globe, there were occasions when players had to self-organise in order to overcome the distributed nature of the player base. These came in the form of players having to volunteer or be delegated to retrieve physical items or make local telephone calls. Secondly, self-organisation occurred when players developed recognised proficiencies and competencies within the game. This included experienced players who came into the game with a reputation for codebreaking, or players who showed that they had an in-depth knowledge of the game's history and background. Self-organisation manifested itself when other players would defer to these players when it came to problem-solving or knowledge building.

We see that *translation of power* has strong positive effects on *self-organisation.* Throughout the game, translation of power took place through the four stages. At key points in the game, active players would consolidate the thoughts and posts from the previous pages and clarify and define problems that needed to be solved. This would often refocus the players on what needed to be worked on. Also, as there was an in-game forum where in-game characters could interact with player characters, there was often cross-forum organisation that took place, with players reporting back in the Unforums on

what needed to be done (as defined by in-game characters) and then taking the lead in task-solving and role-delegation. In addition, active players who developed relationships with in-game characters became a key channel to these characters, and volunteered as the key intermediary when information needed to be transferred between players and in-game characters.

The effect of the *sensemaking* process on self-organisation was also evident. Players would share what they had already tried in the problem-solving process, and ask others to focus on other methods. There were also several occasions where players would rearrange themselves into a semi-hierarchy without prompting from an external source. For instance, newer players who entered the game midway sometimes commented that they would lurk until they could gain enough information to help with the game. Several players also established themselves as experts within the game with regards to the background and history of the game world, and were called upon specifically as needed to help in the sensemaking process.

Collaborative technology also had a strong effect on *self-organisation*. For instance, image-sharing sites like Flickr and Imgur were a big help to players. They helped in particular the geographically distributed players who could not attend physical events. Players who were able to retrieve physical game artifacts uploaded images of the items onto these sites without prompting. New players also often made introductory posts that self-reported the use of reading the forums to catch up on the game situation before fitting themselves into the "hiercharchy", as mentioned above.

In particular for We Are Earthborne, there was an attempt to use a wiki as an important part of the sharing process. Using wikis as an information repository theoretically allowed newer players to quickly situate themselves within the game, or for older players, to refer to a past event to refresh their memory. However, the data provided little support to show that collaborative technology had an effect on *sensemaking*. Although it is evident that collaborative technology can provide the affordance, especially for distributed organisations, to be able to share information quickly within the group, it was potentially not realised in application. For example, a problem that came up in the group was that the player-created wiki was not updated quickly and thoroughly

enough to allow completely new players to catch up with the current events of the game. Players had to be redirected either to the in-game wiki (which was managed by the game masters) or wait for another player who had the information available.

Although there was strong support in my study with regards to most of the hypotheses, there are several limitations that need to be considered. My research revolved around a particular case study that lasted three months, and as such the results may be somewhat limited. That is to say, the results obtained from this study may only be applicable to "We are Earthborne". Future research could examine if the model holds true for other ARGs, or for other processes that take place over a longer period of time.

In addition, more study needs to be done on the effect of collaborative technology on sensemaking. Although there was a lack of a unique effect of collaborative technology on sensemaking, there was a strong, significant correlation between the two variables. This suggests that collaborative technologies use effects are subsumed in the effects of the other variables. As such, the relationship between the two variables is worthy of greater study and any possible redundancy should be eliminated through better operationalization, which should include capturing actual behaviour, not only verbal mentions of communication technology use. One other reason why my data resulted in no effect of collaboration technology on sensemaking is that users who used the collaborative technology were not necessarily the same users who contributed also to the sensemaking processes, although the collaborative technology might have been useful to other users in the sensemaking process.

Also, there could also have been problems in the operationalisation of the use of collaborative technologies, which resulted in a distinct lack of effect of collaborative technology on sensemaking in my results. For the most part, my study only tracked specific references to the use of collaborative technologies, but did not necessarily note if there were actual interactions with collaborative technologies. That is to say, my study only tracked visible mentions of the use of collaborative technology in the forums, but could not examine if users had actually used collaborative technology, but did not refer to it in the forum. It is thus entirely possible that people were actually using collaborative technologies much more than my dataset represented.

In general, a more in-depth study could be done to investigate the manner in which collaborative technology was used between users and within the entire sensemaking process. For example, in addition to studying behaviours on an individual level like I have done in this study, it might have been helpful to split the game into different arcs and track the development and problem-solving process within these arcs. To determine the usefulness of collaborative technologies, the usage of particular collaborative technologies could also have been tracked, possibly by observing users over a period of time as they engaged in playing the game.

However, the results of the research shows that there is considerable potential and room for study in the manner of sensemaking and collaboration in gaming. Overall, my study has shown that sensemaking and collaborative technology are indeed vital in promoting self-organisation in ARGs, and that there is value in viewing self-organisation and sensemaking via the context of actor-network theory. With more in-depth study into the models presented in this study, more understanding and insight can potentially be created with regards to collaboration and the interactions that take place during the collaboration process.

In particular, there are two areas in which future research can take place.

5.1 Training and Modelling Processes

Future research can look into the manner in which ARGs can be adapted for training and other activities in organisations. As seen from previous research, sensemaking processes have largely been studied in emergency situations such as the military and the hospital, while ARGs have been studied for their educational importance. With evidence that sensemaking procedures similar to that in crisis situations do take place in the genre of ARGs, perhaps it is possible that ARGs can be developed to provide training grounds and scenarios for organisations.

5.2 Improving use of collaborative technology in organisations

In the research shown above, some effects were seen between the use of collaborative technology and self-organisation in ARGs. Future research can further extrapolate this information and further investigate the use of collaborative technology in the workplace and how they can potentially contribute towards workplace efficiency when used to aid specifically in sensemaking processes. This will be especially important when distributed collaboration is necessary in the workplace, much like the way ARGs are played by people who are geographically distributed.

5.3 Conclusion

The ARG game environment is not just another gaming platform. With its unique characteristics, the ARG arguably acts as a microcosm of the real world, and the insights that we gain from ARG studies will have plenty of real-world implications and benefits. In my study, we have seen that efficient self-organisation in ARGs emerged due to several processes, including sensemaking, translation of power, and a variety of collaborative technologies such as the forums, wikis and cloud computing. There is much to be learnt from the manner in which these elements work together to produce self-organisation. As can be seen, further study into ARGs is a relevant and important step into understanding the processes of collaboration.

LIST OF REFERENCES

LIST OF REFERENCES

Albolino, S., Cook, R., & O'Connor, M. (2006). Sensemaking, safety, and cooperative work in the intensive care unit. *Cognition, Technology & Work*, *9*(3), 131–137. doi:10.1007/s10111-006-0057-5.

Bijker, W.E., and J. Law eds. (1992). *Shaping technology/building society: Studies in sociotechnical change.* Cambridge, MA: MIT Press.

Callon, M. (1986). "Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay." In *Power, Action and Belief: A new sociology of knowledge?* ed. J. Law, 196-233. London: Routledge & Kegan Paul.

Camazine, S., Deneubourg, J-L., Nigel R. F., Sneyd, J., Theraulaz, G., and Bonabeau, E.. (2001). Self-Organization in biological system. *Princeton Studies in Complexity*. Princeton University Press.

Feldman, M.S. (1989). *Order without design*. Stanford, CA:Stanford University Press.

Fleiss, J. L. (1981). Statistical methods for rates and proportions. New York: Wiley.

Freelon, D. (2010). ReCal: Intercoder reliability calculation as a web service. International Journal of Internet Science, 5(1), 20-33.

Freelon, D. (2013). ReCal OIR: Ordinal, interval, and ratio intercoder reliability as a web service. International Journal of Internet Science, 8(1), 10-16.

Gao, P. (2005). Using actor-network theory to analyse strategy formulation. *Information Systems Journal*, *15*(3), 255–275. doi:10.1111/j.1365-2575.2005.00197.x

Gurzick, D., Landry, B. M., White, K. F., Dombrowski, C., Lutters, W. G., Kim, J. Y. (2011). *Designing the future of collaborative workplace systems: Lessons learned from a comparison with alternate reality games*. Presented at iConference 2011, February 8-11, 2011, Seattle, WA, USA.

Huang, Y., Ye, W., Bennett, N., Contractor, N. (2013). *Functional or social?: exploring teams in online games.* In Proceedings of CSCW '13. (pp 399-408). New York: ACM.

Huber, G. P., and Daft, R. L. (1987). The information environments of organisations. In Jablin F.M, Putnam, L.L, Roberts, K.H., and Porter L.W. (eds) *Handbook of organisational communication* (pg 130-164). Newbury Park, CA: Sage.

Hutchins, E. (1995). *Cognition in the wild*. Cambridge, Mass.: MIT Press.

Jensen, E. (2007). Sensemaking in military planning: a methodological study of command teams. *Cognition, Technology & Work*, 11(2), 103–118. doi:10.1007/s10111-007-0084-x

Johnson-Lentz, Peter and Johnson-Lentz Trudy. (1991). Post-Mechanistic Groupware Primitives: Rhythms, Boundaries, and Containers. *The International Journal of Man Machine Studies*, 34, 395-417.

Kim, J. Y., Allen, J. P., & Lee, E. (2008). Alternate reality gaming. *Commun ACM*, 51(2), 36-42.

Kim, J., Lee, E., Thomas, T., & Dombrowski, C. (2009). Storytelling in new media: The case of alternate reality games. *First Monday*, 14(6-1).

Klein, G.A., (1989). Recognition-primed decisions. In Rouse, W.B. (Ed) *Advances in man-machine systems research.* Vol 5, 47-92. Greenwich, CT: JAI.

Krippendorff, K. (2004). Reliability in content analysis: Some common misconceptions and recommendations. *Human Communication Research, 30*(3), 411-433.

Latour, B. (1986). The powers of association. In *Power, Action and Belief: A New Sociology of Knowledge?* ed. J. Law, 264–80. London:Routledge & Kegan Paul.

Latour, B. (1995) On Recalling ANT. In. Law, J. and Hassard, J. (Eds.), Actor Network Theory and after. Oxford: Blackwell Publishing.

Latour, B. (2005) Reassembling the Social: An Introduction to Actor-Network Theory. Oxford: Oxford University Press.

Law, J. (1992) Notes on the Theory of the Actor Network: Ordering, Strategy and Heterogeneity. Published by the Centre for Science Studies, Lancaster University, Lancaster LA1 4YN, at
http://www.comp.lancs.ac.uk/sociology/papers/Law-Notes-on-ANT.pdf

Leedom, D.K. (2001). *Final Report: Sensemaking Symposium*. (Technical Report prepared under contract for Office of Assistant Secretary of Defense for Command, Control, Communications & Intelligence). Vienna, VA: Evidence Based Research. Inc. [Online]. Available: http://www.dodccrp.org/files/sensemaking_final_report.pdf

Li, Y., Dong, M., & Huang, R. (2009). Toward a semantic problem for active collaborative learning. *Educational Technology & Society*, 12(4), 71-86.
Lotus Development Corporation. (1995). Lotus: Groupware - Communication, Collaboration, Coordination. Cambridge.

Luscher, L. S., Lewis, M. W. (2008). Organizational change and managerial sensemaking: Working through paradox. *Academy of Management Journal*. 2008, 51 (2), pp 221-240.

Manning, P. K. (1997). Organizations as Sense-Making Contexts. *Theory, Culture & Society*, *14*(2), 139–150. doi:10.1177/026327697014002012

McGonigal, J. (2003). 'This Is Not a Game': Immersive aesthetics and collective play. In *Proceedings of the Fifth International Digital Arts and Culture Conference*. RMIT, Melbourne, Australia.

McGonigal, J. (2004). *Alternate Reality Gaming: "Life Imitates ARG"'*. PowerPoint presentation to MacArthur Foundation Board of Directors, November 2004, available at http://www.avantgame.com/McGonigal%20ARG%20MacArthur%20Foundation%20NOV%2004.pdf (accessed 9 September 2013).

Mintzberg, H. (1980). Structure in 5's: A synthesis of the research in organisational design. *Management Science*, 26(3), 322-341.

Monteiro, E. & Hanseth, O. (1996). Social shaping of information infrastructure: on being specific about technology. In: *Information Technology and Changes in Organizational Work*, Orlikowoski, W.J., Walsham, G., Jones, M.R. & DeGross, J.I. (eds), pp 325-242. Chapman & Hall, London, UK.

Ntuen, C. A., Munya, P., & Trevino, M. (2006). *An approach to collaborative sensemaking process.* In the Proceedings of the 11th International Command and Control Research and Technology Symposium, Cambridge, UK.

O'Hara, K., Grian, H., & Williams, J. (2008). Participation, collaboration and spectatorship in an alternate reality game. In *OZCHI 2008 Proceedings*. Cairns, QLD, Australia.

Orasanu, J., Connolly, T. (1993) The reinvention of decision making. In: Klein, G. A., Orasanu, J., Calderwood, R. et al. (eds.) *Decision making in action: models and methods.* Ablex, Norwood, NJ, p 3–20.

Paul, S. A., Reddy, M. C., & deFlitch, C. J. (2008). Information and communication tools as aids to collaborative sensemaking. In *CHI'08 Extended Abstracts on Human Factors in Computing Systems* (pp. 3105–3110). Retrieved from http://dl.acm.org/citation.cfm?id=1358815

Ranson, S., Hinings, B., & Greenwood, R. (1980). The structuring of organizational structures. *Administrative Science Quarterly*, 25 (1): 1-17.

Reed, M. (1991).Organizations and rationality: The odd couple. *Journal of Management Studies*, 28: 559-567.

Schön, D.A. (1983). *The reflective practitioner*. New York: Basic Books.

Serugendo, G. D. M, Foukia N., Hassas, S., Karageorgos, A., Most´efaoui, S. K., Rana, O. F., Ulieru, M., Valckenaers, P., and Van Aart, C. (2004). *Self-Organisation: Paradigms and applications*. In the Proceedings of the International Conference on Autonomous Agents and Multiagent Systems 2003, pp. 1–19.

Shotter, J. (1993). *Conversational Realities: Constructing Life Through Language*. SAGE.

Stanforth, C. (2006). Using actor-network theory to analyze e-government implementation in developing countries. *Information Technologies and International Development*, *3*(3), 35–60.

Wasserman, S. and Faust, K.(1994) Social Network Analysis: Methods and Applications. Cambridge, MA: University of Cambridge Press.

Steinkuehler, C. A. (2006). Why Game (Culture) Studies Now? *Games and Culture*, *1*(1), 97–102. doi:10.1177/1555412005281911

Weick, K. (1993). *The collapse of sensemaking in organisations: The Mann Gulch disaster*. Cornell University.

Weick, K. (1995). *Sensemaking in organizations*. CA: Sage.

Williams, D. (2006). Why Game Studies Now? Gamers Don't Bowl Alone. *Games & Culture*. 1(1), p. 13-16.