Wild networks:

The articulation of feedback and evaluation in a creative inter-disciplinary design studio

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Abstract

It is argued that design exists within a collective social network of negotiation, feedback sharing and reflection that is integral to the design process. To encourage this, requires a technological solution that enables designers to access, be aware of, and evaluate the work of others, and crucially, reflect upon how they are socially influenced. However in order to develop software that accurately reveals peer evaluation, an understanding is required of the sociality at work in an inter-disciplinary design studio. This necessitates an acknowledgement of the complexities of the feedback sharing process that is not only socially intricate in nature but is also potentially unacknowledged. In order to develop software that addresses these issues and makes explicit the dynamics of social interaction at play in a design studio, a 'wild networks' methodological approach is applied to two case studies, one in an educational setting, the other in a professional practice. The 'wild networks' approach uses social network analysis, through and in conjunction with, contextual observation and is used to map the network of numerous stakeholders, actors, views and perceptions at work. This methodological technique has resulted in an understanding of social networks within a design studio, how they are shaped and formed and has facilitated the development of prototype network visualisation software based upon the needs and characteristics of real design studios.

The findings from this thesis can be interpreted in various ways. Firstly the findings from the case studies and from prototype technological representations enhance previous research surrounding the idea of a social model of design. The research identifies and highlights the importance of evolving peer-to-peer feedback, and the role of visual evaluation within social networks of feedback sharing. The results can also be interpreted from a methodological viewpoint. The thesis demonstrates the use of network analysis and contextual observation in providing an effective way of understanding the interactions of designers in a studio, and as an appropriate way to inform the software design process to support creativity. Finally the results can be interpreted from a software design perspective. The research, through the application of a 'wild networks' methodological process, identifies key features (roles, location, levels, graphics and time), for inclusion within a socially translucent, network visualisation prototype that is based upon real world research.

Academic papers associated with this work

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Academic papers associated with the topic and/or methodology, using different datasets

Joel, S., (2010) A social network analysis approach to a social model of the creative industries: the design sub-sector in Creative Industries Journal, 2(2) pp.191-201

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CIO: Cordoso, E., Carnicero, L., Dempster, A., Joel, S., Kai, L., Mould, O., Pessana, S., Roodhouse, S. (2008). A report on the Design subsector in London, Creative Industries Observatory, University of the Arts, London: UAL.

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Glossary of terms

Actors (nodes): “Social network analysis is concerned with understanding the linkages among social entities and the implications of these linkages. The social entities are referred to as actors. Actors are discreete individual, corporate, or collective social unites. Examples of actors are people in a group, departments within a corporation, public services agencies in a city or nation states in the world system.” (Wasserman and Faust 1994 p17)

Connections (relational ties or edges): “Actors are linked to one another by social ties... the range and type of these ties can be quite extensive. The defining feature of a tie is that it establishes a linkage between a pair of actors. “(Wasserman and Faust 1994 p18)

Network: “A social network consists of a finite set of sets of actors and the relation or relations defined on them. The presence of relational information is a critical and defining feature of a social network.” (Wasserman and Faust 1994 p20)

Ego-net: “An ego-centred network consists of a focal actor, termed ego, as set of alters who have ties to ego and measurements on the ties among these alters. For example, when studying people, one samples respondents, and each respondent reports on a set of alters to whom they are tied, and on the ties among these alters.” (Wasserman and Faust 1994 p41)

1. Introduction

The ability of designers to reflect and discuss feedback about their own work and that of others, is a fundamental feature in a social model of design (Sosa and Gero 2005). Feedback has been shown as contributing to design performance by allowing designers to correct their actions and learn which practices and techniques produce better design outcomes (Ivancevich and Mchonen 1982; Pritchard et al 1988). It is this feedback sharing and social evaluation process that the following thesis aims to understand, and support technologically.

1.1 The Research Problem

Busby (1998) stated that “learning from experience, and attending to the consequences of one's work, are strong norms in design organisations” (p103). He found that “feedback to designers was often unreliable, delayed, negative and sometimes missing altogether” (p103). It is the latter of these problems (lack of feedback sharing) which the following thesis seeks to address through the development of technology that can support social evaluation within the design process. To do this, this introduction looks at why the social reflection and the evaluative process are difficult to achieve in practice, to study and to technologically support. Although each of these points are inter-related, for instance the difficulty in studying feedback stems from a difficulty in achieving it, the following sections aim to explain the issues surrounding the research problem.

1.1.1 Issues surrounding feedback sharing in a design studio

Busby (1998) put forward four categories of issues that surround feedback sharing. These were:

- “Design organisations planning design activities in ways that were at odds with outcomes of previous activities” (Busby 1998 p109). Not learning from past experience and projects.
- “Design related errors being repeated (often by different designers)” (Busby 1998 p110). Not learning from past experiences of other designers.

- “Unreliability in feedback received by the design organisation” (Busby 1998 p111). If the feedback is somehow “loaded”, for instance, getting feedback from someone in a superior hierarchical position in a company gives the feedback a level of pressure that may require the designer to accept any suggestion even if it is not suitable.
- “A negative nature of most feedback” (Busby 1998 p112). For instance, seeking feedback from someone who has a conflicting point of view, dealing with “creative abrasion” (Leonard & Swap 1999).

Busby (1998) also discussed other issues that surrounded feedback, including absence of data about designs and ineffective peer reviews. In addition to this is the issue of environment. The studio setting needs to support the sharing of feedback in terms of physical location, technological provision, organisational structures etc. For instance there are many questions as to how designers give feedback if they are not within close physical proximity of one another.

Many of the problems listed above can be addressed through revealing and visualizing patterns of feedback within a studio. For instance having access to other people during the design process is a fundamental aspect of sharing feedback. How can you give feedback if there is no one to give feedback to? Similarly, awareness of other people's work can aid the feedback process. If a designer is not aware of someone's work (particularly if that work is of relevance), how can the designer request that person give them feedback?

1.1.2 Issues surrounding the *study* of feedback sharing in the design studio

There is a shifting of emphasis, both practically and academically, from achieving individual design work to group based design. Sosa and Gero (2005) maintained that conventional research had centred on understanding what makes someone creative, what is special about a certain individual, and what cognitive processes those individuals go through. Recently, other theories have been put forward that support the idea of creativity being a social activity (Sawyer 2007, Leonard & Swap 1999, John-Steiner 2000, Csikszentmihalyi 1990). The following thesis sits within this body of research and argues the case for a group based, societal concept of design, where design exists within a collective social sense (Buccerelli 1994), and where social evaluation is integral to group working and a social concept of design. However proving the effectiveness and success of social influence, and the benefit of social activity upon design, is difficult (Devine 2002). This is primarily because the greater the number of people involved, the greater the number of variables that need to be acknowledged and filtered.

The knowledge that designers maintain is derived from the influences of others and the social interactions that the designer participates in (Berger and Luckman 1966). These interactions are a product of the time in which they occur, with the concepts and techniques designers rely upon and the design work they produce socially, culturally and historically specific (Burr 2003). This creates a social context that is evolving and is as complex as the people who operate within it. The task of studying people, social dynamics and how designers interact is a multi-faceted problem.

Scope is another issue that makes the study of social influence and feedback sharing a difficult one. There are many social influences upon the work of the designer: economic, political, cultural etc. Furthermore, there are many types of interaction: work related, hierarchical, friendship based. Evaluation can also be inspirational, critical, bureaucratic etc. The communication of evaluation and feedback could be creative, or it could be financial, such as a discussion concerning the cost of a potential product. Evaluation and feedback can be verbally articulated, written and visual in basis. It can range from “unambiguous, rapid, compelling and strongly reinforcing... [to feedback that] is negative, intermittent and deceptive and only compelling after major failure” (Busby 1998 p117). Evaluation and feedback sharing, therefore, has a broad remit that can make its study all encompassing.

The next issue relates to the nature of feedback sharing. It can be hidden and serendipitous in nature and can potentially occur in ad-hoc places. It may also be unacknowledged and unconscious (Gregory 1988). Designers may not realise they do it, or may not wish to divulge that they do it. Either way, capturing data on a subject matter that is amorphous and changeable is difficult, especially because it concerns a subject matter that may potentially be undisclosed.

1.1.3 Issues surrounding technologically supporting feedback sharing in the studio

Technology needs to address the barriers facing the sharing of feedback in practice, such as proving its value and worth, overcoming personal conflicts in the studio and removing environmental pressures. Technology also needs to do this in light of the issues concerning its complexity of study.

One of the issues surrounding feedback sharing in practice is that of awareness. In particular not knowing what other designers are doing and not being able to participate in a feedback sharing process. Furthermore, a designer may not be aware of how they are socially influenced. Designers should question how the world appears to be and crucially, reflect on how they and their work are a consequence of society and social influence. This thesis looks to reveal and articulate the social feedback process through the use of social translucence software.

Supporting a social model of design through the use of technology is not straightforward. Social situations are complex, with influence, interpretations, and the needs of individuals often competing or generating conflicting accounts. This makes the task of understanding social interactions within a design studio all the more difficult. It also makes the development of software for that task equally as problematic. Searl (1995 p4) noted “complex social structure of reality is, so to speak, weightless and invisible”. How then to understand or visualise, the “invisible”? This is all the more compounded if the creative activity does not occur through a technological medium and creative knowledge somehow occurs and is gained tacitly.

The process of understanding the social interactions of informal feedback needs to reveal patterns that are true to the actual context of the real world. In essence, any visualization needs to accurately portray what occurs in the design studio. This means that any software engineering process must “turn to the social” (Grudin 1990). Software design must embrace the sociality of the situation that software tools exist within, in addition to incorporating features within the software that are required by real people in context.

1.2 The research question

The research problem described above leads to the following research question:

How can a social model of design be supported through technological articulation?

With the following research aims:

- To justify an understanding of design as a social model
- To justify how technology can support a social model of design
- To justify the theoretical and methodological stance taken in understanding the design studio
- To understand and reveal the reflective and feedback process within a design studio, in order to technologically articulate it in a realistic and purposeful way.

1.3 How does the thesis address the research question?

The research question contains three aspects. The first is to understand a social model of design in a real world context and how this informs the design research community about feedback sharing (through case study research and visualisation findings). Also, how this investigative stage informs the development of articulation and visualisation software. Secondly the appropriateness of the methodology to understand the complexities of social influence within a design studio and to accurately portray and reveal patterns of social interaction. Thirdly, technology that suitably supports feedback sharing in a design studio through visualising the dynamics of how designers reflect and give feedback to one another.

In order to address the research question, two case studies were carried out. The first of these concerns inter-disciplinary design in an educational studio. The second focuses on inter-disciplinary design in a professional design practice. In both case studies the combination of contextual observations and SNA were applied. This technique was used to a) understand the field site, b) gain network data that will be visualised, and c) inform the development of a creative software tool. In order to specify a prototype software tool the “wild networks” (in homage to Crabtree 2001 and his “wild sociology” thesis) methodological approach was used to gain rich descriptions and network analysis from the field research. A prototype articulation tool was then built and tested with five designers.

1.4 Contribution to knowledge

This thesis explores the sharing of feedback within the design studio (both in professional and educational practices) through face to face interactions and through software tools. This will contribute to existing academic literature surrounding a social model of design, by addressing the role of technology within the design studio as a facilitator to social evaluation and reflection. The following thesis also contributes to knowledge in designing software tools that support creativity, by using a combination of SNA and contextual observations to produce a network visualisation tool.

1.5 Visualisation of PhD argument

The thesis can be interpreted in various ways and through differing lenses of academia. The following thesis takes the reader on a journey which could easily have taken a different route. In order to aid the understanding of the thesis and the steps and processes involved, a visualisation of the argument, structure and logic is provided in figure 1.

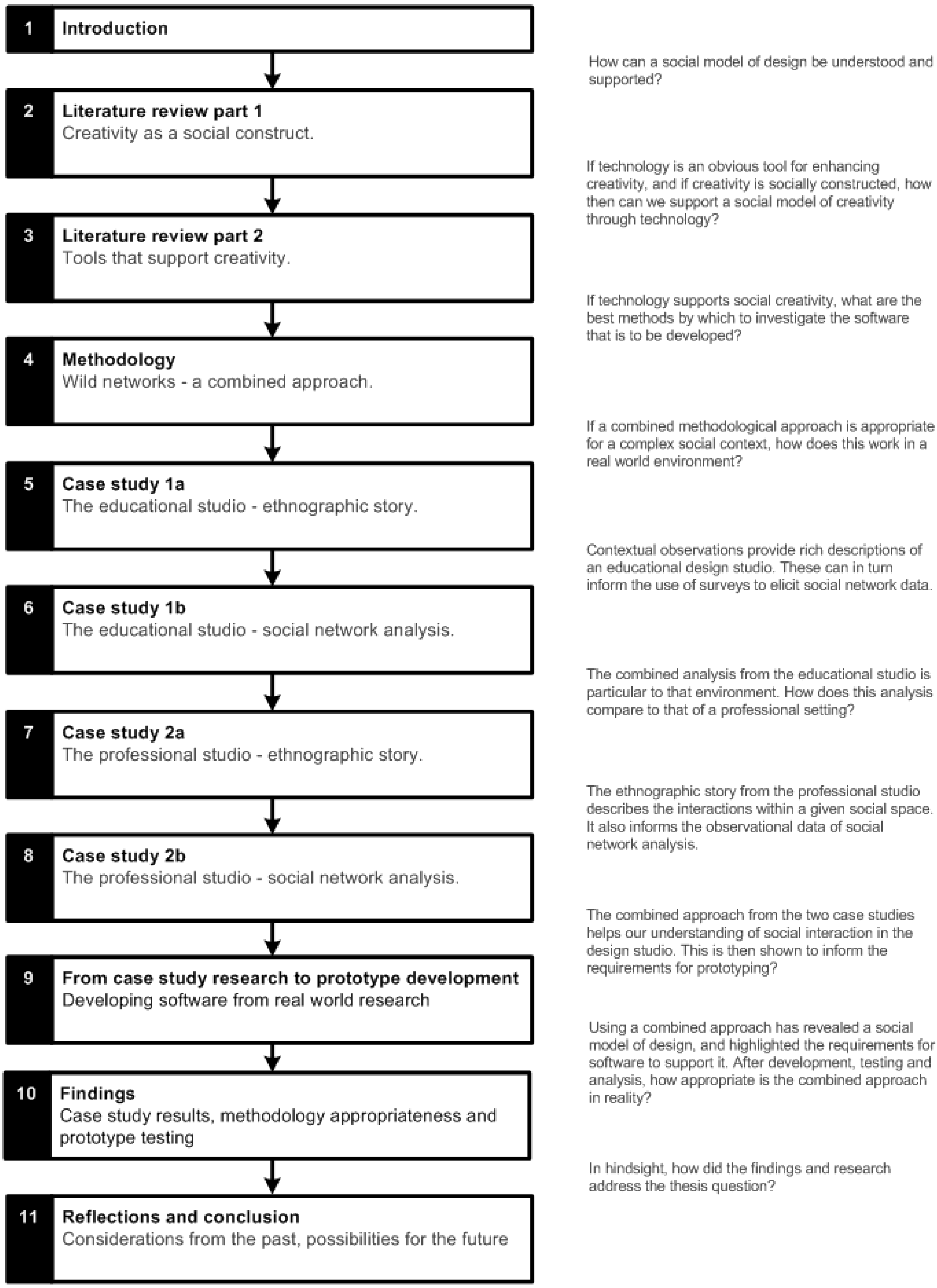


Figure 1: Visualisation of thesis

1.6 Chapter Summaries

Chapter 1: Introduction

This chapter introduces the reader to the thesis. It puts forward the research problem that is posed, the research question and how it is answered.

Chapter 2: Literature review part a - creativity as a social construct

This chapter discusses the wider context of the research, discussing the broadest aspect of the research context, progressing to the more specific. It firstly considers how creativity is socially constructed and the influences involved in creativity in general. Design, in particular, is then explored and the differing models for characterising design are evaluated, arguing the case for a social model of design. The literature review then looks at how the social model of design manifests itself and examines the social dynamics of informal feedback within the studio. This specific area of social influence is discussed in more detail as it is this connection that is to be analysed using network analysis within the thesis.

Chapter 3: Literature review part b - technology that support creativity

This aspect of the literature review considers how creativity is supported by technology in general and the role of technology within the design domain specifically. This chapter discusses the role of visualisation software to aid in the reflective process of design, proposing that technology can be used to articulate how designs work socially. This chapter also begins to discuss how this software can be achieved, and the requirements and research needed in order to develop it.

Chapter 4: Methodology - wild networks, a combined approach

To understand, a difficult, often indistinct, perhaps unacknowledged concept requires a technique that allows for such a notion to emerge. Within the methodology of network analysis, techniques to understand a given problem are, in general, based on quantitative survey analysis. This technique, although perfectly suitable in most circumstances, requires that the survey respondents are aware of the issue at hand and are also willing to admit, without bias, to informal collaborations between their peers. If there are any questions that this might not be the case, other techniques should be considered, such as observing what is actually happening rather than simply relying on what people say they do. In consequence the methodology section discusses the use of ethnographic based techniques to inform a network analysis approach to understanding design studios.

Chapters 5 and 6: Case study 1 - the educational studio

The first case study analyses social interactions within an educational design studio setting. Although team based design projects are becoming increasingly important to design education, fundamentally design education assessment looks at individual results. Student designers can operate within teams but also in ad-hoc groups that they rely upon to advise, appraise and discuss their work with. Student designers from three class cohorts are analysed using a mixture of techniques to understand peer networks that exist within the studio.

Chapters 7 and 8: Case study 2 - the professional studio

The second case study takes a professional inter-disciplinary design studio and seeks to understand the social influences at work. This second case study is not a direct comparison of the educational studio setting. Instead it directly considers the intricacies of the professional practice in its own right. The influences of commercial factors, rigid team structures, multiple projects existing at differing points during the design process, are all of consequence. These factors result in the methodological approach being slightly different to the educational studio context, however the aim of understanding the social dynamics in the studio remains the same.

Chapter 9: From case study research to prototype development

The findings of the case studies are used to inform the prototype development. This process has two elements: revealing the relationship data that has been collected and, based on requirements from the case study material, what should the software prototype reveal. The testing of the software with designers is also discussed, giving an insight into what can be eluded from the visualisation.

Chapter 10: Findings

The results of the two case studies are discussed in their own right, and where possible, in comparison to each other (noting the methodological limitations involved in achieving this). The articulation of social interaction is also discussed from the prototype testing, and how this can inform the development of the software. Findings are also discussed in terms of the appropriateness of the method to the case study as a way to articulate feedback sharing, and as a way to inform software development.

Chapter 11: Reflections and conclusions

The final chapter summarises the results of applying network analysis to understand the social influences at work in a design studio. This chapter reflects on the PhD, its process and the argument put forward within the thesis. It also discusses what was intended, how the thesis contributes to our academic understanding of design and the use of a combined methodological approach to design systems. Future work looks to develop the software that was prototyped and the possibility of using the methodological approach for software design purposes in other instances.

2. A Social Model of Creativity

Introduction

The research question of this thesis asks how a social model of design can be understood and supported through technology. In order to answer this question, this section of the thesis places the research into context and discusses the literature surrounding creativity and design and argues the case for a social model of design.

It is proposed that within the process of design, designers exist within a network of creativity that is social in nature and socially constructed. These networks provide many influences to the designer, from inspirational idea generation to pragmatic networks that support the marketing of a new product. To understand the concept of a design network, the following literature review firstly looks at how creativity (and in particular design) is socially constructed. This chapter begins by looking at the concept of social constructivism, and how our understanding of the world is a consequence of our social interactions. This chapter then discusses how creativity is a social phenomenon, fitting within a cyclical model of feedback sharing, alteration, modification and acceptance. Design work is also a result of the groups the designers relate to, the social influences they face and the wider design domain that evaluates their work. It will be argued how the following research can inform the field of design and how the research aids in the general understanding of networks in a creative field, finally posing the question of how best to support a social constructivist view of design through the use of technology.

2.1 Social constructivism

This chapter discusses creativity and design and puts forward the argument that they are socially constructed. Social constructivism is a concept that purports that meaning is imposed on the world by us, rather than existing in the world independently of us (Duffy & Jonassen 1992). It is a view that sees understanding as social in origin and attempts to make sense of the world by constructing knowledge. Burr (1995) described six tenets which define social constructivism:

-Anti-essentialism: that there is no objective nature to the world or people
-Anti-realism: we construct our own versions of reality
-Historical and cultural specific knowledge: knowledge only exists in the current and in knowing the historical and cultural background to it.
-Language as a pre-condition for thought and as a form of social action: reality is constructed through shared meanings and ideas, arrived at through social negotiation using language (Vygotsky 1978).
-A focus on interaction and social practice: the focus of research is based on social relationships rather than cognitive practices
-A focus on processes: to study the dynamics of social interaction
(Burr 1995 p 5-8)

Earnest (1998) proposed that over the course of the history of philosophy and epistemology, there has been a tendency to neglect or repudiate the social dimension. He maintained that traditional epistemology objectifies discourse and knowledge and focuses either on the individual knower and the cognizing subject or on objectivised knowledge. From the objectivist stance, knowledge is detached from the knower, and once accumulated the knower retains that knowledge (regardless of whether it is the property of one individual or is shared by many or all). Historically, teachers have taught and lectured in a way that presents the world as 'completely and correctly structured, in terms of entities properties and relationships' (Lakoff 1987 p159). The goal of understanding is, therefore, to know the entities, attributes and relations that exist. In the same sense, it is to build 'the' correct structure, and 'know' the entities, relationships and attributes (Duffy and Jonassen 1992).

Whilst objectivism maintains that meaning is separate from experience, constructivism maintains that meaning is rooted in, and indexed by, experience (Brown, Collins & Duguid 1989). Duffy & Jonassen (1992 p4) expanded on this point and stated that "each experience with an idea – and the environment of which that idea is part – becomes part of the meaning of that idea". Vygotsky (1987) also maintained that understanding was acquired by the individual through interaction with his/her environment:

> “Activity and practice: these are the new concepts that have allowed us to consider the function of egocentric speech from a new perspective, to consider it in its completeness... But we have seen that where the child’s egocentric speech is linked to his practical activity, where it is linked to his thinking, things really do operate on his mind and influence it. By the words, things, we mean reality. However, what we have in mind is not reality as it is passively reflected in perception or abstractly cognised. We mean reality as it is encountered in practice” (Vygotsky 1987 p78-79)

2.1.1 Interpreting design as socially constructed

Design can be envisaged as being socially constructed, as design work can be understood only in the social context in which it is produced. Designs are given meaning by the social world, and in the professional setting designs are evaluated by peers, managers and clients. In the educational studio designers are judged by their peers, tutors and examiners. There has been much debate within the educational academic domain about the application of social constructivist learning. Dougiamas (1998) for example, suggested that within a socially constructed view of learning, students come into class with an established world view, formed by prior experience. Even if this view evolves, the student’s world view filters all experiences, affecting their interpretation of observations. Dougiamas (1998) also maintained that students learn from each other as well as the teacher and that students learn better by doing and that by allowing and creating opportunities for all to have a voice that promotes the construction of new ideas.

Similarly, designers (both inside and outside education) call on prior knowledge and experience, they call to mind previous work they have designed, or have seen that fits the particular constraints of the current situation (Rowland, 1991). These previous experiences play a central role in specifying content and determining strategies that are implicit in any designs produced. Carroll and Campbell (1988) argue that many design artefacts reflect this underlying theory, for example computer interfaces being targeted at the social and with the growing realisation of this need (Grudin 1990).

A central feature of social constructivism is the centrality of language and how we construct and share meaning through the medium of language. Although we construct our knowledge socially and collaboratively through dialogue, no two people will have exactly the same conversations with exactly the same people. This view acknowledges that multiple realities exist.

Social constructivism puts forward the claim that who we know and what we know is a consequence of the interactions of others. For designers, what they design and what they know about design is a result of their social interactions. “It is through the daily interactions between people in the course of social life that our versions of knowledge are fabricated” (Burr 1995 p4). These interactions are central to this thesis, as supporting a social view of design relies upon understanding design as socially constructed with a social network of ties and relationships. Von Glaserfeld (1995) noted that a social constructivist reality is “made up of the network of things and relationships that we rely on in our living, and on which others rely too” (1995 p 7).

These two tenets of social constructivism are the primary focus of the following investigation;

- firstly how networks of relationship create a social reality of creativity
- secondly how the feedback within the studio allows for corrections and “re-presentation” of the world.

The following sections discuss these two areas in more detail, with the next section looking at the concept of creativity networks.

2.2 Social creative networks

Creativity is an elusive concept, difficult to define and difficult to replicate. Durling (2003), stated that creativity is “the ability to produce work that is both novel and appropriate” (2003 p 2). He considered that it encompassed the unexpected and original (Hudson 1966), the useful and worthwhile in context (Taylor and Barron 1963), often causing surprise (Bruner 1962) and was a process of setting aside convention (Guilford 1950). It has been studied through various approaches in order to understand and distil its essence so that people and companies can harness and increase their creative power.

2.2.1 The lone creator

Many theories and suggestions abound, some of which put forward the case for the sole creator, its autonomy and the relative ease at which it is understood through cognitive science. Goldschmidt (1995) for example, argued for “the designer as a team of one”. She questioned who produces better designs, the lone designer or teams of designers. Through the use of protocol analysis, she maintained that there was “almost no difference between individuals and the team in the way they bring their work to fruition” (1995, p189). This is a valid point when analysing a contained project in a repeatable objectively researched context. However, there are many practical issues surrounding team work that are difficult to address through an allocated comparative study. For example, a project can be completed more quickly through teams as more people are allocated to the work. Goldschmidt does not factor time into her study, just the quality of the output. Although it is noted that the individual and team had the same amount of time allocated to them, the analysis was based on small snippets from the time period that best facilitated comparison. A team project can also be more broad-ranging, utilising the skills of the members of the team. Goldschmidt's project was in a knowledge area of both the team and lone designer, and as such each individual knew the subject. Goldschmidt also compared the lone designer speaking out aloud to that of the team speaking conversationally. There are many research issues with this comparative approach, one of which is that in each protocol analysis comparison, team conversations will contain overlaps in speech. Furthermore non-verbal interplay between the team designers is not captured through protocol analysis. Also, the individual designer speaking out loud, is a somewhat artificial approach to designing. Goldschmidt entitled her paper “The designer as a team of one”, and this is a very apt title, as it does not propose the designer works in isolation. There is an implication from this title that the designer, in teams or otherwise, are, have been in the past and will be in the future, socially influenced. The designer has informal associations, personal links and previous knowledge (possibly and probably from other designers), which means that the lone designer is a team of one but not a team in a formal sense.

2.2.2 The team creator

Sawyer (2007) claimed some theories are based on myths and misconceptions. One of these is the idea of the lone creative genius, working in isolation in their studio, producing unique masterpieces. He maintained that this view does not take into account that humans are social in nature, that projects often require numerous people to fulfil tasks, and that any design work produced needs to be accepted by other people. In response, a growing community of scholars argue the case that creativity is not the result of one individual, as many people perceive, but is instead a result of group collaboration and social networks:

> "Thus the philosophically abstract conception of self sufficiency of the individual mind, free and independent of others, serves to conceal its origins as a social product of rule-governed reflection. 'I think therefore I am' totally obscures the social process whereby the use of the term I is acquired" (Doyal and Harris 1986 p 86).

The philosophical basis for this argument has emerged from ideas of social origins of personhood, espoused by the likes of Ludwig Wittengenstein, Karl Marx and Michel Foucault. Their notion of 'social selves' is based on how identities are socially constructed and shaped by involvement in the communities and cultures in which people live (Bakhurst,and Sypnowich 1995). More recent academic discussions have looked at creative networks within contemporary settings.

Recent academic literature surrounding the topic of creative networks such as *Group Genius by Keith Sawyer (2007),* have looked at a broad array of creative endeavour. Sawyer (2007) discussed the concept of lone creativity and argued that:

> "When scientists first began looking at creativity in the 1950, they focused on the solitary creative person. Although this research provided important insights.... by the early 1990s, those of us studying creativity had reached the limits of this approach. " (Sawyer 2007 p 8).

Sawyer (2007) maintained that creativity increasingly occurred from collaborative sources, and questioned how this could be researched through psychological tests. Even research that looks specifically at the cognitive and psychological processes of teams, often use techniques that require the acknowledgement and use of social data. Stempfle and Badke-Schaub (2002), for example, based their analysis of cognitive operations on the conversations of the three design teams.

2.2.2.1 Increasing reality of team based creative projects

Sawyer (2007) also proposed that within professional fields, more and more companies are opting for group based projects. To elaborate on this point Sawyer (2007) gave numerous examples organised in three sections: the collaborative team, the collaborative mind and the collaborative organisation. Each of these sections provides examples and evidence of creativity only occurring through the combined efforts of a number of people. The idea that creativity can be effectively achieved through “many hands making light work”, resulting in a creative project that can be completed more quickly

Sawyer’s discussion of the collaborative team involved specific examples where creativity has sprung from collaborative sources. These examples range from the Wright Brothers to improvisation in Jazz. From these examples, Sawyer identifies seven characteristics of the creative team and then expands the group creativity idea by reviewing Csikzentmihalayi’s (1990) concept of Flow. The Flow concept is an experience of “a unified flowing from one moment to the next, in which we feel in control of our actions, and in which there is little distinction between self and environment; between stimulus and response; or between past, present and future” (Csikzentmihalayi 1990 p42). Sawyer argues that groups can enter a state of Flow and gives ten “flow-enabling” conditions for the group to be creative.

Csikszentmihalyi maintained that Flow is achieved in activities where there is the learning of skills, there are set goals, there is a level of feedback and control is possible (Csikszentmihalyi 2002). He also stated that creativity operated in the intersection of two aspects, the domain (the cultural aspect) and the field (the social aspect). To be creative an individual would need to operate within these two areas.

The domain is needed because any innovative idea needs a background of traditional building blocks and context to be judged against. “Without rules there cannot be exceptions, and without tradition there cannot be novelty” (Csikszentmihalyi, 1990 p315). If a change occurs within the domain, the person or persons who had the idea is said to be creative. It is the field that will then ultimately do the judging and accept or reject the idea that has been proposed, and whether something is deemed creative. That field does not need to be large in number, it simply needs to be a group of experts that are a social organisation that manifests itself as representatives of the domain.

Similarly John-Steiner (2000 p5) proposed that “creative activities are social, that thinking is not confined to the individual brain/mind, and that construction of knowledge is embedded in the cultural and historical milieu in which it arises”. In her book *Creative Collaboration (2000)*, John-Steiner looks at innovative partnerships and associations between artists and scientists. Grounding her approach in the theoretical work of Vygotsky (1978), she discusses how creative thought occurs within a social-historical context. Through the use of examples, case studies, interviews and Q-sort personality research, she explores several themes that occur within collaborative creative processes.

2.3 Issues surrounding collaborative creativity

2.3.1 Size

The first of these themes is the idea of large organisational communities. In large communities such as in “Troupe Disney” where 300 artists and architects were assembled for Snow White and the Seven Dwarfs, members ranged in closeness. No-one can of course be closely connected to 300 people. Large collaborations require some kind of division of labour, and that people perform their role at a specific time. For example, the painter is dependent on the museum curator or the dealer, or the animator requires the story to be completed. In contrast an individual could not achieve such large undertakings alone, group creativity enables a project to be divided and allocated to individuals with specific skills to meet the task at hand. Building a house for example, requires differing skills and normally differing people to carry out those skills: the architect, the builder, the plumber, the carpenter etc. This kind of set up can be achieved in formal collaborative teams, with people working for the same company. Within informal settings, “fields” of creativity exist which are supported in a complex network of institutions. These fields of creativity require a common bond or motivation. Csikszentmihalyi (1990) gives the example of fifteenth century Florence, where many people were involved from bankers, churchmen to the artists themselves and who were all motivated in making Florence beautiful.

2.3.2 Support

John-Steiner argues that artistic development illustrates the concept of “self-on-relation”, the notion that the self develops in the context of important relationships such as close friends, family and lovers. She maintains that collaboration stretches one's own ability through inter-weaving of social and individual practices. The common agenda to produce a work of art can often mean that individuals need to support one another. Working in partnership can be mutually beneficial, to heighten success but also when times are difficult and an artist struggles. These difficulties can vary from financial hardship to emotional need. John-Steiner gives the example of Vincent Van Gogh and his brother Theo. Theo, an art dealer, provided financial support for his artist brother. People often face loneliness and doubts about their work and Theo provided Vincent with encouragement and emotional support as well as a level of financial security. Security is often illusive to creative people, whereas in contrast academics have a support structure in the university institution for which they work. Creative people need a network of people that support them emotionally and creatively in order to offer constructive criticism, whilst also spreading the risk of their work. Creative people need individuals they trust, to give them the support they need to take risks and to feel confident about their work. Jean Paul Sartre remarked to Simone de Beauvoir: “You did me a great service. You gave me a confidence in myself that I shouldn’t have had alone.” (John-Steiner 2007). Equally artists can also support one another in temperament or in facets within the artistic process. Helena Pyciot describes Marie Curie as a thinker-doer. Pierre Curie on the other hand, was the thinker-dreamer.

The relationship between the artist and their support mechanisms are often complex, with psychological inter-play making situations fraught. Issues of control and dominance can make partnerships difficult especially if one partner financially funds the other, as in the case of Theo Van Gogh financially supporting his brother. Another example is if the partnership involves family members and where traditional roles shift. The artists Gail and Zack Rieke's explained that they would go through cycles of change, and each would interchange the role of parent and artist. Partnerships involving family member and spouses can require a delicate balance of these roles.

2.3.4 Ownership

Additionally, co-authorship and collaborative groups can also have issues associated with ownership. Within academia, co-ownership of an idea can be achieved through publications in the name of both scholars. This is a situation that is actively encouraged, although there can be many problems associated with it. For example, the authors of *Women's Way of Knowing* chose to list their names alphabetically, however many assumed that Belenky (the first named author) was the senior author. In artistic works, the formal authorship procedure is less prescriptive although works are often attributed to other artists. Ownership becomes far more complicated when the cooperation of people is less formal and more serendipitous in nature. Artistic ownership of works created in collaborations is a large and complex subject which cannot be given suitable attention in this section alone. There are a number of court cases which have arisen to address this very topic when artists feel they have not been properly attributed (as well as financially so). The case of the band Procol Harum is one such incidence. In 2009 the organist of Procol Harum won a court case to be named an official co-writer to the band's song "A whiter shade of pale", and to receive his due financial contribution.

2.3.5 Differing types of collaboration

Collaborative groups can take many forms: the intimate partnership, short term intense teams, and long-term formal associations. In some groups there is an intense period of creativity, while in others there is a continual venture that lasts a lifetime. Partnerships can start within a larger group such as the partnership between Balanchine and Stravinsky which was formed within an artistic ensemble that featured painters such as Picasso, Roualt, Braque and Matisse, as well as choreographers Fokine, Massine and composers such as Stravinsky (John-steiner 2000). John-Steiner identified four patterns of partnership (see figure 2), that accounts for these variations of intensity, duration, interactional processes and objective. The differing types of collaboration and the issues raised around them, all have at their heart a “joint, passionate interest in a new problem, art form, or societal challenge... and this is crucial to collaborative success.”(John-Steiner 2000, p189) Discovering and identifying these types of collaboration are useful indicators for understanding the influence collaboration has upon the creative person.

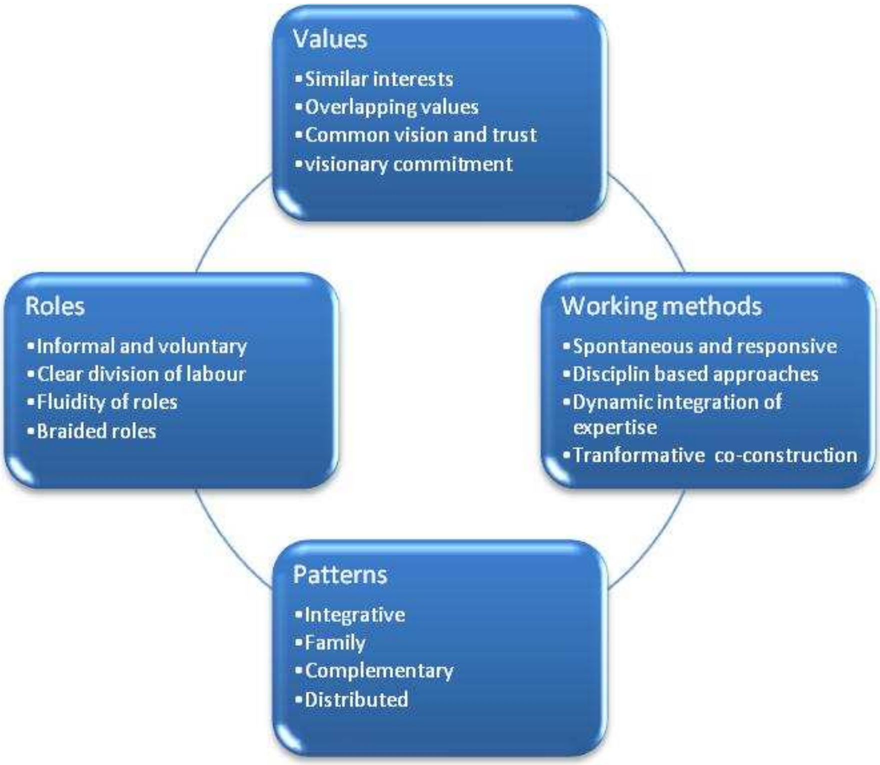


Figure 2: Collaborative patterns: roles, values and working methods (John-Steiner 2000)

John-Steiner (2000) emphasised the idea of creativity as a social construct. Creativity exists within an environment which requires social support (be it financial, creative, emotional etc). It also exists within varying types of collaboration patterns, roles, working methods and values (see figure 2). In essence what exists is the creative person, with varying types of relationship to other people that are relied upon in order for a creative output to be made. This can be seen as a creative social network, with creative people, and people they have relationships with, in order to create. Nadel (1957) proposed that social networks are a type of social structure; a network of people, actors and objects, all of which can be seen within the creative arena.

To summarise this section:

- It has argued the case for creative endeavour as a social construct
- It has shown the benefit of collaborate creative projects and has given examples of successful group projects.
- It has discussed the issues surrounding creative group endeavour
- It has proposed that a social constructed idea of creativity relates to the idea of a social network of creativity.

So far, it has been creativity that has been discussed as a social phenomenon. Durling (2003) noted that within the literature surrounding creativity, the focus has been upon comparisons of art and science rather than design in particular. In the next section design is considered specifically. Many of the arguments for creativity as a social model relate directly to the creative field of design. This section aims to describe design as a social process in more detail.

2.3 Design

2.3.1 Design process models

Design, like creativity, is difficult to define. It is the development of a plan, process or structure (verb), whilst also being the final solution in the form of a model, graphic or website (noun). In addition to this, design is difficult to compartmentalize as it plays a role in many very different professional fields (e.g. an important aspect of both manufacturing and branding). Design can be seen within a spectrum of professions, covering industrial design at the engineering end (Lesko 1999) to graphic design at the more artistic end (Fletcher 2001). Design is often seen as the intersection of art and engineering, or the bridge between the scientific and quantifiable on the one hand, and the aesthetic and evaluative on the other (Flusser 1999). It can cover a huge spectrum of activities that can be individualistic, team-based or across many design domains. Trying to define, categorise and model design is not, therefore, straightforward. Descriptions of design have inevitably relied upon metaphor that can contain individual creativity, cultural influences, problem solving, and complexity amongst many others factors (Coyne & Snodgrass 1995; Snodgrass & Coyne 1992).

2.3.1.1 What can be achieved from modelling design?

To encompass and encapsulate what design entails, models of the design process are used. Models aim to describe a system, an item, a thing or process in a symbolic, often simplified, representation (Gero 2006). Models in general aid our understanding of the thing which they model, and they enable that thing to be categorised, replicated, and improved upon. In design, with increased understanding of what it entails, comes the ability to model the design process more and more accurately. Design models can simply be used to categorise what constitutes the design process; for instance, to distinguish the act of designing in comparison to say healthcare for government industrial classifications. Design models can be used for replication. A design course in one university using a proven design model can then be replicated in another university. Models that are used for replication can be applied to design activities that are supported by technology. Software can be used to facilitate part of design models, with the aim that they can assist or even replace routine design tasks (Gero 2000). Thirdly a design model can aim to improve the design work that is produced. If, for example, a key feature of design has not been identified within an existing model, this facet could become overlooked in a design course or in the process of designing. By including this new feature, the design model is a more accurate portrayal and may enable better designs.

2.3.1.2 A history of design models

In the 1950s and 60s logical design models were reported which adhered to dominant forms of behavioural activity such as analysis, synthesis and evaluation as seen in figure 3 (Asimov 1962; Archer 1963). In the early 1960s new procedures began to emerge which, according to Jones (1970), tried to reduce design error, re-design and delay, and to advance design to make it more imaginative. Those procedures or phases model the design process and can be applied generically to a spectrum of design activities from the technological to the creative. Since then it has been proposed (Stumpf and McDonnell 2002) that recent design literature could be structured around four paradigms: problem solving (Simon 1969), hypothesis testing (Broadbent 1984), experimental learning (Schon 1991) and social process (Bucciarelli 1994).

2.3.1.3 Problem solving and hypothesis testing

The hypothesis testing model is empirical in nature, with a designer testing ideas and products before deciding on a final solution. It is a concept rooted in the idea of "trial and error" and of precedents and mistakes. Similarly Simon's (1969) model of problem solving is also rooted in an empirical process of design. Simon (1969) argued that design followed a linear, rational model that involved problem solving. Simon's concept of the "science of design", provided a "body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the process of design itself" (Simon 1969 p58). The concept prescribes a formulation of a problem, and the systematic search for possible solutions. Simon maintained that these solutions should be *satisfying,* in that the solutions should be good enough, as any designs are within *bounded rationality,* whereby designers are human and limited by decision making and problem solving. However, this prescriptive stance and orderly approach of search and planning, is not without its critics. Cross (2006) noted that

> "The appositional nature of design reasoning has been neglected in most models of the design process. Consensus models of the design process, such as that promulgated by the Verein Deutscher Ingenieure [VDI, 1987]…propose that designing should proceed in a sequence of stages….In practice, designing seems to proceed by oscillating between sub-solution and sub-problem areas, as well as by decomposing the problem and combining sub-solutions" (Cross 2006 p57)

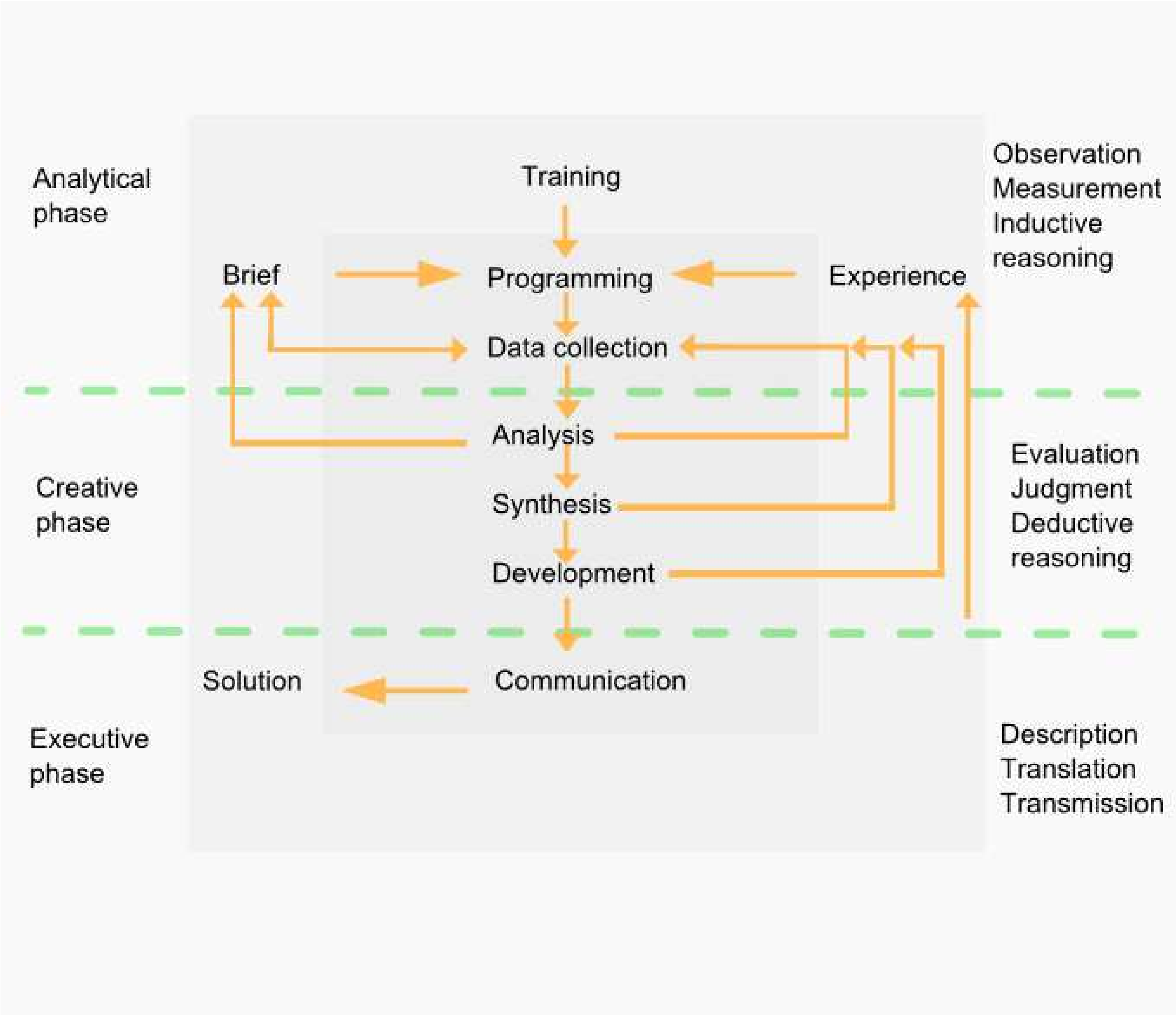


Figure 3: Basic design procedure by Bruce Archer (1963). Reprinted by Cross (1984 and 2000) and Rowe (1987).

Furthermore, Agre (1997) maintained that the problem solving model of design does not account for improvisation or the “the continual dependence of action upon its circumstances” (1997 p156). Nor does the model allow for differing agendas that stakeholders within the design process may have (Ehn 1988). This is particularly pertinent for inter-disciplinary and group design work. Argyris (1977) asserted that:

> “Simon used *satisficing* to rationalise incompetence... [and] he had not taken into account the material conditions and historical and cultural factors which largely govern human behaviour” (Argyris 1977 p194)

2.3.1.4 Experimental learning

In contrast Donald Schon (1983, 1987, and 1992) proposed an alternative model of design. Schon puts forward the idea of reflection-on and reflection-in action as a design model. Reflective practice can be described as "a set of abilities and skills, to indicate the taking of a critical stance, an orientation to problem solving or state of mind" (Moon 1999 p 63). Schon (1983) describes a situation where students do not use espoused theories when they design. Instead they work with context specific “theories in use” in which they learn by doing. Schon also distinguished between reflection in and reflection on action. Reflection in action refers to the student who, whilst carrying out their design work, comes across something unexpected. They then learn from this experience and subsequently modify their work. This is referred to as “seeing-moving-seeing” (Schön 1992, p5), in which the designer firstly evaluates their current work, then moves their work by modifying their design which leads to a new evaluation of the design (Gero and Kannengiesser 2003). Reflection on action, on the other hand, is retrospective and occurs when a student looks at the actions and work they have already done in order to learn from past experience.

2.3.2 A social model of design

The final view of the design process discussed here is the social model. It is this model, in conjunction with Schon’s concept of reflection and the idea of social reflection, which is argued throughout this thesis. Traditionally the idea of creativity and a person being creative has centred on individual processes. Research into creativity has previously looked at the “characteristics that distinguish a person, a product, or a generative process as creative” (Sosa and Gero 2005 p19). Conventional research has concentrated on understanding what makes someone creative and what is special about a certain individual, and has attempted to understand what cognitive processes occur when someone is being creative. However, recent research into creativity such as historical creativity (Boden 1994; Sternberg 1999), or big-C creativity (Gardner 1993); have supported the idea of creativity being social. In light of this, the idea of design as a social activity has been put forward (Sosa 2010).

2.3.2.1 A systems view

Sosa and Gero (2005) argue that recent research has shown social evaluation as an important aspect in the definition of creativity. They modelled creativity using computational simulations and formed a social model of design based on the "interaction between individuals that generate and introduce new ideas, and societies that collectively evaluate and decide to adopt or reject those ideas" (Sosa and Gero 2005 p1). They maintain that "design process... may be affected by the social assessment of previous artefacts and designers" (Sosa and Gero 2003 p2), that any evaluation of a designed artefact will be influenced by other designers, solutions and evaluations. They put forward a framework of creativity (DIFI Multi-agent Framework – see figure 4) and sought to study individuals within social groups. This model is based on a systems view of innovation: the Domain-Individual-Field-Interaction or DIFI framework (Feldman, Csikszentmihalyi and Gardner 1994). This 'systems view' approach has previously been applied within the design domain by using Grounded Theory to highlight the importance of the group within a design company (Mival 2005)

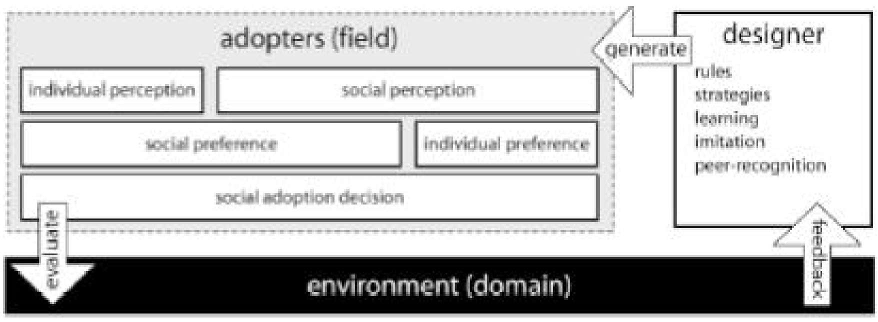


Figure 4: Domain – Individual – Field Interaction (DIFI) map of creativity

Csikszentmihalyi (1990) put forward this 'systems view' of creativity, with three dimensions (views) that interact cyclically: the domain, the field and the designer. In the domain view there are shared beliefs, knowledge and evaluation criteria within a community. Kuhn (1974) emphasized the importance of the wider community as they not only produce but also validate knowledge. He defined community as a group of individuals bound by common elements in their education and practice, aware of each other's work, and characterized by the fullness of their communication and relative professional judgement (Kuhn 1974). The assessment from this community then passes information to the person (designer). The field view involves groups of individuals who are part of a common domain such as a studio existing within the wider design domain. The designer view is the person who creates, and it is their work that is evaluated by the field, which judges creative output and transmits this to the domain. The key tenet of the DIFI framework is that creativity is not an individual process, it is within a dynamic environment and in which designers, in relation to external factors, create (Gero and Sosa 2005). Any designed product therefore needs to be the right product at the right place at the right time, where ‘rightness’ is defined by society (Simonton 2000). In this manner creativity transcends the individual reasoning process to include its situatedness (Clancey, 1997).

The three dimensions of creativity put forward by Csikszentmihalyi (1990), can map to the idea of the Creative Industries (CI) being the wider creative domain, the field view equating to a design studio, and the designer view as the individual designer and their closest connections (informal and formal teams). The CIs may seem a broad ranging community, but it is proposed that all CI sectors have a common thread of creativity. This creativity can, in theory, be passed from one sector to another. A graphic designer could, for example, go into the film industry and although this may require differing skills, the creative talent needed would be the same. This is even more categorical if the skills required in one sector are the same as another, such as TV production and film production. This results in an industry that has a high degree of convergence. Furthermore the idea of the field view equating to a studio allows for differing creative industries to feature in a particular studio. In a social model of design, the design process can be the result of many creative and design disciplines. The social model lends itself to inter-disciplinary design as people constitute each individual discipline within an inter-disciplinary team. Thus inter-disciplinary design by its very nature conforms to a social model, in which creativity is shared within a group. This allows for a greater range of design tasks to be offered and undertaken, as the differing skills within the team can be utilised.

2.3.2.2 The role of evaluation in the social model of design

Feedback and evaluation is central to the social model of design, it transcends all three areas of the DIFI model and is integral to how each dimension relates to one another. Sosa and Gero (2005) acknowledged how complementary the evaluation processes is between social groups, experts and peers. They suggest that the designer learns and decides whether to adopt a design from the feedback provided by the social group. Indeed they maintain that “creativity is essentially determined by social evaluation” (2005 p1). It is the interaction of designers sharing feedback and socially evaluating each other’s work, and it is this social influence that is the main focus of investigation in this thesis

Fundamentally, understanding creativity and design within a social framework allows for observing design activity, rather than cognitive processes within the designer’s mind. Csilcszentmihalyi (1990 p. 203) suggested that “there is no way to get evidence for a creative process taking place in a person’s mind independent of social validation”. Sosa and Gero (2006 p3) also maintained that any methodology “should not commence with the notion of creativity as an individual cognitive faculty by which a person is regarded as being creative”. Alternative methodologies should instead look at the process by which the designer became creative by the action and conditions of their environment. It is put forward that the use of a network model of design can reveal the connections and influences of other designers, the studio and the wider community

The social model of design can be seen as the same as a social network model of design. In the design field it is proposed that creativity is part of a cyclical social process in which a designer generates work that is evaluated and adopted by other designers and the wider creative environment. A designer works within a social context, and this constitutes actors and individuals with a social connection and relationship to other people, the very definition of a social network. It is proposed that the wider creative domain can be considered a network of inter-relating actors. The domain view mapped to a two-dimensional network matrix: designers relating to a community and not to each other. Clients and external bodies are important social influences upon the design process. In the designer view, an ego-net network analogy is made. The designer (the ego) and the close connections only they have, and not the inter-relationships within the network (studio) as a whole. In the field dimension the design studio can be considered a social network of actors (designers) relating to other actors in a one-dimensional matrix. Sosa and Gero (2005) acknowledged this connection between a social model and social networks:

> "Social spaces are also characterised by ties, i.e., linkages between nodes in a social network. These links determine what adopters (nodes) have contact with each other. The strength of social ties refers to the likelihood that nodes in the social network are maintained over time. Strong ties are characteristic of resilient social relationships such as kinship or friendship, whilst weak ties characterise temporary social networks such as school peers or travel acquaintances. In networks with strong social ties, adopter agents maintain contact with each other over longer time periods, whilst in networks with weak ties adopter agents constantly change contact with different neighbours." (Sosa and Gero 2005 p3)

2.3.2.3 Roles within the social model of design

Sosa and Gero (2004b) also maintained that gatekeepers may determine how and who is considered creative in a society. The role of gatekeepers within a network can be identified using statistical social network analysis tools. The role of gatekeepers is also a key feature surrounding the debate around social change and the influence design can have upon society. It is possible that 'creative people', are the gatekeepers of novel ideas that shape their society. In particular, "social ties in a population of adopters are shown to shape the way in which designers are considered as change agents of their societies" (Sosa and Gero 2004a p499). In conjunction though, designers and gatekeepers are also a product of social dynamics themselves (Sosa and Gero 2003).

This section has shown:

- Differing models of the design process have been put forward, arguing the case for a social model of design.
- The social model and social networks of design have been discussed as possessing differing levels of connection, from clients and the wider design

domain to individuals and the close personal connections upon which they rely.
- It has been put forward that feedback, reflection and evaluation are central tenets of a social model of design.

The following section looks at team and group activity (both formal and informal) and how they relate to individual designers.

2.3.3 Group activity in the design studio

Cross (1992) noted that research into design activity and the design process has historically been based on studies of individual designers. Increasingly however, understanding collaborative teams within a creative design process has gained academic and professional support. This has allowed recent research to dismiss the idea of the lone designer working in isolation, in favour of group based projects (Ulrich and Eppinger 1995, John-Steiner 1997, Sawyer 2007, Csikszentmihalyi 1990).

In understanding a group and team based design project, Cross and Cross (1996) analysed the Delft protocol workshop. They maintained that design was a social process that interacts with the technical and cognitive design processes, and that working in a team brings with it inherent group related issues. They sought to observe the following aspects:

- Roles and relationships
- Planning and acting
- Information gathering and sharing
- Problem analysing and understanding
- Concept avoiding and resolving

This approach has been revisited more recently with the work of McDonnell and Lloyd (2007).

2.3.3.1 Inter-disciplinary group activity

It can be argued that these issues are even more exaggerated in inter-disciplinary or multi-disciplinary teams. Roles and relationships are a major factor in group dynamics and an increasingly acknowledged dimension to team work (Branki, Edmonds, and Jones 1993, and Minneman and Leifer, 1993). Within an inter-disciplinary and multi-disciplinary team, roles and relationships have an added dimension. For instance, does one discipline have precedence over another if the project is of a certain type? Is one design discipline the more dominant because of the numbers of people represented on the team? Similarly, in an inter-disciplinary and multi-disciplinary team, team members not only need a common understanding of the design problem (Frike 1993), but also one that can be understood and couched in terms specific to each discipline.

2.3.3.2 Un-formalised team structures

Understanding the role of others during the design process has, in general, focused upon formalised team structures and how designers work within a set group of people, often in a prescribed context (Cross & Cross 1996). It is far more difficult, however, to study the ad-hoc social influence of peers within the studio, as they are the un-formalised team that is often random and serendipitous in nature. Addressing this issue essentially tries to distil a collective cloud of knowledge and ideas, which is like “bits and pieces all floating about in the air” (Powell 1995). These “bits and pieces” through a process of discussion and reflection with peers and colleagues, amalgamate together and form a final design (Lloyd and Deasley 1998). This is particularly the case in the conceptual phase of a design project. It has been noted that this stage “is a vibrant, creative and dynamic period.... [with the] exchange of information between design team members.. [and the] transfer of information, ideas and opinion critical to the development of concepts” (Austin and Steel 2001 p 211).

Lloyd and Deasley (1998) maintained that complex design artefacts evolved through designers discussing and negotiating with peers rather than as a consequence of individuals rationally thinking through the problem. They claimed that design was a social process and “spread over a social network and through narratives and discourses that are forged from day to day” (Lloyd 1998, p 101). In a design studio, informal feedback networks, where designers narrate and reflect to one another, are often un-documented and are a set of improvised connections between designers. They exist within the design studio in tandem with formal design team structures and hierarchical constraints. They are, however, much more difficult to understand than formal group arrangements, as they are complex to define, not perceived as having a consequence upon design outcomes, or they are simply a sub-conscious act, unbeknown to a designer. To unearth and reveal this challenging concept is the basis for the research problem that is addressed in this thesis.

If design “exists only within a collective sense” (Buccerelli 1994), the role of peer networks within the studio becomes all the more important. However it is the connection between peers that is of real focus. Two designers may be friends but if that relationship has no bearing on how each of them designs, then there is no reason for there to be any investigation within the context of design studies. It is connections between peers that have the real bearing on whether these ad-hoc groups have an impact on the design process and artefact.

2.3.3.3 Evaluating teams

Evaluating the influence of groups is again a complex task (Devine 2002, Cohen & Bailey 1997). Qualifiers of successful design projects are difficult to pin-point and vary depending on the project itself. Aesthetic value may be one variable of success in an educational project, whilst in a professional project, commercial value and repeatability maybe the deciding factor. Cohen and Bailey (1997) studied the variables of team effectiveness and concluded that the composition of the team has complex and often contradictory effects. They also noted that depending on who was judging the team had an impact on the team’s overall assessed performance. Variables of success have made assessment of group performances all the more difficult and problematic to address. This is exemplified when looking at groups and networks of designers that change and adapt depending the stage of the design process, the need of the project or whims and preferences over whom to work with.

The next section looks at informal groups in which the relationship that binds designers together is the sharing of feedback, evaluation and reflection.

2.3.4 Feedback, evaluation and reflection within the design studio

Glaserfield (1995) in describing a social constructivist stance stated that “learning is not a stimulus response phenomenon. It requires self-regulation and the building of conceptual structures through reflection and abstraction” (p76). Furthermore Glaserfield (1995) believed that “feedback from one’s own action is considered the primary source of knowledge about the world, and based on this feedback, one’s cognitive structure is “corrected” to achieve a viable and coherent “re-presentation” of the world” (p76). It is proposed that design is a process of reflection, abstraction and a dialogue of feedback within a socially constructed model. This cycle of communicating, sharing and socially evaluating is key to a social constructivist view of design. It is this specific aspect of sharing feedback that is investigated within an educational and professional setting of this thesis.

This thesis seeks to understand how peers give informal feedback to one another about their design work, and it is this feedback between designers that is the connecting factor. However feedback and how designers use that to reflect upon their work, is, like design itself, difficult to classify. Information is passed around the studio verbally, textually and visually as a discursive and explanatory narrative (Strickfaden 2005). This narrative between peers is referred to inter-changeably throughout this thesis as feedback, appraisal, evaluation, peer review, or social reflection. It is the occasions when designers discuss and view their work with their peers and colleagues, normally in conjunction with, and in reference to, the design work in question.

Investigations into feedback sharing have shown that it improves task performance through corrective action and learning from practices and behaviours that produce desirable outcomes (Busby 1998). It has also been shown that the effectiveness of feedback sharing is enhanced if it is part of a goal setting process (Latham and Locke 1991). Additionally feedback is most successful when it is positive in nature

(Ilgen et al 1979), and frequent (Harold et al 1987), a level of complementarity (knowledge, skills, techniques etc) and constructiveness (John-Steiner 2000). Feedback sharing that is not in a prescribed sense (student friends in a studio, for instance) also requires high levels of trust. There are, however, occasions when feedback sharing can have a negative impact upon the design process (Ancona & Caldwell 1992). For example, feedback that conforms to pre-existing belief systems is normally accepted. In contrast feedback that is contradictory, whether it is correct or not, is not as well received (Einhorn and Hogarth 1978). Another exception to feedback being a positive concept is if a design problem is a complex one, in which case feedback can, in some instances, distract from the task at hand (Ashton 1990). Furthermore, if the outcome of the task is the guiding principle by which feedback is given, the task process is not taken into account. Lipshitz (1989) gives an example which encapsulates this problem: a commander disobeying an order but winning a battle (wrong process, right outcome), to another commander obeying an order but losing the battle (right process, wrong outcome). If the feedback giver ignores the process involved in reaching a successful design in the past, then future feedback may provide poor process guidance because the outcome had previously been a success.

2.3.4.1 Formal feedback sharing

It is perhaps, more accessible to understand feedback when it is given in a formal context. The concept of formal appraisal and review is widely recognised within the design community, particularly in regard to critiquing sessions (Oak 2001, Uluoglo 2000, Craig, 2000, Teasley, 1997, and Bruckman, 1998). Throughout the design process, appraisal is a phenomenon that is perceived as being integral to the development of design work, from both an educational and professional standpoint (Boyer and Mitgang, 1996; Goldschmidt, 2002: Schön, 1984). For more experienced designers, appraisal allows the designer to constructively give their opinion in a formal critiquing process (Mirochnik, 2000). Similarly in an educational setting, formal critiquing sessions are timetabled for the duration of most projects (Uluoğlu, 2000). Informal peer review, on the other hand, is more serendipitous in nature. It is less structured and as such the times when people seek appraisal may occur at varying points in the design process. Informal appraisal allows the designer to reflect on their own work with their peers, and by reflecting on the work of course mates peer based learning can be encouraged (Trigwell, 2001). Recent pedagogical literature has encouraged educators to facilitate student peer appraisal in order to reflect on each other's design experiences as well as interpreting the social dynamic of their work (Nicol and Pilling, 2000).

2.3.4.2 The inter-relationship between evaluation, feedback and reflection

The terms evaluation and feedback have, so far, been used interchangeably but there is, however, a subtle difference between the two. Evaluation is a broader concept than feedback. It can be used from technologically testing a product solution, to observing design work in relation to that of others. It can encompass the uncommunicative, the cognitive and technical. Gregory (1988 p147) suggested that "in evaluation we attempt to find a value for a particular proposal arrived at by synthesis". He went onto suggest that "evaluation gives information about the way a design is proceeding and suggests the direction in which change should be made in order that the complex of policies behind the design should be fulfilled in a satisfactory manner"(1988 p152). Although he refers to evaluation in a social context (see below), it is not just social in nature:

> "Design in the applied arts and the useful arts fields is directed at other people. There is an external evaluation structure which involves objectives, their interrelationships, ways of appreciating and measuring the associated values, and the interrelationships of the values" (Gregory 1988 p148).

Feedback in contrast to evaluation is more specific. By definition it involves designers giving opinion back that is informative to both the feedback giver and the person receiving the feedback. It allows designers and organisations to effectively learn from experience (Busby 1998). Feedback is, generally, social in nature, with verbal or written feedback about design work. It can also be a reflective, cognitive conversation about a designer's own design work. Busby (1998) distinguished that feedback was either "promoting learning through unconscious conditioning or through deliberate reflection" (1998 p104).

It is argued here that feedback is a reflective process. It may seem the case that Schon’s reflective practice may be considered as mutually exclusive from social constructivism (with its sharing of feedback facet). That reflection is an internal cognitive process, whereas constructivism is an external social process. Indeed there has been criticism of Schon’s work and in particular his lack of attention to the discursive, a central tenet of social constructivism (Day, 1993). Schon (1986) however stated that “whatever language we may employ, however, our descriptions of knowing-in-action are always *constructions*. They are always to put into explicit, symbolic form a kind of intelligence that begins by being tacit and spontaneous” (1986 p25). Furthermore, Schon (1986) also maintained that the constructivist position was an important factor for the professional reflective practitioner:

> “The reflective practicum should include ways in which competent practitioners cope with the constraints of their organizational settings. The phenomenology of practice – reflection on the reflection-in-action of practice – should enter the practicum via the study of the organisational life of practitioners. And here a construction perspective is crucially important; for the phenomena of practice in organizations are crucially determined by the kinds of reality individuals create for themselves, the ways they frame and shape their worlds- and what happens when people with similar and different ways of framing reality come into collision” (Schon 1986 p322)

Similarly, Solomon (1987) also makes the case for reflection as a social practice. He maintains that the articulation of ideas to others is central to the development of a critical perspective and appreciation. Within a reflective practice, designers look at their work and their motivation and relationship to it, clarifying their ideas and reaching a better understanding (Schön, 1983). Part of this process is the internal cognitive reflection of how their own work is influenced by the work of others.

Reflection can therefore be considered as part of constructivism, as the theory fully supports having designers reflect on their work (Hlubinka 2002). Constructionists also suggest we build things in part to externalize our thinking in order to have an object to think with (Papert, 1980). The production of objects allows designers to externalise their thinking with themselves, and also with others. The object becomes the prompt which helps other people reflect on the work for their own benefit (how their work relates to other work); it also facilitates conversational feedback to the benefit of the designer who created the object. There are subtle variations here to the sharing of feedback and social reflection. Viewing other people's work, discussing the work of other people, appreciating designs that are around (in the studio or the wider domain), all facilitate the designer passively reflecting on their work in light of other people's work. It is how the designer sees their work in relation to the work of others. This can occur without conversational interaction, although it is most obvious when dialogue does occur. In effect it is easier to assess (and a more realistic situation) when the social reflection involves a designer discussing their own (or others) work with someone else rather than assessing an internal cognitive conversation (analysing thoughts spoken out loud).

2.3.4 3 Why is feedback sought?

The importance of appraisal and feedback within the design process can be understood by looking at why it is sought. Dong (2006), analysed student peer appraisal via blogs, and categorised the appraisal exhibited in three ways: rational decision, kinship support, and muse. From this it can be seen that people seek appraisal because it fulfils a certain need. For example, appraisal can give a designer emotional support for their work, which is particularly useful for novice designers. Similarly, Ashton and Durling (2000) proposed that students needed to know whether they were "doing the right thing". They categorised the concept of "doing the right thing", as students fulfilling creative uncertainty by referring to past experience and learning, assessing user needs and comparing their work socially. Ashton and Durling (2000) maintained that student designers sought appraisal to ascertain whether they were doing their work correctly, and following the right process to produce results of an adequate standard.

2.3.4.4 Unacknowledged feedback

Peer review and feedback is quite often comprised of a hidden undercurrent of connections that exists between designers in a studio. It often also occurs outside of the studio setting (discussions at the pub, for instance) but in this thesis it is generally referred to as feedback within the studio environment (only that which was observed). It is ethereal, often unforeseen and lies under the surface of formal structures, hierarchical chains of command or positions of power. It can be difficult to define as it is amorphous, intuitive and possibly unacknowledged in some instances. Designers may not even be aware that they are reviewing each other's work, or may not want to admit to doing so in case it was somehow construed as "copying" other design work. These issues surrounding the concept of peer review have resulted in the subject being difficult to approach at all, let alone using a suitable mechanism that will truly capture the essence of the socially constructed design process.

In summary:

- Feedback is a fundamental aspect of a social constructivist concept of design
- It is argued that feedback is integral to the development of design work from both an educational and professional standpoint
- It is discussed how feedback offers a variety of support to designers
- The practical issues surrounding the concept of designers sharing feedback have been discussed

Conclusion

This chapter has sought to argue for a social model of design, and the sharing of feedback within that model. To do this, this chapter has put forward a social constructivist position of creativity, and how design specifically can be viewed as a consequence of the environment to which the designer belongs. It has been discussed how there is a misconception that design is solely an individualistic process but puts forward the argument for an iterative cycle of feedback and evaluation between designers, their studio and the wider creative domain. The social model of design encourages and allows for:

- design to be carried out in groups (informally and formally)

    - so that projects can be split into the various skills sets of the people within the group
    - so that the project can be completed more quickly – 'many hands make light work'
    - so that a greater range of task can be achieved
    - so that support (emotional, financial etc) can be provided between people
- various stakeholders, such as clients, and the influence they may have
- design within a wider domain in which everything is social, where designers are influenced by their friends, family, previous colleagues, current work peers .

In this literature review, it has been argued that design is a social process, in which creativity happens through a social network of interactions. It is a network of relationships based on informal feedback sharing. How best then can this social model of design be supported, particularly when trying to support the sharing of informal feedback - a phenomenon that is serendipitous and often unpredictable in nature? The following chapter attempts to understand the tools that support creativity and in particular those which support a social (network) model of design.

3. Software that supports creativity

Introduction

The previous chapter has shown how creativity is not only a phenomenon that is difficult to conceptualise and define, but also arguably a socially constructed concept. This chapter looks at how technology can support a social model of creativity. It discusses how software can support creativity in general and then examines in more detail the role of visualisation and social translucence in enhancing the idea of social creativity. This chapter attempts to understand the social design studio, and in particular how to elicit requirements from a design studio in order to design and develop support software. It begins to argue the case for a combined methodological approach for software engineering; suggesting that contextual observations and SNA can be used within the software design process when looking at a subject that is fluid and amorphous like the influence of peers upon design. To understand further how software tools can support creativity as a social process, it is useful to appreciate the various ways in which software can aid creativity in general.

3.1 Creativity support tools

Creativity and a social model of design can be supported in various ways. Florida (2004) documented the rise of creative industries and their contribution to economic growth. He emphasised and argued for the encouragement of three different ways to support creativity and the creative industries. He called these the three Ts: Technology, Talent and Tolerance, which are needed to attract and sustain creative people. Florida (2004) advocated that tools, props and techniques are needed to improve creativity in the future. Creativity support technology and tools aim to empower users to be more innovative and enable creative professionals to be more productive. Creativity could, therefore, be improved if problem solving was aided in some way, there was help with group decisions, or obstacles to the creative process were removed (Fischer 2004). This section of the thesis reviews the various technologies that purport to enhance creativity, and in particular the visual tools that can reveal the creative process.

To understand software that supports the creative process, differing frameworks have been proposed that distinguish software by how or what it aims to achieve. This also partly inter-relates to how creativity is defined. Depending on how creativity is described, alters how the software is used to support it. If, for example, creativity is seen as a group phenomenon then software that enhances that aspect will reflect the need for group connectivity. The differing schools of thought will ultimately relate to differing types of software, or potentially a specific example of software that supports creativity. Depending on your personal understanding of creativity, software will be used in different ways. Shniederman (2000), split communities of creativity authors into three areas: Inspirationalists, Structuralists and Situationists. Each of these categories puts forward a certain motivation for creativity which is enhanced by certain software tools. Inspirationalists emphasise the “aha” moment, with software helping the designer to look at a problem in a new perspective. Brainstorming software for example, would fall into this category. The next creativity community is Structuralists, who view the creative process as a series of steps. Software can enhance this sequential approach by exploring previous work or evaluating possible solutions exhaustively. Testing solution tools which can reveal whether one design will work or not, is one such example within this category. Finally Schniederman (2000) discusses the Situationalist category which emphasises social, emotional and intellectual aspects of the creative process. They see creativity as part of a community of practice and a collaboration of peers. Software tools that offer feedback and reflection from mentors and peers fits into this group. It is the Situationalist viewpoint that is explored in this chapter as it is based on the social context in which creativity takes place. A social model can be seen as fitting into this category of creative understanding.

Shneiderman (1998b) also put forward a Genex framework which built upon Csikszentmihalyi’s (1996) Individual, Field and Domain categorisation of creativity. The original Genex framework had four phases:

- Collect
- Create

- Consult
- Disseminate

More recently Shneiderman (2000 and 1998) has modified these four phases to accommodate an educational philosophy of relate-create-donate. This approach emphasised collaborative teams working together so that creativity supports learning and learning supports creativity (Shneiderman 2000). This educational philosophy had four foundational beliefs:

- New knowledge is built on previous knowledge
- Powerful tools can support creativity
- Refinement is a social process
- Creative work is not complete until it is disseminated

The four beliefs above are rooted in the concept of creativity as a social process and how technology needs to support a Situationalist viewpoint. The philosophical approach can also directly equate to a social constructivist position. For example, creative work as not being complete until it is disseminated, with creative work needing to be accepted by evaluators (by a social reviewing process).

Schneiderman went onto combine the above educational philosophy with that of the original Genex and produced a revised four phase Genex framework:

—*Collect*
—*Relate*
—*Create*
—*Donate*

Schniederman (2000) discussed the refined the Genex framework as an iterative rather than linear model. This cyclical approach is in contrast to other frameworks which are more structural in nature. Cougar (1996), for example, put forward a five phase plan (see below). Cougar's plan does not include any consultation with peers or mentors, nor does it refer to any kind of dissemination:

—Opportunity, delineation, problem definition
—Compiling relevant information
—Generating ideas
—Evaluating, prioritizing ideas
—Developing an implementation plan

3.1.1 Eight software activities to support creativity

Schniederman (2000) went onto describe the four phase Genex in more detail by formalising eight activities which occur during the phases:

- Searching and browsing digital library, the web and other resources
- Visualising data and processes to understand and discover relationships
- Consulting with peers and mentors for intellectual and emotional support
- Thinking by free association to make new combinations of ideas
- Exploring solutions – what if tools and simulation models
- Composing artefacts and performances step-by-step
- Supporting reflection - reviewing and replaying session histories
- Disseminating results to gain recognition and add to searchable resources

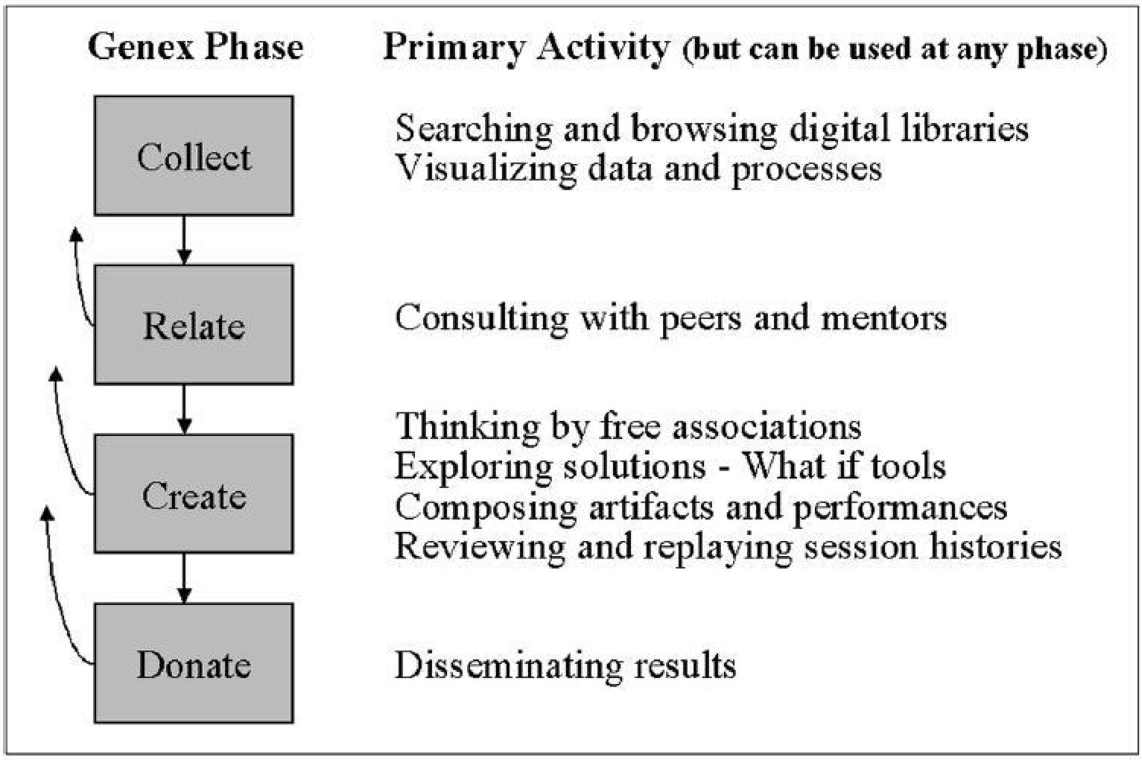


Figure 5: Genex phase with primary activity

Figure 5 shows how the eight activities fit within the four phases, although each of the eight activities could occur during any of the phases. For instance, searching the internet could be helpful when disseminating results as well as at the initial phases of the creative process. The visualisation process could also be a facet of every phase. Indeed this thesis puts forward the case for visualisation of peer consultation and thus relates to the Genex categories of both collect and relate. The following descriptions of each of the eight activities have previously been applied to creativity support software (Mival 2005) and it is re-visited here with reference to Inspirationalist, Structuralist and Situationalist interpretation. In this chapter, because of the importance of visualisation, further exploration of this role is again featured at the end of the general discussion of all eight categories. Tools that support reflection are also seen as pivotal to this thesis and are also considered in more detail.

3.1.1.1 Searching

Libraries and online searching facilities offer a rich array of information that can support creativity. The likes of Google and other search engines have improved their search results, enabling searches to be more accurate and relevant to what the user is looking for. Taking an Inspirationalist perspective, searched for information can provide a new idea, whereas for Structuralists it gives an understanding of previous work. From a Situationalist’s view, researching digital libraries can provide an enlightenment of work in the context of others. One issue with searching facilities available to designers centres on trust. It is difficult to know whether the search result that has been provided is accurate unless it is found from a reliable source. People in general acquire a knowledge of which websites to trust and which sources to use, often based on prior experience or word of mouth. Getty images, for example, have been used on numerous reputable websites such as the BBC and in so doing have become a trusted source for designers searching for images.

3.1.1.2 Visualising

Visualisation of data can help Inspirationalists to sift through large amounts of data in order to find a chosen idea. It can help Structuralists comprehend the mass of work that has gone before, quickly and more easily, and can help Situationalists to understand where their work fits within a given context. It is this aspect which this thesis seeks to explore, as social network data from the studio is sought to be visualised. Visualisation can also relate to the other 7 categories of creativity support tools. Visualisation can aid in searching digital libraries for example, but it can also aid in displaying free–associations.

3.1.1.3 Consulting with peers and mentors

Both asynchronous (email) and synchronous (instant messaging) communication provide tools for the discussion of creative ideas with peers and mentors. These types of software tools are obvious ways to support a Situationalist stance of creativity, as people are able to place their work in context by discussing it with their peers. Discussing ideas and gaining insight supports the Inspirationalist view of creativity as well, whilst the Structuralist argument supports the concept of designers learning from the previous work of their peers in order to build upon it. Consultation with peers can also occur throughout the design process, from creating ideas, to assessing idea validity and finally evaluating ideas in order to disseminate the results (potentially to those same peers). An issue with the consultation process, however, relates to privacy, protection and ownership. Ideas spread between peers can easily be adopted by other people. Hence technology that supports consultation needs to balance a fine line of encouraging group discussion of ideas on the one hand (rapidly disseminating results), whilst also protecting ownership of new fledgling concepts that have not been fully explored.

3.1.1.4 Thinking by free association

Free association and brain-storming are very much at the heart of the Inspirationlist approach to creativity. Brain-storming software aims to support the designer's ability to make connections between concepts and ideas. There are many software solutions available on the market to support thinking by free association. Mindmanager (www.mindmanager.com), for example and Freemind (http://freemind.sourceforge.net/wiki/index.php/Main_Page) both offer the ability to visualise the mapping process, save and return to the session. The software can in essence represent that which would have occurred with pencilled diagrams formed in face to face brain-storming sessions. They enable images to be included within the mind map to enhance the visual representation. The software also enables brain-storming to be carried out across distances. Without such software, brainstorming had previously been restricted to face-to-face meetings in the same room. Brainstorming software can facilitate group work across geographical distances, both in synchronous and asynchronous sessions (a Situationalist view of thinking by free association).

3.1.1.5 Exploring solutions: what if tools

There are a variety of software solutions available that provide simulations of weather, traffic, flights etc. These can span professional software used by engineers and scientists, to game enthusiasts who use SIM City, for example. Simulation software can be very useful for designers, particularly those at the engineering end of the design spectrum. Objects that are designed can be tested to see if they withstand certain pressures. The design of a car can go through a simulation of various factors, such as weather, how it performs under certain road conditions, aerodynamics and so on. Simulation software can be expensive to produce and purchase, but it can help to understand whether a designed artefact performs in a given circumstance. Ascertaining whether it will perform, can in the long term, be cost effective as an object can be accepted or rejected before it goes into production. For example, the development of aircraft is very expensive and producing a simulation model can test key functionality before an aircraft is built. Similarly training a novice pilot to fly is also costly, and flight simulators enable people to gain experience of flying a plane without paying for the cost of the aircraft, fuel, experienced pilot to fly with etc. This type of software supports a Structuralist view of creativity by learning from past experience and testing solutions.

3.1.1.6 Composing artefacts and performances

Software can of course support the actual production of artefacts and performances. An artist may use a canvas, but artwork may equally be created and viewed through a digital medium. Indeed, most writers have moved from the typewriter to the computer, often using Microsoft word. Many designers use Adobe software packages, such as Photoshop, Illustrator and Premier in order to manipulate photos, graphics and videos. Adobe have also acquired the Macromedia software company and with it the software Flash Professional and Dreamweaver. These two software packages are heavily used within the web design domain. For architectural and engineering creative industries, there are many Computer Aided Design (CAD) programs available, such as AutoCad. Additionally there are many 3D software packages such as 3D Studio Max and Maya. Many creative practices use software tools to actually produce their work and do not require the traditional tools that their profession is normally associated with. The tools that aid the production of creativity can range from the everyday software package such as excel and word, to specific software that is designed with the creative practitioner in mind. Adobe Photoshop for example, is useful for everyday photo modifications, and has facilities within it that are tailored towards expert creative users. Many software packages, such as Adobe Photoshop, are large and can encompass facilities that meet the needs of Inspirationalists, Structuralists and Situationalists alike. The history function, for example, allows past processes to be kept (and replayed if need be) and this fits with the Structuralist viewpoint.

3.1.1.7 Supporting reflection

Schon (1987) maintained that through a process of reflection, the practitioner has the ability to consider their past experience when applying new knowledge. A Structuralist interpretation of this would argue for reflection to consider previous work. An Inspirationalist would take this knowledge as a muse or source of inspiration, and a Situationalist would reflect not only on their own work, but the work of others and how other people's work relates to their own. This has relevance for design as design problems are rarely categorical and often complex, and that by learning through doing, designers can learn from past experience. It also has relevance as reflection goes hand in hand with the exploration of the problem itself. The designer's self awareness develops in conjunction with the problem definition (English 2008). Dorst and Cross (2001) describe this as a co-evolution of problem and solution, and English (2006) argues that we cannot frame the problem without acknowledging the design space that the designer operates within. As such, attention is increasingly being focussed on reflection in design. Recent examples include Badke-Schaub et al. (1999), Lauche (2001 and 2002), Reymen (2001), Stumpf and McDonell (2002), and Valkenburg (2000). Reflection in design is now being increasingly recognised as a way of improving the efficiency and effectiveness of the design process (Reymen 2001), thus allowing designers to modify inadequate strategies whilst supporting successful ones (Badke Schaub et el 1999).

Schon described various types of reflective conversation with the situation: "reflection in action", "reflection on action" and "reflection on practice". Stumpf and McDonell (2002) extended these ideas of individual reflective practice to encompass team designing, whilst Valkenburg extended the reflective practice theory to cover design projects.

There are many examples of software that supports reflection, some of which is specifically designed to be reflective (such as d-tools developed at Stanford: http://hci.stanford.edu/research/dtools/), whilst others are reflective only as a by-product of their original intention. The following five categories are discussed in terms of how they can be used as reflective tools:

3.1.1.7.1 Blogs

The blog (or weblog) is probably the most common example of a reflective tool. Blogs are beginning to be used by designers (students in particular) to narrate their design process. Research, such as the "Folio Thinking" project at Stanford: http://scil.stanford.edu/research/projects/folio.html, combine the idea of the blog with the designer's personal portfolio, enabling students to document and track their learning process.

3.1.1.7.2 Wikis

Wiki (collaborative web pages), can be used in many of the same ways as blogs. They help designers to narrate their own personal experience of the design process. They do also allow for multiple people to access, write and edit the content. This makes them particularly useful as a collaborative reflective tool. Some example wikis include: http://www.wikispaces.com/ and http://www.pageflakes.com/)

3.1.1.7.3 Multimedia

Multimedia can allow for digital stories (reflections) to be told via video. There are a number of software packages available that facilitate the editing of movies and stories. Some examples are:

- Macintosh: iMovie, GarageBand, Audacity
- Windows: MovieMaker2, PhotoStory3, Audacity

3.1.1.7.4 Interactive micro blogging

Interactive micro blogging refers to sending brief text messages to state the thoughts and actions of a person. The most well known interactive micro blogging facility is Twitter, although there are others available on the market such as Google's Jaiku. Through this medium, designers can reveal their thoughts during the design process. This can be thought of as "micro-reflections".

3.1.1.7.5 Social networking

There are numerous social networking sites available online at present: Facebook and Myspace to name but two. There is even portfolio software that links with social networking sites: Epsilen, Mahara, Elgg for example. There are also websites that allow new social network groups to be formed (Ning). These websites allow designers to add people to their network, thus building a group of people (their social network) with which they can interact, share comments, photos and videos etc. These types of social networking sites allow designers to build communities. The notes capacity within many of these social networking sites facilitates the reflective process. The ability to share tagged photos and video allows for reflection of personal work and that of friends. It does not, however visualise the social network (although there are some add-on software services that do this. Touchgraph (http://www.touchgraph.com/TGFacebookBrowser.html), for example uses tags from photos to connect people. Social network sites are often concentrated on friendship groups or on a common interest).

3.1.1.7.6 Reviewing and replaying session histories

This includes reviewing and replaying the work carried out by designers, or work that informs the designer and allows them to reflect on how they came to be at the point they are at. Replaying a session history can be achieved through the software used to produce the artefact. For instance, replaying a session history in Adobe’s graphical suite of software. The designer would use Photoshop, for example, to produce a graphic and can then replay their working processes to see how they achieved that graphic, what was deleted, what was modified, and how the graphics were moved. Replaying session histories can also be achieved through software that supports other areas of creativity, such as searching the web to inform and enlighten the designer. The history of those web searches can then be revealed. All these software features support a Structuralist viewpoint.

3.1.1.8 Disseminating results

The output of creativity can be disseminated in numerous ways, ranging from software packages that simply communicate an idea (emailing a friend); to software that specifically publishes creative work (a discussion group on a particular subject matter). This dissemination can be shared with close friends, to a wider circle of individuals, and potentially to the whole domain in which the designer is working. The internet allows a greater degree of access to many people. Creative people are more able to find the people they wish to contact to and also contact people on mass (posting videos on YouTube or photos on Flickr reaches a massive audience). Similarly, a huge audience is able to review and respond to the work produced. All of which are useful tools for Situationalists to reach a mass audience and have their work reviewed in context by many.

3.1.2 Caveats to Schniederman's framework

It is worth noting that technology changes rapidly and in the ten years since Schniederman (2000) categorised software that supports creativity, there have been many developments. Technology has since become increasingly more user centred (Web 2.0 for example), social and collaborative. There are numerous project management software packages available that are used within the creative domain. Also there are suites of applications (Google Pack for instance) that support everyday practices, from writing documents to emailing, that are free and can be downloaded on demand. They offer a range of online services, that can be used collaboratively from any computer with an internet connection.

To conclude and summarise this section, it has looked in more detail at the differing ways software can support creativity using Schniederman's (2000) framework. It discussed in terms of Situationals, Inspirationalists and Structuralists interpretations, the differing technological approaches. It also showed the intertwining nature of creativity support tools and how these can be used in differing ways, such as visualisation used to disseminate results and reflect.

3.2 The role of software to support design

Schniederman's (2000) framework for understanding and categorising software that supports creativity can be applied to creative endeavour in general. Although there are many references within the framework to design related examples, the following section discusses how technology can specifically support design.

Lawson (2004) asked directly what role computers play in designing and maintained that "computers can actually play quite different roles in the design process" (2004 p64). That the main problem computers have is "to actually assist in the real business of design as opposed to performing relatively menial supporting tasks" (2004 p65). Lawson proposed that the potential of computers was to support creative human process, rather than a computer that actually designed. He categorised that the various roles that computers play in the design process as follows:

3.2.1 The computer as "oracle"

This idea maintained that computer-aided design was some kind of "oracle", in which a computer proposes a design. Fraser (1995), for example, looked at how computers could put forward a suite of solutions for a given design task. However this often required human input or "conceptual seed", and a human to decide which solution to choose. Lawson (2004) put forward that there is limited ways to rationalise between different options, other than human decision making. Hence, Lawson dismissed this type of role as a "mirage" (2004 p67).

3.2.2 The computer as draftsman

The computer as draftsman is now considered commonplace. Indeed the use of drawing systems is particularly advantageous when drawings are completed over lengthy periods of time, by many individuals. It also "separates the process of creating the information from that of reproduction or printing" (Lawson 2004 p 67). The reproduction and printing of information was once a costly and time consuming effort, today it can be achieved far more effectively and cheaply through computer support. Not only does computer support mean that printing can be more cost effective but it can be reproduced quickly and easily too. However these advantages relate primarily to the presentation stage of the design process rather than to earlier conceptual stages.

3.2.3 The computer as a negative force

Lawson put forward the argument that "having to work with a computer tool that does not represent knowledge the way you do may cause considerable interference in your thinking" (Lawson 2004 p71). Goel (1995) for example, showed that drawings done by Macdraw were not as intricate as the hand drawn versions. The designers using Macdraw also produced fewer ideas. It is possible from this research and others (Bilda and Demirkan 2002) that current vectoring systems, "may not map well onto the internal mental symbolic representations used by designers" (Lawson 2004 p71).

3.2.4 The computer as modeller

This relates to the concept of two and three dimensional design, particular in the fields of product, interior and architectural design. These types of computer system allow buildings, cars and a host of other items to be created that without computer modelling technology would not be achieved. Often modelling packages produce adept and accurate drawings but their mathematical input does not lend itself to a "conversation with the drawing" (Lawson 2004 p75). Gehry for example does not model with computers but with plastic material (Lindsay 2001).

3.2.5 The computer as critic

Hand drawn images do not reveal any potential problems with a design, whereas computer software could. Some CAD programs for example will reveal energy consumptions in a designed building. The potential of this software is lost, however, if the checking process is not carried out at a point in time when it would be most constructive. Furthermore, for CAD systems to critique or "converse" with design, needs diverse levels of understanding to address the various levels of cognitive thinking.

The categories discussed above have focused upon the creative side of design, however design needs computers to co-ordinate and manage the process. This is particularly true in large design teams, that are not co-located, that require speedily produced results. With increasing specialisation of designers, design teams as the norm, and increased pressure of cost efficiency and speed of production, have all meant a greater interest in aiding design teams (Peng 1994). This thesis does not seek to replicate the human critiquing process but looks to understand how software can be used to aid the designer themselves to critique and reflect upon from the groups structures they operate in. Through visualising networks of designers, the software proposed in this thesis should enable design information to flow between people by revealing the work out there, allowing access, and understanding how design and their work exist with a network of social influence.

3.3 Supporting a social model of design

It has already been discussed how technology can support creativity and design through various ways and viewpoints. Schneiderman (2000) described how three types of viewpoint can interpret and use technology. Inspirationalists, by using technology to provide ideas, Structuralists by using technology to learn from past experience and previous artefacts, and Situationalists, to use technology to learn from others and design in context. These viewpoints could interpret each of Schniederman's eight point framework in differing ways. It was previously shown how technology could support a Situationalists view, or social design model. For example, tools that support disseminating results enable the Situationalist to present their work to peers, clients, and the wider social context. Similarly, email can facilitate designers discussing their work with other people. Without reviewing each of the eight categories is was generally shown how technology can support designers to work socially and the Situationalist view.

Another argument is that all software that supports design, should be designed with humans in mind. It should be designed through an understanding of the people involved regardless of whether it is used individually or collaboratively. Designing software to be human centred provides many benefits such as a greater return on investment, safety, ethics and sustainability (Benyon 2010 p 23). Benyon (2010, p27) noted that “people use technologies to undertake activities in context”. Designers use technology to produce design work (graphics, artefacts, ideas etc) and they do this within many social contexts (close personal reflections with other people, in a design studio, in presentations with clients). To understand the role of technology in a social context, Benyon (2010) proposed a PACT framework:

- People
  - Physical differences
  - Psychological differences
  - Mental models
  - Social differences
- Activities
  - Temporal
  - Cooperation
  - Complexity
  - Safety critical
  - The nature of the content
- Context
  - Physical environment
  - Social context
  - Organisational context
- Technology
  - Input
  - Output
  - Communication
  - Content

The importance of designing software with people in mind, is even more of a factor, if the software is to be shared or is collaborative in some way (both formally and informally). Increasingly software allows for different people to add content for others to peruse (a feature Web 2.0 for example). A consequence of which is that software is social in nature and technology that supports design is also based on social interactions, influence and factors. However the increased number of people involved in using software, increases the complexity and issues involved in designing, developing and evaluating a system. A branch of computing that has looked at this area specifically is Computer Supported Cooperative Working (CSCW).

3.3.1 CSCW

CSCW and workplace analysis is the study of organisations and the work systems in place, either for their own intrinsic value or for the incorporation of tools to benefit that system (Luff et al, 2000). Luff et al (2000), gave a comprehensive overview and analysis of the subject in their book *Workplace studies: recovering work practice and informing system design*. The book explores the concept of workplace studies and gives a series of case studies where academics have ethnographically studied a particular workplace. The book also discusses how the results can be used when designing new technologies.

Workplace studies have been particularly focused on the development of Computer Supported Collaborative Work (CSCW). CSCW "refers to both the range of networked software systems developed to support group working in organisations and to the study of such systems" (Benyon 2010 p440). There are numerous examples concerning the study of workplace systems and how CSCW programs can be incorporated. Studies of aircraft control (Hughes et al., 1992), ambulance control, banking and the small office (Martin et al., 1997; Martin and Rouncefield, 2003; Rouncefield et al., 1994) are just some examples. Workplace studies and CSCW have become increasingly inter-linked because they both seek to break down formal work procedures and organisational routines (Crabtree, 2001).

Work procedures can be documented by a series of prescribed sequences, however how people actually carry out their day-to-day activities may be remarkably different. Suchman (1995) noted:

> "The way in which people work is not always apparent. Too often, assumptions are made as to how tasks are performed rather than unearthing the underlying work practices" (Suchman , 1995, p56)

This can be particularly seen in the case of Blau's (1964) work in the 1950s. Blau (1964) tried to understand the organisational life of a U.S government agency. He looked at the Department of Public employment and the processes involved in meeting general employment needs. The organisation was given a set of procedures to follow, however in practice the process was very different to the theoretical procedure. Understanding what occurred in practice, therefore, was most successfully judged by participant observation and this is a compelling argument for the use of ethnographically informed techniques.

There has been some criticism of the CSCW term (Olson and Olson 2007) as it can cover many work related relationships that are not cooperative, not at work nor using desktop computers. However the issues that surround its central idea can still be applied to the design studio. One of the challenges to CSCW that Grudin (1994) puts forward is that of social, political and motivational factors. “Work is not just a rational activity, but a socially constructed practice, with all the shifting, conflicting motivations and politicking that this implies” (Benyon 2010 p 443). The design studio can be seen as a clear example of this and is a specific example of one type of workplace. Buccarelli (1994) referred to the design world as the creative system at work. He looked at the everyday world and reality of design engineers when designing three different types of device (an x-ray inspection system for airports, a photoprint machine and a photovoltaic energy system). Buccarelli used an ethnographically informed technique to understand design engineers and using such a technique can be seen as all the more convincing in creative environments, as creativity and innovation by its very nature is not prescribed. Other examples of ethnographically informed workplace analysis within creative practices are that of Mival (2004), Murray (1993) and Strickfaden (2005). Mival researched a product design company and described the relationship between researchers and designers within the company. Murray, for example, studied graphic designers in order to gather requirements for CSCW software solutions. Strickfaden used an ethnographically informed technique to study the student design world and processes at work and reflected her work upon the documented procedures within the design domain. Additionally Pycock and Bowers (1996) looked at fashion designers and Lewis et al (1996) looked at film production.

Technology should support the social aspect of the design studio. There are many proprietary systems that support collaboration at work (Microsoft Sharepoint for example), and even those that are domain specific (for example LightCMS is designed for web designers). There are also examples of software that facilitate sharing and support communication between people (email and instant messaging for example). CSCW can relate to shared work spaces (shared server space, and ftp clients for instance). Similarly desktops can be remotely accessed by others with the appropriate authority and administration privileges to do so. Other examples of CSCW systems are shared whiteboards (e.g LiveBoard – Elrod et al 1992), Groupware kits (e.g MAUI – Hill and Gutwin 2003) and collaborative virtual environments (e.g. MASSIVE – Bowers et al 1996).

Social networks analysis has also been applied to the field of CSCW. Wellman and Salaaf et al (1996), for example, argued that members of electronic communities made up social networks. They also argued that there was a strong connection between social networks and computer networks. These studies look at social interactions in relation to technology from a top down approach, how the analysis informs sociological knowledge. In contrast, computer mediated social networks are from a user's perspective and reveal what the user gains from viewing social network visualisations. Specifically how the user understands his or her own social network (Wellman 1993). There are many other issues that surround how the user understands their network visualisations. For example, whether the network is single mode or multi-modal where network connections are tied by a common event, artefact or interest or if the network is automated, or static.

Another issue is whether the network is an ego-net or a full network. Ego-nets relates to person connections, (close connections to the central ego/actor). This can be seen as a personal networks like contact lists. For example network analysis based on mobile phone address book names (Berg, Taylor et al. 2003; Grinter and Eldridge 2003) and email contact lists (Ducheneaut and Bellotti 2001). An example visualisation of the ego net contact list is ContactMap (Nardi, Whittaker et al 2002), which was a desktop tool to manage contact information.

Full network visualisations, in comparison, can reveal the wider network and connections, which may or may not be known to the user. It raises the awareness of the wider network and the work of co-workers. “Being aware of what co-workers are doing and whether they are busy or available for discussion is an important part of effective collaboration.” (Benyon 2010, p450). This type of software is known as social translucence and can support social computing and a social model of design by revealing what other people are actually doing in a studio.

3.3.2 Social translucence and information visualisation

Social translucence has three core principles:

- Visibility
- Awareness
- Accountability

The social translucence concept stems from an IBM project (Erickson and Kellogg 2003a), the most well known prototype from the project being Babble. This has been described as “a social proxy for meetings, chat and email. People are represented by 'marbles' … The more active people are, the nearer the centre they are, and the marbles gradually move toward the periphery if they do not participate in the chat for some length of time” (Benyon, Turner and Turner 2005, p631). Kellogg and Erickson (2005) argue that “that creating socially translucent systems – those that support mutual awareness and accountability by providing perceptual cues about participants’ presence and activities – is a key enabler for the emergence of social behaviour and norms” (2005 p30).They believed that by supporting awareness and accountability would make it easier for people to carry out conversations, imitate one another, be influenced by peer pressure, to create, notice and conform to social conventions and partake in collective interactions (Erickson and Kellogg 2003a).

Another example is the Portholes system. This system provided small video snap shots of other areas in the workplace. This system had many advantages, seeing if someone was in their office for example, but there were also some trade-offs such as privacy (Benyon 2010).

It is proposed that this type of system could support designers in a design studio by making people aware of each other’s work. However in designing this type of software there are numerous issues that are specific to design. Understanding how this type of system could work effectively in a design studio requires a comprehensive of the context in which designer's work. In particular, how they interact, how they share feedback, and potentially the impact of providing a social translucence system. It also needs to address the purpose of the visualisation process. Any socially translucence system should not only make people aware of each other but how they are socially influenced, in order to reflect on their work in light of other.

Social translucence and information visualisation go hand in hand, as social translucence is visualising information about what people are doing, and making other people aware of that information. Information visualisation can be defined as the creation of a visual image with the act, purpose and process of interpreting in visual terms (Owen 1993). This is represented graphically in figure 6. Visualisation has been categorised as an activity which human beings engage in with potential to give insight and understanding (Ware 2000; MacEachren 1995). It should also perform a purpose and any articulation of feedback patterns should do just that. In the tube map of London for example (figure 7), the task of the visualisation is to aid the planning of tube journeys. In terms of a social translucent system, the purpose should be to inform the designer of how they are socially influenced, they should also be able to find the people they are not influenced by.

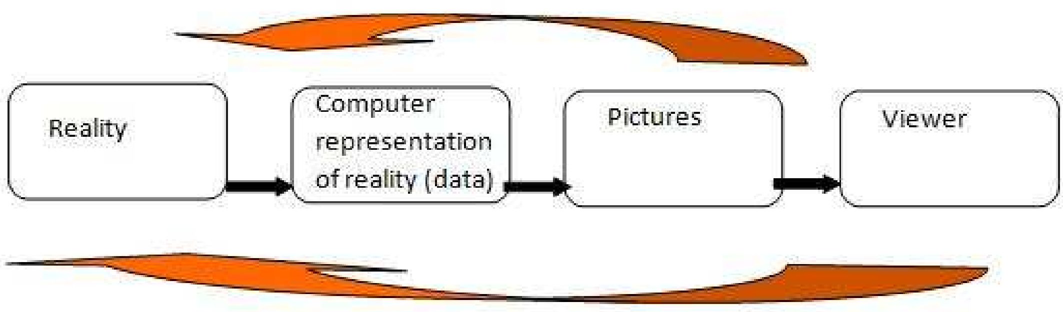


Figure 6: Graphical Representation of Scientific Visualisation process
(Domik: http://www.siggraph.org/education/materials/HyperVis/domik/folien.html)

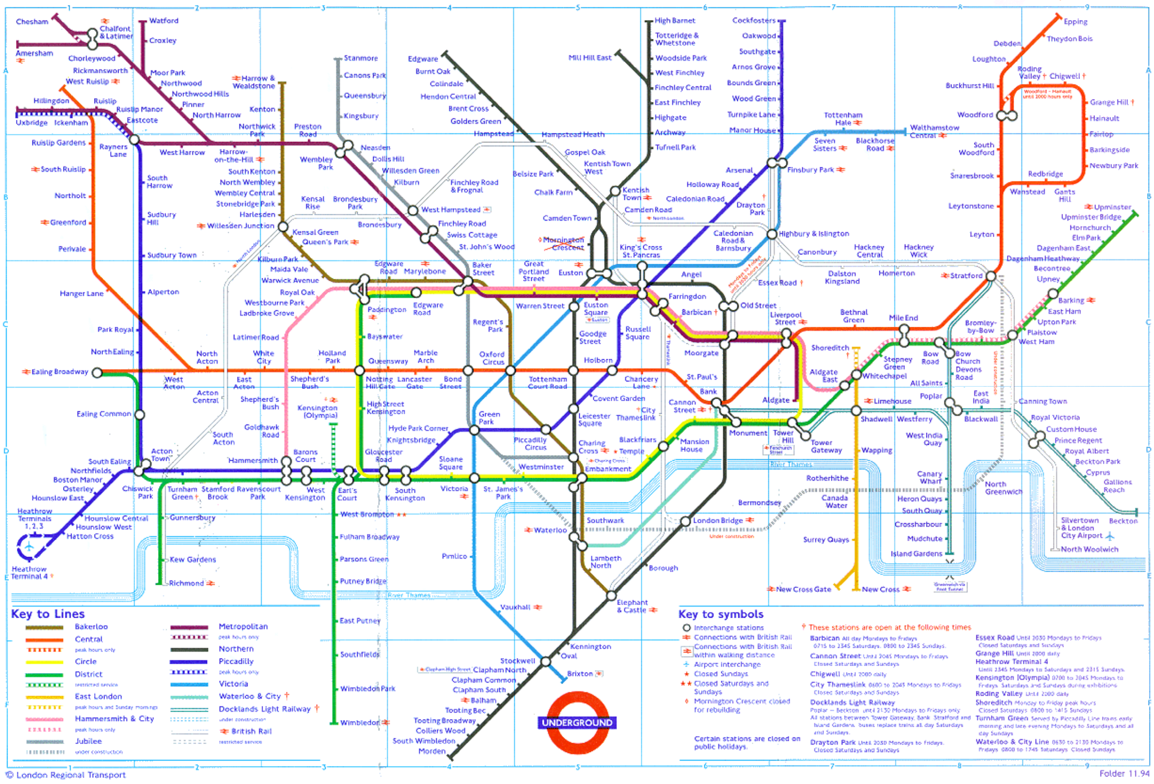


Figure 7: Harry Beck's Tube Map

3.3.3 Visualising social networks

Many visualisations refer to underlying features of connectivity. Harry Beck's visualisation of the London underground system is graphic representation of connections between tube stations (figure 7). Many visualisations of connections are rooted in network visualisations. Connectivity and network visualisations are normally composed of nodes and connecting links. This concept, known as a sociogram, is shown in figure 8. It is comprised of nodes representing people, and lines connecting nodes that represent the relationships between those people. The nodes in figure 9 represent people who used a telephone exchange, and the links represent the conversations between those people. The nodes and links in the sociogram can also display attribute data. In the case of the telephone exchange for examples, these include the level of interactivity, the length of the conversation, how many times someone was called, or the most popular nodes. There are other attributes and parameters that have influenced the basis for how the sociogram is displayed. The SO-gram (significant others grams), for instance, is used by sociologists to describe personal relationships (Davenport and Buckner 1998, and Davenport et al 1998). The So-gram is shown in figure 10 and shows connections around an ego. Other types of visualisations that are based on the connections between people are tree structures. There are numerous examples of tree structures that show organisational charts such as hierarchy, with the CEO at the root and those reporting to him or her at the next level down (see figure 11). These “family tree” like visualisations are incredibly popular for showing links and connections, particularly when the connections are binary (a woman either is or is not your biological mother) and works effectively for showing family connections. It also works well if the links are standardised with set groups that have no crossing links. Tree-like visualisation structures have been the subject of much research (Tree maps – Shneiderman 1992, Cone trees – Robertson et al 1995). One tree structure technique has been called a circular tree structure of hyperbolic geometric transformation (Lamping and Rao 1994). The root node exists in the centre of the tree and its subordinate nodes arranged around it and their subordinate nodes around them. The entire tree to its very last branch forms a circle (see figure 12).

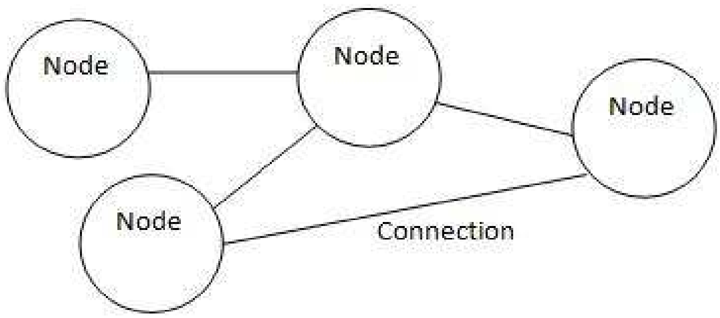


Figure 8: The sociogram

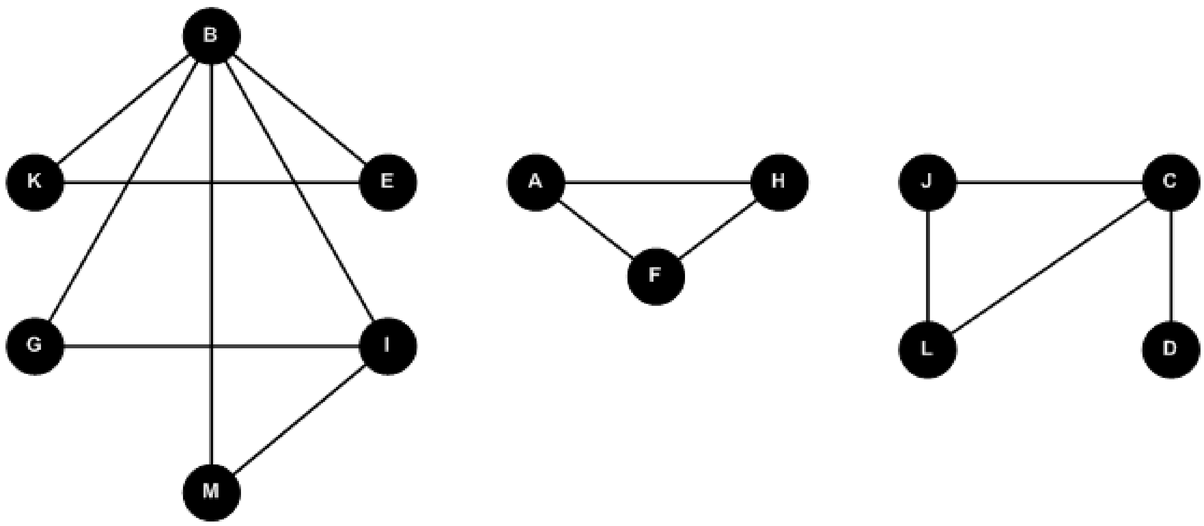


Figure 9: telephone exchange network

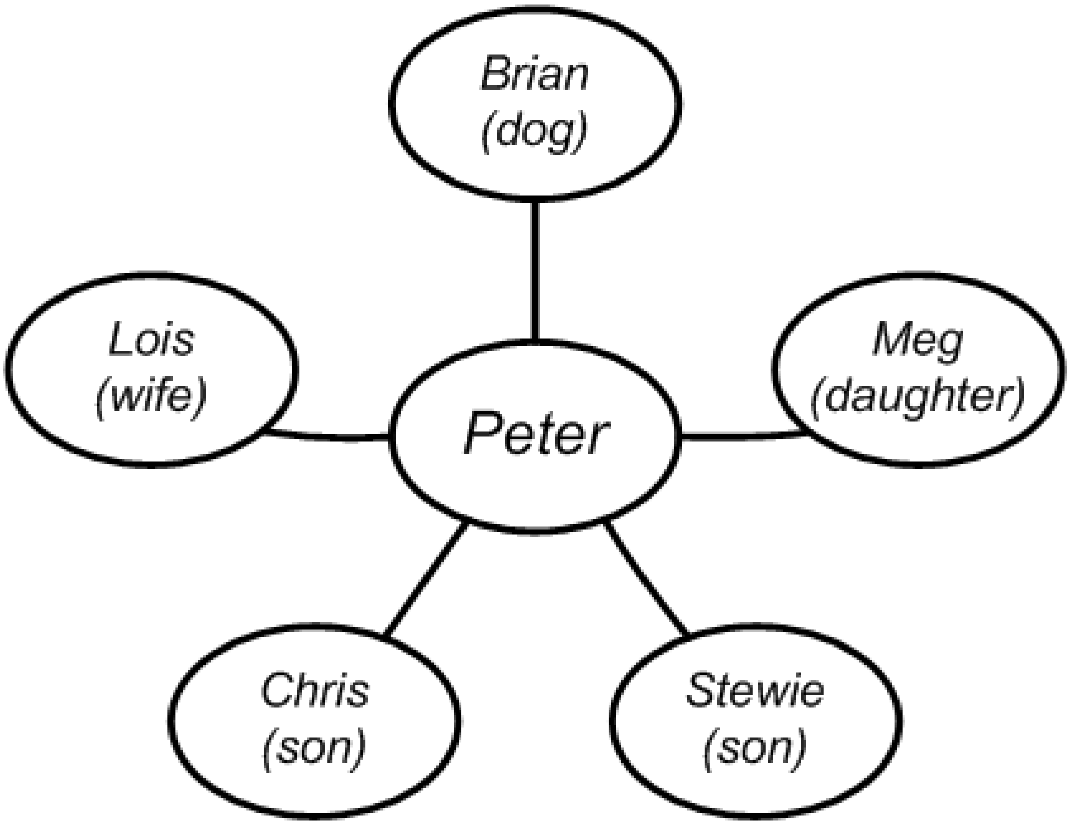


Figure 10: SO-Gram

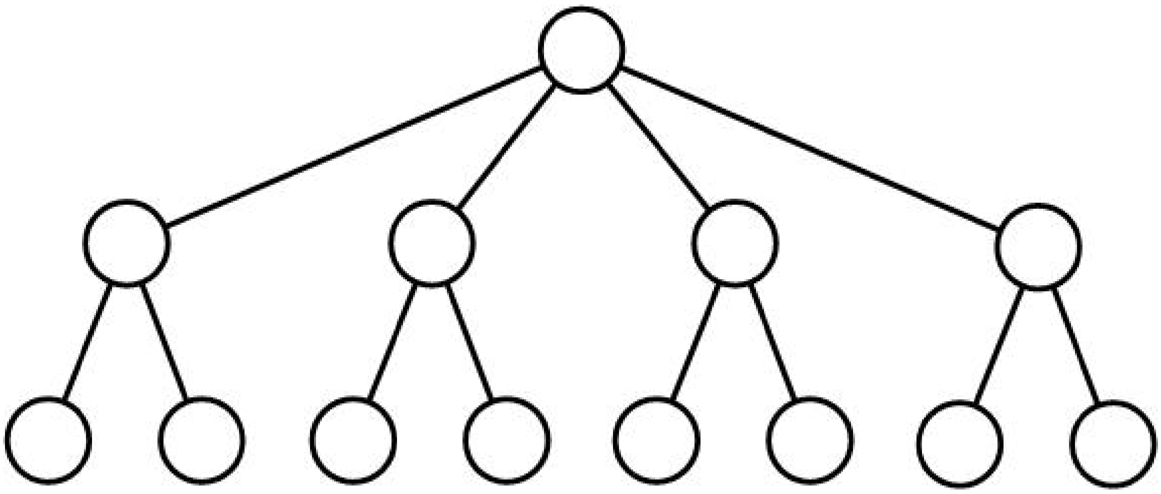


Figure 11: Tree structure diagram

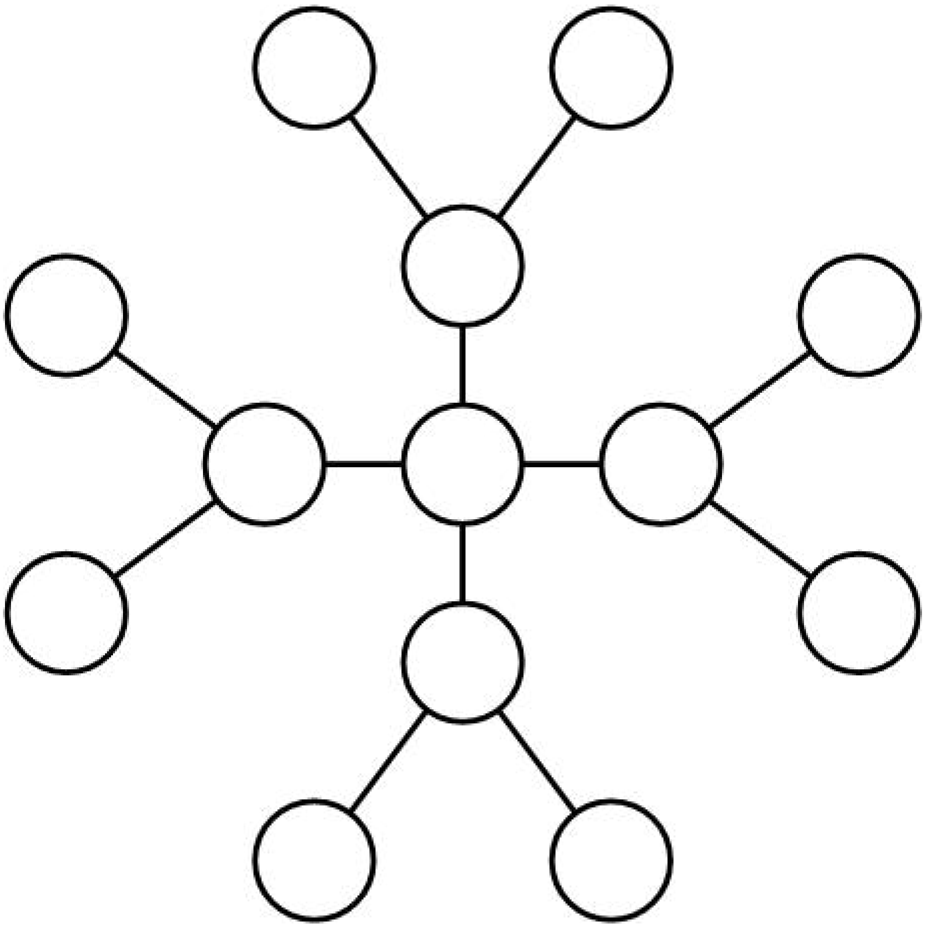


Figure 12: Circular tree structure diagram

Given the nature of this thesis, and the use of SNA to understand the social study to inform software development, visualising social networks as a reflective tool is the particular choice to develop further. Social network data is readily available through a process of understanding the social context of the studio; and by revealing how designers are socially influenced can enable them to reflect on how their work exists in a social space.

Visualisation is a key aspect of social network analysis. Many assessments of a network can initially be identified by simply viewing the network diagram. There are many social network tools that visualise data and enable the user to broaden their understanding of the network that they are shown. Figures 13, 14 and 15 all show musical connections that help the individual to understand how one band relates to another. This may simply be useful information for the user but may also help them decide on what music to listen to or what music to buy. Visualising social networks, however, is complex. Visualization software needs to reveal the nodes (actors involved), potentially the attributes they have, the connections between them and any grouping or clustering. Most network visualisation packages use algorithms that position nodes and connections in such a way that the network makes sense. Isolated nodes are set aside, groups of nodes are positioned close together, nodes with high centrality scores appear centralised and nodes and connections do not cross or overlap. There are a number of network visualisation tools that do exactly this: NetDraw, GraphViz, and Inflow to name but a few. There are also software packages which analyse social network analysis statistically: UCINET, Pajek, KrackPlot etc. However, Perer and Shneiderman (2008) noted that these tools are “a medley of statistical methods and overwhelming visual output that leaves many analysts uncertain about how to explore their networks in an orderly manner” (2008 p4). He maintained that it is hard for users to find patterns and trends using purely statistical tools. Additionally, using purely visual tools may result in the user not appreciating or noticing a pattern that may be revealed by applying a statistical approach. He proposed that the answer to this problem is to integrate the visual with the statistical more closely. He gave 7 design goals needed for systematic flexible social network tool which were used to develop the SocialAction software. The following goals are listed below:

- See an overview of the sequential process of actions
- Step through action
- Select actions in order
- See completed and remaining actions
- Annotate their actions
- Share progress with other users
- Reapply past paths of exploration on new data

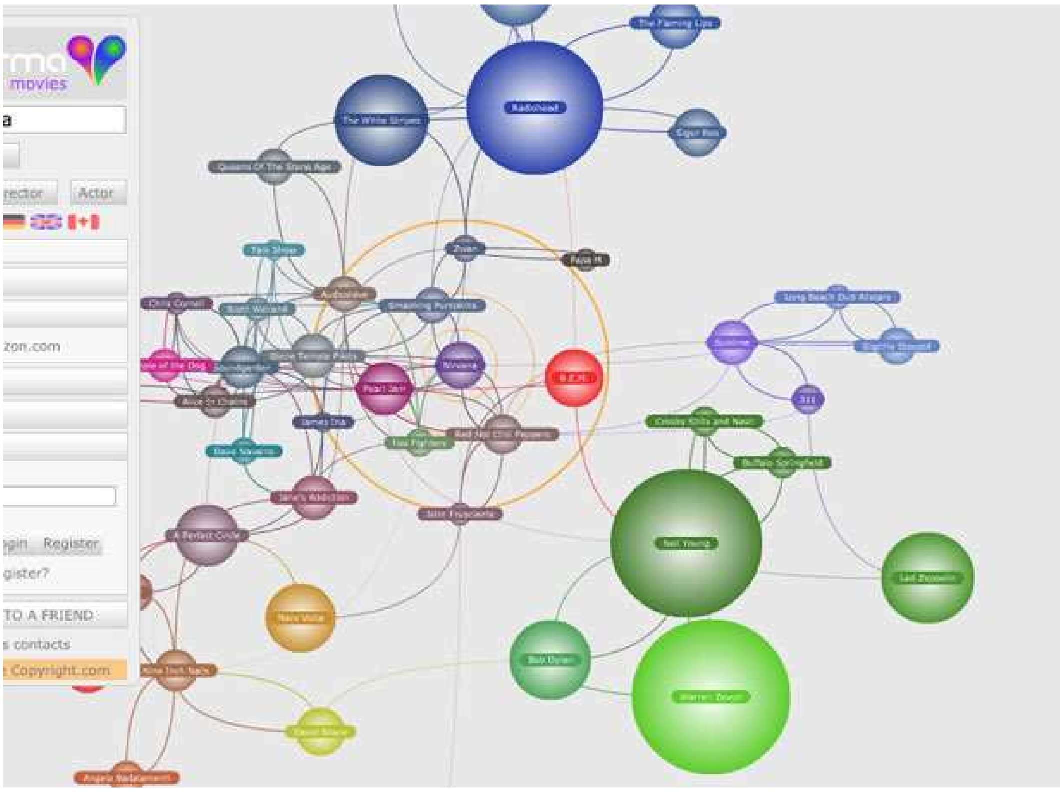


Figure 13: network visualisation of movie connections (http://www.liveplasma.com/)

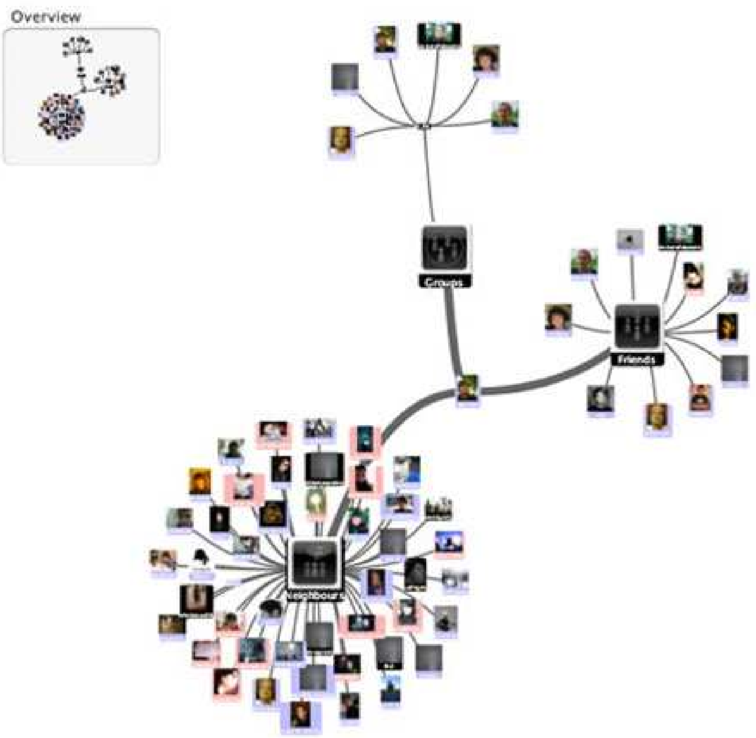


Figure 14: open source software for visualising social network (http://build.last.fm/item/42)

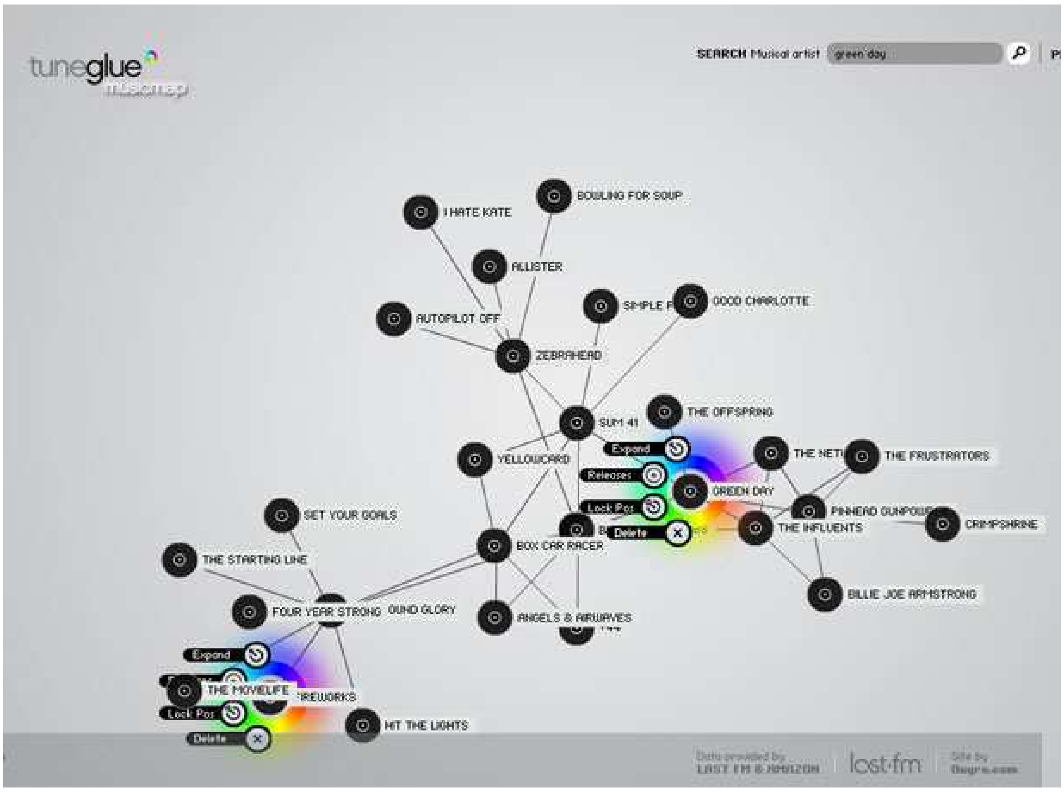


Figure 15: network visualisation for representing music connections (http://audiomap.tuneglue.net/)

SocialAction aimed to show the intricacies of the data, and the ranking of nodes etc through colour classification. However, adept users of other programs can also recreate this. Within UCINET, for example, attribute files can be imported which allow nodes to be coloured based on the attribute file. SocialAction also aims to combine the statistics of network analysis with the visual, and although it incorporates annotations, those comments are made by the analysts about their observations as a whole. It is possible that rich descriptions about the data could also be included, particularly about why a certain relationship is made.

Another social networking visualisation tool is SONIA (Social Network Image Animator: http://www.stanford.edu/group/sonia/). Sonia is aimed at testing and comparing layouts and techniques and for testing attribute rich network data (Bender-deMoll and MacFarland 2002). It also aims to visualise dynamic networks over time. Visualising networks has predominantly been based on static notions of interaction. When data has been collected sequentially over a period of time, it has been done so in intervals (often quite large in nature). However the issue of collecting and visualising time based networks is beginning to take momentum (Choudhury and Pentland 2004; Choudhury 2004; Motoyoshi et al. 2002). It has meant that network analysis requires a shifting of perspective, to adapt theoretical standpoints (Moody et al. 2005), and refinement of statistical and modelling techniques (Wasserman and Pattison 1996; Snijders 1996; Snijders and Van Duijn 1997; Robbins et al. 1999; Snijders 2001)

Bender–DeMoll and Macfarland (2002) also discuss the many issues surrounding social network analysis and in particular the various issues surrounding SNA visualisations. One issue relates to social network concepts being an abstract idea. Social networks do not refer to physical networks or wired computer networks; they are instead a social construct of an individual's perception. This can be either the researcher making social connections between people, or the actors involved, answering interviews or questionnaires about how they perceive the world. Connections can of course be inferred from other sources. Email interactions for example, allow friendship networks to be abstracted from email communication (behavioural networks). The network in this sense can be seen as a proxy for the "real" network.

Networks can be seen as abstract from the real world. For instance a friendship network can be considered an abstraction from the actual set of interactions (both positive and negative). How one person feels about another may alter throughout a day (Jane might dislike something John has said). If a survey was given at this point in time, it would be more negative than on other occasions. Network surveys given over a period of time would average out the relationship ties but would not reveal sudden disagreements. The issues of actor fluctuations is not easily resolved through surveys, however this problem is less prevalent in observation based data, computer data and automated collection techniques. Even if network data is collected over a time period, how is it then to be presented? In each time period a network diagram is produced and as such over time, there would be a series of network diagrams. Do these diagrams become averaged out? Does one network diagram morph into another one? Or are there other techniques that can be applied to display the transitions of networks?

While there is little comprehensive theory that relates to social network visualisations, it should be known what the intention is in creating pictures of networks, even if a network visualisation can convey multiple purposes at once. It needs to asked what the visualisation informs us of, bearing in mind that a network visualisation can also distort our opinion too. Bender-DeMolll and Macfarland (2002) noted that “when constructing a map of a network, we must select a suitable organizing principle and choose which relationships and structural properties are the important ones to display from among the multitude present in a high-dimensional network” (p15). Visualising social space involves many implied relations (Monge and Contractor 2003), and a combination of techniques or choice of network analysis (be it revealing certain attributes, showing centrality of actors or clustering for example) can be used to provide multiple takes on the same network visualisation tool for a specific context. What then constitutes whether the choice of network tool is particularly suitable for the job at hand? What constitutes a "good" layout? Bender-Demoll and McFarland noted the following criteria useful to consider before creating network visualisations:

1. What is the underlying set of relations we are really interested in looking at, and how can they be best expressed?
2. What is the functional relationship between collected data and relations of interest?
3. What time-scale are the patterns of interest likely to be visible at?
4. What set of transformations do we need to apply to get from the data to a consistent social space?
5. How might node and arc attributes relate to the pattern of network structure, and how can they best be translated into display variables in order to highlight and explore these relations?
(Bender-Demoll and McFarland 2002)

Network visualisations have predominantly been tools for sociologist and mathematicians to reveal patterns and trends of interaction. If network visualisations are to "become more than an illustrative toy, various concerns need to be overcome." (Bender-Demoll and McFarland 2002 p 2). One major concern is assessing what to visualise in the network. For instance, whether users prefer certain visualisations, such as the positioning of nodes and lines in differing arrangements. The network visualisation therefore has to adapt to display the type of information that the user needs to know. In this research, it is questioned how social networks are formed and how social relationships are influential within a design studio. Moreover, how can a social network visualisation tool help designers to understand and reflect on how they are socially influenced? To achieve this, the visualisation software should be based upon networks and user needs formed from field work, and the rich descriptions that they can provide. The field work should elicit what the software should visualise, what features should be included and how it should fulfil its purpose. The following section discusses the ways in which requirements can be identified, and the argument for using certain techniques in order to understand the use of network visualisation in a practical context.

3.4 Software requirements and design

Software design and Requirements Engineering (RE) is part of a system development process that discovers ‘what is to be built’ (Crabtree 2001). It seeks to understand the purpose of software, with meeting that intention being the primary measure of a software system’s success. It is referred to as RE or the eliciting of requirements, rather than requirements capturing as this avoids the assumption that somehow requirements are out there to be ‘captured’ (Goguen & Jirotka 1994). To understand RE it is worth understanding its history, current trends and where it currently stands, particularly when arguing for a certain RE approach. Current thinking defines RE as:

> “The branch of software engineering concerned with the real-world goals for, functions of, and constraints on software systems. It is also concerned with the relationship of these factors to precise specifications of software behaviour and to their evolution over time and across software families." (Zave 1997 p315)

Presently, the emphasis of RE is centred on understanding real world problems, that lead to ‘precise specifications’. This combines analysing, validating, defining and verifying, all of which evolve over time and through differing software facilities (as referred to in the above quote). Nuseibeh and Easterbrook maintained that requirements engineering (RE) is the “process of discovering the purpose [of software], by identifying stakeholder and their needs, and documenting these in a form that is amenable to analysis, communication and subsequent implementation” (2000, p37). They describe RE’s core activities as:

- Eliciting requirements
- Modelling and analysing requirements
- Communicating requirements
- Agreeing requirements
- Evolving requirements

Historically however, RE was a combination of system design and software development which Buxton (1978) described as a ‘cottage industry’. The increasing scale and complexity of software systems meant that requirements needed to be explicitly extracted and documented to allow for differing sections and goals of the system to be modelled accurately. The increasing complexity of software systems meant that the system was divided into sections that could be programmed in "chunks". To address the intricacy of larger systems, the concept of a Waterfall Model was developed in the 1970s. The Waterfall Model divided requirements analysis, design and development into stages. The requirements analysis stage of the model centred on the requirements specification document. This document had a series of prescribed steps with external intangible factors limited to economic and managerial influences. This resulted in a bounded documentary process which provided the "answer" to the requirement's "problem". The Waterfall Model of requirements was suited to monolithic systems (such as payroll systems) where many users interacted with one large computer system; an architecture that was predominant in the 70's and early 80's. However with the increasing use of personal computers, users became distributed autonomous stakeholders, and the systems became more socially complex. DeGrace and Stihl noted that:

> "In these [older systems], humans serve the machine, providing it with the input it needs to produce results. But we are now encountering problems of a different nature where the computer is no longer at the centre of things – the human is – and the machine is now acting to provide or organize information the humans need to produce results" (DeGrace and Stahl cited in COMIC D2.1, p. 51).

A consequence of this shift in technology is that RE now looks to identify human need (Crabtree 2001). Current RE practices need to "be sensitive to how people perceive and understand the world around them, how they interact, and how the sociology of the workplace affects their actions"(Nuseibeh and Easterbrook 2000 p 38). Sensitivity to the role of humans upon the system (and understanding humans as part of the systems) has meant that systems and requirements are becoming increasingly complex. The procedures to gather requirements are not, therefore, trivial tasks. Stakeholders (clients, users and developers) may have at best, the same requirements from differing perspectives, at worst, conflicting requirements. That is of course if there are an expressed set of requirements from each stakeholder. The requirements may be implicit or difficult to articulate. Ability to satisfy all stakeholders, all of the time, may not be viable due to pressure outside of the control of the requirements engineers (e.g. limitations of cost may restrict what the system can do).

Requirements engineering brings with it inherent difficulties. Brooks noted that:

> “The hardest single part of building a software system is deciding what to build … No other part of the work so cripples the resulting system if done wrong. No other part is more difficult to rectify later.” (Brooks 1987, p. 18)

Satisfying numerous stakeholders, all of whom may have many needs from the systems, results in problem domains that can be termed ‘wicked’ (Rittel, Horst and Webber 1984). Problems with numerous stakeholders, particularly those that are social in nature may only be fully appreciated after they have been solved (DeGrace and Stahl 1990). O’brien (2000) describes the situation in which RE now exists as:

> “It arises in the social realm and is concerned with trying to improve some characteristics of how people work together using computer-based support … [it is not, as such] a neatly formulated, precise [problem], that emerges from a narrowly-conceived technical agenda. It is instead rooted in the contingencies of ‘the lived reality of the organizational context-of-use’, *and just what that is, and, furthermore, how we might go about ascertaining that, are not settled matters*.“(O’Brien 2000, p. 34 original emphasis)

To address these “wicked” problems, Nuseibeh and Easterbrook (2000) refer to a spectrum of techniques, combining “cognitive and social sciences to provide both theoretical grounding and practical techniques for eliciting and modelling requirements” (2000 p2). Nuseibeh and Easterbrook outline five research areas that are used to gather requirements:

- *Cognitive psychology* provides an understanding of the problems users may have in describing their needs (Posner 1993).

- *Anthropology* provides a methodological approach to contextual observations that helps to develop a richer comprehension of the situation (Gogeon and Jerotka 1994). For instance Ethnomethodology (Gogeon and Linde 1993) techniques have been applied in RE to develop observational techniques for analysing team interaction.

- *Sociology* gives an appreciations of the political and cultural changes caused by technology

- *Linguistics* is important because of the dominance of understanding requirement through the language (user language in particular) that is used.

- *Philosophy* provides the context which RE is concerned with . RE is concerned with an understanding of beliefs of stakeholders *(epistemology),* the question of what is observable in the world *(phenomenology),* and the question of what can be agreed on as objectively true *(ontology).* Issues that are important when validating requirement.

Traditionally, RE techniques relied upon surveys, interviews and documentary evidence such as organisational charts. More recent requirement elicitation tools have used model driven techniques, such as cognitive techniques and prototyping which can discover stakeholder feedback (Saaltink 1997). In the 1990s an alternative approach of contextual techniques was used to elicit requirements. Emerging from sociology and anthropology (Gogeon and Linde 1993), this technique used ethnographic-type research based on participant observation, and often used ethnomethodology and conversational analysis to study in depth conversation and interaction patterns (Viller and Sommerville 1999).

It is argued (Crabtree 2001) that only through understanding requirements *in situ* can the *real* system be understood in context. Rather than focus on abstract notions of what should be done, contextual techniques describe what is actually done. Contextual techniques allow for the setting and boundaries to be discovered and stakeholders to be identified, rather than the boundary setting and stakeholder list prescribed to the requirement's researcher. Allowing for and observing the differences between users and stakeholders enables the eliciting process to identify different stakeholder classes (novice and expert users for example) (Sharp, Finkelstein and Galal 1999). Observations of the field can also bypass issues relating to requirements not being articulated by users, as requirements are seen rather than based on user conversations (Johnson 1992).

The accomplishment of the orderly work of the office is crucial to understanding workplaces and software that supports it such as CSCW (Crabtree 2001). This is because the design and development of CSCW is based on the coordination of dependent work activities that, as highlighted in the Blau (1964) case, should reflect real world work actions. Crabtree noted that:

> "it is not a prescriptive necessity (let alone a causal one) but one of conducting organizational affairs in a manner whereby the rules can be said to have been adequately applied in the face of the unavoidable contingencies of the particular 'case' to hand. Insofar as contingencies are recurrent, and the manner whereby they are dealt with suffice, then the improvised ways of adequately applying the rules become routine and standard practice for persons who do the work. Curiously, the organizational adequacy of improvised practices might be said to consist in their not being noticed, remarked upon, etc., by management in that, and precisely because, they suffice to 'get the job done' without undue problem or recourse for concern". (Crabtree 2000a, p 233)

Contextual requirements engineering processes such as ethnomethodologically inspired techniques, do bring inherent difficulties. The technique requires huge time and personal commitment by those eliciting the requirements. The research can take many months (even years) and in a commercial setting this equates to a larger financial outlay than other, possibly quicker, techniques such as surveys. Contextual techniques have generally resulted in auto-biographical first person descriptions of the field site, and although this is easily understood by stakeholders, can be difficult to map to formalised requirements modelling techniques including entity relationships or UML use cases. Finally, judgements and assessment that are made from the research are also, in general, based on the one person's perceptions of the situation and that in itself may be flawed or biased. This can be overcome by a group of researchers looking at the system and comparing their interpretations, but this increases the costs involved. Assumptions made by contextual researchers can also be validated by users and stakeholders. However if those assumptions and recommendations differ completely from those of the stakeholders the requirements research would need to begin again (another costly exercise).

Some argue that RE should not focus on specifying the functionality of a new system, but instead should concentrate on modelling the environment *(*Zave and Jackson 1997). Only by describing the environment, and expressing what the new system must achieve in that environment, can we capture the system's purpose, and reason about whether a given design will meet that purpose. This may suggest that attempting to build a complete set of requirements is futile and that RE should instead look to resolve differing stakeholder perspectives and inconsistencies (Ghezzi and Nuseibeh 1998).

Nuseibeh and Easterbrook (2000) proposed that future trends within RE would look at “bridging the gap between requirements elicitation approaches based on contextual enquiry and more formal specification and analysis techniques” (2000 p8). The rich descriptions provided by the contextual observational techniques do not map well to formal modelling structures. In an attempt to map these rich descriptions onto models of interaction, a Social Network Analysis (SNA) is proposed to combine with contextual techniques. SNA allows for a more structured format to the contextual information either through structuring the observations to provide the SNA, or allowing the techniques to provide context to the SNA result. SNA can also reveal gaps in the network and the systems, and it can highlight the promoters and inhibitors of software being introduced and accepted. This combination approach to understand informal feedback in the studio and to visual it, is discussed in more detail in the following methodology section.

This section has given

- An overview of software design (in particular software requirements process)
- Discussed how ethnographically informed research fits into software design

- Begins to argue the case for contextual observations with network analysis to understand how social translucence and visualisation can aid software to support a social model of design

Conclusion

A major issue of creativity support tools is how to judge whether a piece of software is effective and enhances creativity. Creativity and innovation by their very nature are difficult to define and is arguably a subjective concept. It is therefore very difficult to judge whether a piece of software has added to the creative process, especially if a precise definition of that process is elusive. If a person is a Situationalist, they may not rate a piece of software that supports the Inspirational aspect of creativity. Additionally, certain software may not be designed to enhance creativity, but may do so as a by-product. Powerpoint for instance, is a classic means by which a designer can disseminate their work, although it may have been developed as a display tool regardless of the content of what is displayed.

Analysing how effective a software tool is at enhancing creativity is a subjective issue, particularly when development of a tool is a result of research based on field work. This is particularly the case in the task of visualising social networks. SNA visualisations have predominantly been based on the needs of sociologists to aid in their ability to perform network analysis. Increasingly though there are number of SNA visualisation tools that show patterns of relationships within creative fields (figures 13, 14, 15). They show how one piece of music is related to another, how book authors relate, or relationships between differing fields of art. This thesis seeks to understand the relationship between designers in a real world context and the impact this can have. It has been argued that SNA visualisations should move beyond a sociologist's tool, and reveal patterns of interaction that have a use in a real world setting. To do this two case studies of real world research and requirements elicitation are used to understand what networks occurs, how they form, and how they should be visualised. A mixed methodological approach of SNA and contextual observation (ethnographically informed) is used to carry out this software design process. The following chapter discusses the argument for such an approach.

4. Wild Networks - Methodology

Introduction

This chapter explores the techniques used and methodological theories applied in order to understand the networks of peer evaluation within a design studio, to inform the development of a software visualisation tool. The mixed methodological approach put forward is a fusion of many disciplines such as anthropology, sociology, mathematics etc. It is an intertwining of techniques that is a conscious decision to strengthen the arguments proposed in the most suitable and rounded mechanism possible to produce the most accurate description of the social networks within a design studio. The central thread of peer evaluation, through observation and the communication of feedback, is researched through a combination of contextual observation (ethnographically informed) and Social Network Analysis. This is referred to as wild networks, akin to Andy Crabtree's 'Wild Sociology' that combined ethnography and design (Crabtree 2001). Contextual observation and SNA both offer differing and complementary views of the central research question. These two research methods both have theoretical influences that impact on how the techniques are approached and how the results are interpreted. The following chapter looks at ethnography and SNA independently but also how they then can work effectively together. This chapter then outlines differing theoretical viewpoints such as Activity theory, Grounded theory, Ethnomethodology and Actor-network theory that can influence both techniques. It is proposed that this thesis uses techniques and theory that seeks to describe the situation at hand such as through Actor-network theory or Ethnomethodology, rather than explain phenomenon that occurs. Actor network theory and Ethnomethodology both rely on describing how networks occur rather than why they occur and as such the use of both SNA and ethnography are applied to portray the design studio in order to visualise what actually happens. Finally this chapter gives an in depth description of the specific methods used in the educational and professional case studies and in testing the visualisation software, justifying the specific techniques used so that the research can potentially be replicated in future studies.

4.1 Social Network Analysis using contextual observations (ethnographically informed) techniques

Sociological description requires that an adequate picture of the focus of study is portrayed using the best techniques applicable and available and that in any given circumstance there is a rigorous understanding of events. Sociological description needs to describe a situation as close as it can to what occurs in reality. This, however, is difficult and problematic. Techniques can be biased, observations can be misinterpreted and judgements by both the researcher and those under scrutiny can be misled. In attempts to overcome this, researchers choose methods that best explain the situation for a particular context. In this thesis a combined methodological approach of Social Network Analysis using surveys and ethnographical type studies has been applied to the research question. The decision to choose two complementary techniques was taken in order to produce a more holistic description of the design studio and to strengthen the overall arguments put forward. The design studio, by being a situation of complex social influences requires more than numeric survey responses. The design studio is a consequence of social, historical, cultural, economic and political influences (John-Steiner 1997), and this requires a broader, richer understanding that qualitative descriptions can give. This is even more the case, when the social influence under scrutiny, of peer evaluation and informal feedback, is somewhat amorphous.

Putting forward a case for choosing a combined approach, of course, requires that there is an understanding of each methodological technique in its own right. Both SNA and ethnography have their strengths and their weaknesses but it is intended that by choosing these two approaches, some of the weaknesses in each approach can be rectified. To appreciate the issues of each approach, SNA and ethnography are discussed separately, with the benefits and pit falls of each examined in light of how the use of the differing approach could potentially provide an overarching view of the design studio.

4.1.1 Social Network Analysis

The first technique applied to the research is a sociological/mathematical one, namely Social Network Analysis (SNA). SNA can be understood as a specific set of linkages among a defined set of actors (Mitchell 1976). Or as Wasserman and Faust (1994) described it:

> “The social network perspective encompasses theories, models, and applications that are expressed in terms of relational concepts or processes… The unit of analysis in network analysis is not the individual, but an entity consisting of a collection of individuals and the linkages among them.” (Wasserman and Faust 1994 p4)

Social network analysis helps to interpret group data such as communities of practice. It can identify cliques, trace how information flows through networks and holistically understand what is going on with a connected number of individuals. SNA can also be used to test hypothesis for groups or clusters of people, such as the idea boys socialise more with other boys. Or people with strong ties are more likely to support others with strong ties. Or that people with weak ties are useful for learning about new ideas or jobs (Granovetter, 1973, 1982 and 1983). SNA can also be mapped visually using network diagrams and sociograms. This enables the visual identification of groups, clusters, cliques, isolates, go-betweens and bridges.

SNA can be categorised as a subset of sociometry (Scott, 2005). It is a field of research that has evolved over the last century and emerged from anthropologists' observations about relations in face-to-face groups, and mathematical graph theory (Hanneman, 2010). SNA is an intersection of disciplines, which can be traced from its historical influences. Scott (2005), who reviewed the historical progression of SNA, discussed the people and domains that were historically significant and how the three areas of influence were interlinked. The development of SNA has been charted and is shown in figure 16. That progression is seen as moving from Moreno (1934) and intersecting with the works of Barnes (1972) and Mitchell (1969 and 1974) and the anthropological tradition. Moreno, who came from the gestalt tradition of SNA, was the first to evolve the idea of the ‘sociogram’ to represent social structures. The sociogram shows individual people, objects or actors as points and relationships to one another as lines, and enables the visual identification of groups and isolated actors. The sociogram is repeatedly use in this thesis to visualise connections between the designers. In order to understand the visual interpretations of the network data, it is perhaps worth explaining the concept in more detail. In figure 17, person A received feedback from B, C and D. However person A only reciprocates by giving feedback to person C.

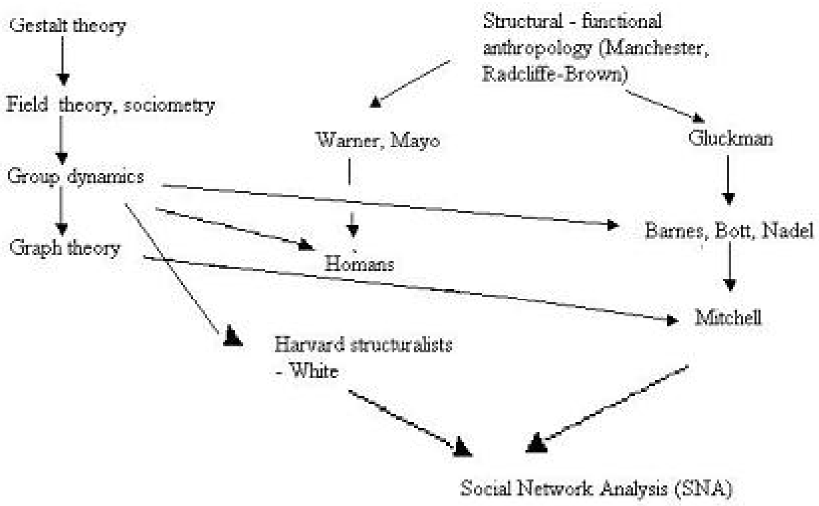


Figure 16: The development of SNA (Scott 2005)

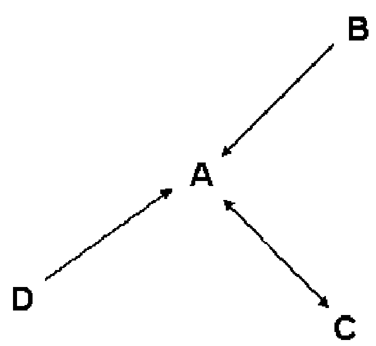


Figure 17: A sociogram with directed ties

The work of Manchester anthropologists, namely Barnes (1972), Mitchel (1969, 1974), Bott (1957) and Gluckman (1963), revealed SNA as a “structures of networks of relations, combined with formal techniques of network analysis with substantive sociological concepts” (Scott, 2005 p27). Clyde Mitchell for example, took mathematical graph theory and formulated it into a sociological framework. His work applied the ideas of density, where a network is compared to another where all possible ties are present. Others defined the use of “reachability” as how easy it is for one person to connect with another. Barnes looked further into the idea of clique and cluster analysis and looked for the network to reveal those social groupings.

The different strands that make up the lineage of SNA converged in the late 1960s. Harvard structuralists began to push the analysis of social networks much further than their predecessors. The key to this breakthrough, Berkowitz (1982) believed, was that this development lay in two mathematical ideas. Firstly, algebraic models of groups and secondly, the development of multi-dimensional scaling which visualised social relationships in social space. Subsequent to this, works from Granovetter (1973) and others appeared in academic publications and became widely popular. Granovetter (1973) tried to explain the networks involved when people seek employment. His work applied mathematical ideas to the very tangible concept of job seeking, and ultimately helped popularise SNA. The findings by Granovetter had a very “real” aspect to them and the benefit of using SNA could be easily understood. His work, amongst others, helped show the power and potential of SNA.

This brief history of the development of SNA brings us to present day research. SNA is now established as being particularly useful for investigating “kinship patterns, community structure, interlocking directorships and so forth” (Scott, 2005 p2). Borgatti (2005), for example, looked at the network structures of innovation, and how different types of network configuration benefit different types of creativity. His work and the work of others reveal how SNA can be applied to creative and innovative fields such as design. SNA can be used to understand the creative process and make recommendations on how to improve it. It is recognised however, that each design discipline, company, institution and course will have their own idiosyncrasies and cultural baggage (Strickfaden 2005), and that may make their network configuration distinctive.

In comparison to other types of methodological approach, SNA looks at the relational rather than at the attribute. It also looks at the structure and composition of connections that make a group rather than looking at individuals and their characteristics. Network analysis has been described as an "attempt to reintroduce the concept of man as an interacting social being capable of manipulating others as well as being manipulated" (Boissevain and Mitchell 1973, preface). In perceived groups of individuals, SNA can be used to describe causal mechanisms at work; such as the identification of a group, and what that group has in common, in comparison to a case study of an individual (Yin, 1994). A causal mechanism can be a theory or explanation of why one event causes another, such as social proximity in the network having an effect on spill-over. Within creativity it is proposed that one piece of creativity may affect another. A trend for example may become formed within the design sector and this in turn filters into another creative sector. Similarly one individual in the design studio may influence another individual. It is this flow of creativity that can be particularly well understood by SNA as it can identify the spread of ideas from one person or group to another. The quantitative results can highlight, for example, where a connection exists, while the use of longtitudinal network analysis, can reveal the spread of ideas traced over time.

4.1.2 Ethnography

Ethnographic based research can be described as a set of methods rather than a theory in itself (Hammersley, M. and Atkinson, P 1995). Ethnography encompasses participant observation, interviews, literature analysis and information gathering, and can be summarised as:

> "… the study of people in naturally occurring settings or 'fields' by means of methods which capture their social *meanings* and ordinary activities, involving the researcher participating directly in the setting, if not also the activities, in order to collect data in a systematic manner but without meaning being imposed on them externally." (*Brewer 2000 p1*)

Many have deemed ethnography as being a minority pursuit within sociology (Frazer 1959). Others have accused ethnographic descriptions of producing wholesale generalisation when they should produce a description from ‘the natives’ point of view’ (Malinowski 1922). Some have held it in low esteem and others have accused research under the name of “ethnography” of not being that at all (Sharrock, W. and Hughes, J. A, 2002). Its understanding may indeed have shifted from its original use when described by Malinowski in the 1920s and 30’s (Malinowski, B 1922 and 1926). Malinowski set out an observational programme to understand, in minute detail, the intricacies of social organisation in primitive cultures. Although criticised for its unrealistic scope, Malinowski’s principles of ethnography, or ‘ethnographer’s magic’ are still aspired to today:

> “Imagine yourself suddenly set down surrounded by all your gear, alone on a tropical beach close to a native village … I well remember the long visits I paid to the villages during the first few weeks; the feeling of hopelessness and despair after many obstinate but futile attempts had failed to bring me into real touch with the natives, or supply me with any material. … I knew well that the best remedy for this was to collect concrete data, and accordingly I took a village census, wrote down genealogies, drew up plans and collected the terms of kinship. But all this remained dead material, which lead no further into the understanding of real native mentality or behaviour, since I could neither procure a good native interpretation of any of these items, nor get what could be called the hang of tribal life … it was not until [sometime later] that I began to make any headway; and, at any rate, I found out where lay the secret of effective field-work. What is then this ethnographer’s magic, by which he is able to evoke the real spirit of the natives, the true picture of tribal life?” (Malinowski 1922 p 4-6)

Ethnography is now understood, to refer to fieldwork where the study is carried out in situ and where the researcher takes a first-hand view of the phenomenon under investigation. An ethnographic approach, although seemingly similar to other types of qualitative study, can be distinguished by its use within context that is particularly apt for studying people doing day to day tasks (tasks that may be unknown to the people under inspection). Ethnography is particularly appropriate at understanding tasks that are difficult to define and subtle in their enactment, such as the concept of peer-evaluation and informal feedback. By studying what people do rather than what they say they do, the technique gives a richer, more realistic overview of the whole scene. It also does not rely on people adequately acknowledging that they carry out a certain act and revealing this in prescribed interviews or questionnaires.

Although ethnography can be criticized for the sheer amount of unstructured data that can be produced, ethnographic based techniques can overcome the lack of understanding that prescribed questionnaires offer (Luff, P., Hindmarsh, J. and Heath, C 2000). There are many benefits of using ethnographic based techniques for understanding design in practice. Firstly, a holistic view of the design workplace is given which ultimately is informative and revealing for external bodies (researcher or client), the company as whole and the design practitioner or student. Secondly, such applied techniques can highlight successes and failures in the processes and items that are in use. This may also uncover how existing tools are being used and how they can be improved. It can be argued that an applied ethnographic approach is the most appropriate technique for understanding the varying types of social interactions that are at work during the earlier stages of the design process. Social interactions, regardless of whether relating to one to one or societal considerations are very difficult to analyse. They can often be very complex and random in nature. Pre-determined questionnaires therefore may not capture all that can occur when individuals meet. In the same sense, structured interviews may also not provide a rich enough account. Unstructured interviews on the other hand can give a more insightful description allowing the interviewee to provide information about an unknown concept that the researcher was unaware of.

4.1.3 A combined approach

The ontological basis for Social Network Analysis, that things and people relate, is suitably open to accommodate a diversity of approaches (White and Heady 2005). It can accommodate data such as that collected in fieldwork, interviews, historical studies, and/or surveys. White and Heady (2005) noted however, that many approaches already undertaken needed “far better grounding and less reliance on ready-made computerized datasets.” (p1), instead it is proposed that SNA grounded in observation analysis gives a richer description to the networks revealed. SNA data, the matrices of connections between people, can therefore be open to whatever type of research method that will provide it. For its ease of use and accessibility, most network analysis is based upon survey data, historical datasets or software generated data logs. Questionnaires, for example, allow respondents to give specific answers that facilitate a matrix of respondent data to responses given (one actor referring to another). There are a number of benefits of doing network analysis in this way, such as statistical analysis being applied to the data and previously referred to hypothesis being tested. Specific network analysis algorithms such as reciprocity (if one actor refers to another, to what extent is that relationship reciprocated), or connectivity (how many and how well are other people connected to an actor) can be applied. These techniques, among many others, require numeric data. This data is most easily gained through an automated source such as interactions with a computer program or survey data. Numeric data can though, be provided through observation, for instance the number of interactions that were observed. However this requires greater involvement and interpretation from the researcher than getting computer log files of interaction (noting that the preparation time of log files or analysis is not factored into this example). Additionally visual representations also require some level of numeric network data input.

Surveys provide a good source of network data but they only give an insight into the respondent’s perception, they do not allow for times when the respondent is not aware of a relationship or if they do not want to admit to it. Peer evaluation is a social influence that has many connotations and issues associated with it. Designers may not realise they reflect on their work in response to others or may not think it is of significance. In response to this, observations of the design studio are needed in order to understand complex social relationships. To do this, an ethnographic type approach is put forward. The ethnographic approach, involves qualitative interpretation of the world in which the researcher sees. That interpretation can be greatly influenced by the researcher, the perspective they hold and bias that they may have. To counter this, the SNA questionnaire allows for the interpretation to fall with the designer who completes the survey. The results (that are quantitative in nature) relate to how they, the designer, have interpreted the questions. The researcher can then only reveal what the results show. Thus this allows the design studio to be viewed from two perspectives, from the researcher's (and their ethnographic accounts) and the designer in the studio (and their survey and interview responses). Of course the understanding of the designer may be skewed as much as the researcher's interpretations biased. Data logs from interactions with software can address this as they are categorical, but if the phenomenon under question does not occur through the interaction of software then this argument is purely academic.

Ethnographers Johansen and White (2002) carried out a combined approach to ethnography and SNA. In *Network Analysis and Ethnographic Problems,* Johnasen and White (2004) looked at the genealogies of a nomadic clan in South East Turkey. Their combined approach facilitated the gathering of photos, stories, histories etc from their ethnographical account, whilst the social network data is gleamed from coding the ethnography. They took any network and attribute data that was in an accessible form and examined every aspect of social anthropology from a case study. They essentially moved to and fro between network analysis and ethnography (Johansen and White 2002). An approach that is replicated in the following case studies for two design studios.

Creative and complex scenarios, like that found in design studios, require a suitable mechanism for accommodating creative knowledge and practice. Social networks that exist within a design studio do not form neat patterns of interaction that can be judged on surveys alone, as multiple surveys would need to be given to address the multi-faceted nature of informal feedback. There are multiple relationships in the design studio which are often inter-dependent. There are hierarchical, team structures and communication networks that all have a bearing and inter-connect with ideas of peer evaluation. This requires that many surveys to be given to the actors each asking about the relationship they have and what that relationship is. Additionally there are many issues surrounding how evaluation and feedback are given and sought for. This two-way phenomenon to the idea of feedback is subtle and difficult to capture through survey data. Although seemingly similar, each direction of sharing feedback has an understated difference. Seeking feedback refers to whom you would want to review your work, whilst sought for feedback refers to who would want *you* to review his or her work. In practice this means that the sharing of feedback is a two-way phenomenon requiring a survey question associated with a certain direction of the feedback cycle. By distinguishing between the two directions, questions can be applied such as, are there any characteristics of people who seek feedback more than being sought for feedback? Or who are the types of people who are sought? Comparisons can also be made between the two questions. Theoretically the results from both questions should match. For example, if person A seeks feedback from person B, person B should answer that person A has sought them for feedback. Any difference to this model would suggest that the perceptions of designers vary between each other. The designer's perception can therefore bias the resulting data. To overcome this problem, ethnographic description can seek to portray the reality of the situation as perceived by the researcher, in addition to that which is perceived by the designer alone. Qualitative descriptions can also aid in understanding the perceptions of the actors involved, where they are coming from and why they answered in a certain way and how they may interpret questions.

Surveys would also need to be given at various points during the design process to address the evolving nature of social networks in the studio. Also in any organisation, social networks change over time through personnel leaving, new people being employed, relationships fostered through a common interest or changes in office layouts. All these factors (amongst many others) affect the social networks that exist. Survey are really only a snap shot at a point in time, they do not account for dynamically changing networks which occur in real world situation. Applied ethnographic methods can address this as they provide a rich supply of data gained about various relationships and practices that can be random, often complex and creative. Ethnographical description can reveal how the social network can change and adapt, for instance the impact of an office move on the design studio’s social network. White and Heady (2005) argued that qualitative research can help to understand network dynamics and how networks change. They suggested that network dynamics not only refer to network changes over time, but also movements of networks in space and location, such as the impact of being a contractual journalist as a ‘mobility pioneer’ (Kesselring 2006), and the implications location and geography has on network dynamics.

The next issue relates to the transformation of ethnographic data into network data. If surveys are given and ethnographic accounts are in addition to these, then qualitative data does not necessarily need to be transformed. The network data is based on the numeric survey results and the ethnographic data provides context. However if surveys are not given, qualitative data needs to be analysed and network connections taken from the field notes. If this is the case the results from ethnographic descriptions and how these translate into network matrices are subjective in nature. Ethnographic analysis can be coded in such a way that some statistical algorithms are able to be applied. These coded conversational elements are based on the consideration of the researcher and are essentially “judgement calls” that could be difficult to replicate. Comparison to “like for like case” studies are therefore quite difficult. Attempts could be made to have similar field sites with a framework for analysis that could allow repetition. However this moves away from the essence of ethnography and understanding the context and idiosyncrasies of a specific case. Potentially using network analysis as a framework can aid the reduction or at least aid the categorisation of the large amount of data ethnography can provide. For instance, findings from the network analysis that suggest that isolated students produce poorer design work can guide the ethnographic researcher to focus their attention on this aspect. Although this may reduce the holistic view of the entire scene, it does make the ethnographic descriptions more targeted. Alternatively, the ethnographic research can lead the SNA approach. For example, the researcher going into the studio environment without a prescriptive theoretical stance, after the research the main areas of interest are ascertained and then follow up SNA questions are asked that refer to those research areas. Carrying out ethnography in this way allows for network data that is implicit, with the description emerging without prescribed theoretical influence.

4.2 Influential theory to a combined approach

SNA looks at group interactions and attributes of a group. For example whether a cluster of designers may reside in the same area? However there is often a tendency within SNA research not to explain why a connection exists or pattern revealed. It is acknowledged that many published network studies fail to identify the social theory and generative mechanisms that motivate their research (Monge and Contractor 2003). To address this, the use of SNA should be placed within theoretical grounding that may suggest why certain network connections are made and groups occur, or to use SNA to describe a theory in action.

There are various positions held concerning the theoretical underpinning of SNA. Some academics maintain that SNA contains theoretical features within it, which are associated with concepts and theories such as homophily and equivalence (Monge and Contractor 2003). Boissevain and Mitchell (1973) also maintained that SNA can fit neatly into wider social theories such as Actor Network Theory or Activity Theory. Whilst others claim that SNA is just a sociological technique and should not be confused with theory at all.

Monge and Contractor (2003) argue that two possible reasons influence why certain connections exist. These are based on either theories of self-interest or theories of mutual interest. These theories affect any analysis as to why certain connections exist, and why the network exists at all. The theory of self-interest purports that " people make what they believe to be rational choices in order to acquire personal benefits" (Monge and Contractor, 2003, p142). One example of a self-interest theory is that of social capital. The "theory of social capital suggests that people who try to exploit social holes will do so by seeking to improve their structural autonomy" (Monge and Contractor 2003 p142. This theory of social capital is best exemplified in the work of Burt (1992, 1997), and his notion of "structural holes". Structural holes are gaps in the network which could possibly join two groups together, thus bringing with it greater social capital for both groups. Burt maintains that people will invest in a connection if they perceive that they will gain a profit from the social value of the people they are connected to. Similarly Granovetter (1992, 1997) in his idea of the "strength of weak ties", argued that people sought information, through their social capital, particularly when trying to find a job. Those people that were best able to provide useful information were those in which the job seeker had a weak social relationship. These weak ties, it could be argued, have greater access to groups that are unconnected to the job seeker. Thus a weak tie fills a structural hole and provides greater social capital.

Mutual interest and collective action on the other hand is based on the idea of the possibility of benefits from coordinated action (Marwell and Oliver 1993). Public good theory is one such mutual interest theory. Public goods theory focuses on the contribution to the communal such as the creation/maintenance of public parks. It is proposed that everyone should have access to the public good, regardless of how much they have contributed. An example of a network that can be understood using public goods theory is the Internet (particularly when it was first created). In the spirit of communal action, the content for the Internet was shared and provided voluntarily. Any knowledge or data was available to anyone who had an Internet connection. Although this ethos has changed considerably in the last 5 year or so, by becoming more of a commercial entity, the Internet is still an open provider of information. Importantly it still fulfils many of the public good theory criteria:

- shared interest – with people seeing benefit in the creation of a good
- resources – people possess various resources in which they can contribute to the network
- benefits – people will require the benefit of the good
- costs – those people who contribute to the network incur the cost of their contribution.

In contrast to SNA and the theories that potentially seek to explain why relationships or connections exist, ethnography has developed from theories of knowledge (Brewer 2000). Broadly speaking, ethnography has been defined in terms of humanist naturalism model of social research rather than a natural science positivist model (Brewer 2000). The natural science model maintains that there is a “real world” in which people operate that is independent of their own insight. This allows for law-like statements to be drawn from the world researched, for hypothesis to be put forward and research to be tested against. This approach has, in general, been applied to SNA studies. Although hypothesis within SNA can be complicated as it deals with groups rather than individual, most SNA research stems from scientific mathematical positivist enquiry. The humanist model of social research on the other hand, seeks to describe the natural world and what people think, believe and do.

This is particularly apt when studying design as a socially constructed phenomenon. Brewer (2000) maintained that the three tenets of a humanist naturalism model are:

- The social world is not reducible to that which can be externally observed but is something created or recreated, perceived and interpreted by people themselves;
- Knowledge of the social world must give access to actors own accounts of it, among other things, at least as a starting point, and sometimes as the sole point;
- People live in a bounded social context, and are best studied in, and their meanings are best revealed in, the natural settings of the real world in which they live.

Although some ethnographic research tries to encompass a more positivist approach, most ethnographical research draws on the humanistic model. With ethnographic researchers giving rich descriptions to the world portrayed to them. Those researchers, who try to incorporate a natural science model of ethnography, do so by using standardised techniques and procedures. Whilst those who use the humanistic model aim to become "an insider" in the research setting. The fact that ethnography can encompass both type of models makes the technique a highly contested area in qualitative research today (Denzin and Lincoln 1998). It also means that no single theory or philosophy can lay claim to the rationale behind ethnography (Atkinson and Hammersley 1998).

Ethnographic research is a process therefore, a reflexive process of uncertain and provisional assertions (Law 1994). It is an ordering process which is weaved between suggestions and imputation, where patterns are sensed and decisions are made over what "counts" as data. Garfinkel (1967) made the point that:

> "the investigator frequently must elect among alternative courses of interpretation and inquiry to the end of the deciding matters of fact, hypothesis, conjecture, fancy, and the rest, despite the fact that in the calculable sense of the term 'know', he does not and cannot 'know' what he is doing prior to or while he is doing it. Field workers, most

> particularly those doing ethnographic and linguistic studies in settings where they cannot pre-support a knowledge of social structures, are perhaps best acquainted with such situations, but other types of professional sociological inquiry are not exempt. Nevertheless, a body of knowledge of social structures is somehow assembled" (p 77-78)

Both ethnography and SNA are sociological techniques that have practical ways of ascertaining the reality of a given situation. When interpreting the results gained from these techniques, there are many theories that can guide the research. These theories allow the researcher to apply the techniques in a particular way and also consider what the results show and why any research patterns have been revealed. The following section discusses some the theoretical models that have been applied to SNA and ethnography. There are many theories that have and can influence SNA and ethnography and the following arguments refer to some of the most popular theories, those used by researchers studying similar areas, or theories that are particularly apt or appropriate for studying networks.

4.2.1 Activity theory

One example influential theory is Activity Theory (AT). AT conceptualises human activity and bases activity itself as the fundamental unit of study. AT was originally developed from the works of Vygotsky in the 1920s as a consequence of Russian psychologists moving toward Marxist philosophy. It was Rubinstein and Leontiev who fully formulated the actual theory and Leontiev particularly who is credited as developing the conceptual framework (Leontiev 1978). The basic principles of the theory are (Kaptelinin and Nardi 1997):

- Hierarchical structure of activity – Hierarchy can be broken down into three levels: activity, action and operation.
- Object orientatedness – An object can be physical, social or cultural.
- Internalisation/externalisation – Activities can be internal and external. The internal activity can be the cognitive process of understanding. The external could be the transformation of the imagined action into realized action.

- Mediation – The mediation of artefacts during activity.
- Development – Research method (ethnographic) that encourages active participation in the field of study.

An example of an AT orientated ethnographic research, is the work of McCaulay and Crerar (1998) who carried out a year-long study into information gathering at a UK daily newspaper. The research concluded that AT lent itself to the study of auditory devices as the mode of mediation where activity was studied. However depending on the project other theories maybe more suitable. AT can be seen as particularly apt when studying persons interacting in an obvious way with an identifiable object. However if activities and goals are difficult to articulate, or does not refer to an identifiable object, the process is more problematic.

4.2.2 Grounded Theory

Another theoretical approach is that of Grounded Theory (GT). Grounded theory grew from the work of Glaser and Strauss, who were concerned with the domination of quantitative verification of pre-determined theory (Strauss and Corbin 1990). They proposed that qualitative data could provide a thorough understanding of the subject matter. They believed that GT was an inductive theory based on the study data. In practice this meant that structure, theory and questions are not generated before the research starts. The resulting theory produced is, therefore, formed from the dataset and, it can be argued, perfectly fits that data. The two summarised premises to GT (Strauss and Corbin 1990) are firstly a constant comparative method and secondly theoretical sampling. Constant comparative method requires an iterative process of collecting and analysing data in order to formulate theory. Theoretical sampling requires that theories are developed from the research and then re-tested.

The use of GT has been shown to reveal generalized theory from first-hand experience in Grinter's work on workflow systems (Grinter 2000). GT can be seen as a theoretical framework that allows for new or unexpected theory. However the idea of no pre-conceived research agenda can be difficult when initially starting a study. The theory also requires a great deal of time to formulate rigorous results as any assumptions made require a further testing procedure.

The use of ethnography within a Grounded theory framework can be seen in the work of Strickfaden (2005), who looked at the cultural medium within a design studio. The use of SNA within a grounded theory model has been used by Kettley (2005) who studied the use of networked jewellery. These examples used an open coding procedure developed by Strauss and Corbin. In the case of Strickfaden, open coded transcripts provided the basis for her descriptive analysis. Whilst in the case of Kettley, network analysis was applied to the coded questionnaire results. This supported the use of network analysis and a grounded theoretical ethnographical approach. Similarly this was also proven with the work of Ashton's (2001) research into social influence within an educational studio. It would seem logical to repeat the ethnographical research in an educational and professional studio using the same underlying theoretical technique and the Grounded Theory approach used by Ashton (2001). In the case of Ashton’s study (2001) the use of SNA and ethnography had not been previously applied in a design context, and there were no previous work to build upon and thus a good reason to use a GT approach. However the research outlined in this thesis builds upon their work and other previous studies into networks within the design studio (Ashton & Durling 2001, Shaw 2007, Yaneva 2006 etc). This results in pre-existing theory already being prevalent within the wider academic community. A consequence of which is that there is pre-existing conceptions and theories at hand and this is of influence when embarking on any new network studies based on a design studio.

The second reason to reject a GT approach to the outlined research is the use of software to reveal network patterns within the studio. The software is intended to expose the patterns that exist rather than explain why they occur. Any theoretical informed ethnography would need to take this into account. Essentially, the ethnography would need to describe what occurred in the design studio and the software then reveal those interactions. As a consequence to this, the underlying theoretical position used in this thesis should not provide existential explanations of events. The following two theories, Ethnomethodology and Actor Network Theory approach ethnography in this way. Garfinkel (1967) and Latour (2005) both believed that society could be a science accounting for how society is held together, instead of using society to explain something else. They argue that the ethnographic research should instead describe the events that are unfolded.

4.2.3 Ethnomethodology

Ethnomethodology (EM) is an analytical framework initially described in the work of Garfinkel (1967). In this book *Studies of Ethnomethodology* (1967), Garfinkel put forward a series of ethnomethodologocal studies in which he proposed that EM was the study of how people make sense of the society they live in. Garfinkel stated that is was thus:

> "..the activities whereby members produce and manage settings of organized everyday affairs are identical with members' procedures for making those settings "account-able." … When I speak of accountable my interests are directed to such matters as the following. I mean observable and- reportable, *i.e.* available to members as situated practices of looking and telling. I mean, too, that such practices consist of an endless, ongoing, contingent accomplishment; that they are carried on under the auspices of, and are made to happen as events in, the same ordinary affairs that in organizing they describe; that the practices are done by parties to those settings whose skill with, knowledge of, entitlement to the detailed work of that accomplishment – whose competence – they obstinately depend upon, recognize, use, and take for granted; and *that* they take their competence for granted itself furnishes parties with a setting's distinguishing and particular features, and of course it furnishes them as well as resources, troubles, projects, and the rest" (Garfinkel, 1967 p 1-2).

Heritage (1984), commenting on Garfinkel's work, suggested that EM could be described as "the pursuit of a single question - how do social actors come to know, and know in common, what they are doing and the circumstances in which they are doing it" (Heritage 1984 p76). EM is concerned therefore with how people make sense of the society in which they live, and focuses on how people understand their everyday activities and their created 'reality'. The technique assumes that each individual will have a general view of the world, the actions and interactions within it. For example, two people may have a completely different take on the same event. Questionnaire and interviews therefore would only reveal this individual understanding and not the event itself. The researcher practising an EM approach to field studies would therefore observe the event and the interactions between persons to the event and interpret the occurrence for themselves.

EM uses ethnography to look at the specific and proposes that social situations can be manipulated to reveal insight. The following are some of the major themes within EM:

- Disruptive experiments – A deliberate disruption of the situation under study to observe the before, during and after affects.
- Conversational analysis – Analysis of how we describe the world to one another, the words, sentences and context in which they're spoken and the un-spoken cultural background to what is said.
- Practical reasoning – Analysing how people arrive at conclusions about what is going on in a particular instance.
- Documentary method – Assumption that social order is illusionary and that individuals make sense of their world through selecting certain facts in a social situation that conform to a pattern which is then used as a framework for interpreting new ideas.
- Indexicality – The framework that is used as a socio-cultural "index" for the individual to understand a social circumstance.

EM has often been used to study the workplace particularly when considering Computer Supported Collaborative Work (CSCW) (Sharrock, W. and Hughes, J. A 2002*)*. EM can be seen as having strength in its ability to look at the social interactions at work and as such is especially useful when looking for social collaborations. Studies of aircraft control are a typical example of EM requirements capturing for the creation of CSCW tools (Martin et al., 1997; Martin and Rouncefield, 2003; Rouncefield et al., 1994). This research showed the effective application of EM, and was used not to suggest changes to the design process generically, but rather looks at a particular project or a part of the design process.

Although EM uses many ethnographic based techniques, the two should not be confused. In fact EM can overcome many of the so-called “problems” that ethnography faces. Ethnographic type studies have involved researchers “sitting in” or “following people around”, however what they get from this data is very much based on the researcher’s biases and conceptions. Although this is also true of EM, it is a concept that is acknowledged as very much part of the EM process. The views the researcher has about the world around them is taken into consideration, in the same way the subject under study has views about the world they work in. The objectives of ethnographic studies can be very broad. For example, by looking at the design process in general will result in conclusions about the general and not the specific. It will also result in a huge amount of data. EM, on the other hand, looks at the specific. This results in conclusions about particular instances, by specific people, at certain points in the design process.

Although this may cut down the sheer amount of raw data produced, it should be noted that even looking at specific incidents could also produce a great deal of information. The discretion of the researcher to the level of granularity and detail in the study is then relied upon. Due to its specificity, EM does not come up against the same degree of criticism that ethnography does regarding its un-repeatability. For example if the ethnographer is following a team of designers and they decide to separate – who does the ethnographer follow? It could be the case that the ethnographer follows the “wrong” person and misses out on some revealing insight divulged from another member of the team. Conversely, EM looks at specific people, interacting in a specific way, in a given context. If a team member splits off from the task at hand, they are then no longer part of the EM study.

EM, because it is using ethnographic techniques does still suffer some of the same criticisms. For example, communicating ethnographic or EM findings is very difficult. If EM and ethnography can be considered a source of information that designers can use (Lawson, B 1990), its successful judgement relies on the ability to convey the results. EM produces masses of information that the designer will not wish to filter through. Many of the conclusions made are based on the researcher’s interpretation and are based on explicit reference to evidence within the data. When communicated to third persons, this may require extensive explanation and justification. By not studying the “whole”, focusing instead on specifics, EM can be criticized itself, as it does not take into account the broader implications of the work under consideration. EM can therefore be seen as a method that does not suggest changes to the design process generically, but rather looks at a particular project or a part of the design process. Another criticism of the ethnomethodological approach is that it can seem indifferent, as no theory is produced at the end of the ethnographical journey (Gellner, 1975). However Garfinkel (1986 p 142) dismisses this point and maintains that this criticism confuses ethnomethodological indifference with moral relativism. Others have criticised Garfinkel for his obscure writing style (Gellner, 1975), a criticism that is difficult to argue against.

Ethnomethodology and SNA can also form quite happy bed-fellows. The use of the SNA technique fits neatly with the underlying aim of Ethnomethodology. Ethnomethodology has, at its core, a perception that the world is perceived by individuals in a certain way. They understand the world around them by forming social patterns and frameworks. By using SNA surveys, a researcher is, in essence, asking participants to reveal how they see the world around them and the social connections they have. In contract other types of technique rely on the researcher interpreting the observations they have. Although SNA can be achieved through other techniques rather than questionnaires, surveys are the dominant mechanism for gaining insight into how social actors perceive their networked world. An approach that has been successfully applied in numerous instances, networked learning - Fox 2000 and mediated communities - Goodings, Locke & Brown 2007 are just two examples. Another reason for using a ethnomethodological theory for a combined approach to the research is the role of conversational analysis. Analysing conversations is a key feature of EM, for instance Garfinkel analysed the conversation between a husband and wife (1967 p38-42) and the dialogue between ‘subject’ and ‘counsellor/experimenter’ (1967 p79-96). The use of conversational analysis has been used in the outlined research in both the educational studio and the conversations between the team of four and in the conversational interactions in the professional studio.

4.2.4 Actor network theory

Actor Network Theory (ANT) in many ways is very similar to ethnomethodology. Indeed Latour (2005) described ANT as “being half Garfinkel [founder of ethnomethodology] and half Greimas: it has simply combined two of the most interesting intellectual movements on both sides of the Atlantic and has found ways to tap the inner reflexivity of both actor’s accounts and of texts” (p54). ANT is a systematic way to consider infrastructure that surrounds achievement. It is developed as an analysis of scientific and technological artefacts, ANT's theoretical richness derives from its refusal to reduce explanations to either natural, social, or discursive categories while recognizing the significance of each (Latour 1991, p93). Furthermore "the stability and form of artefacts should be seen as a function of the interaction of heterogeneous elements as these are shaped and assimilated into a network" (Law 1990, p113). Primarily originated by Callon, Latour and Law, it can be seen as attempting to understand innovation and knowledge creation. ANT maintains that an individual or phenomenon does not happen in a vacuum. Galileo, for example, relied on his past experience, his colleagues, new technological advances etc in order to be the genius he was

Latour (2005) refuted ethnographical studies that sought to explain, instead he aimed to be “faithful to the old duties of sociology, this ‘science of the living together’” (p2). He argued that ‘sociology’ should not be defined as the science of the social but as the tracing of associations. He also suggested that ANT descriptions should incorporate non humans as actors. Any description that is stable and are used to explain a state of affairs cannot be deemed ANT (simply relying on SNA surveys would therefore not suffice in an ANT framework) A third and final test to ascertain whether a study aimed at re-assembling the social is that rather than insisting on dispersion, ANT aimed at overcoming these destructions and to check for new institutions, procedures and concepts (Callon et al 2001, Latour 2004). The application of ANT to the field of design has successfully been applied in many cases (Law 2002 – Aircraft design, Yaneva 2009 – Architecture, Shaw 2007 – Design Engineering to name a few). Yaneva (2009) for example argued that by using an ANT perspective, buildings can be seen as a complex mediator that distributes agency between human and non-human participants which both transform social meaning.

Latour (1997) maintained, however, that the actor-network theory has very little to do with the study of social networks. It is assumed that ANT cannot be aligned to SNA as ANT does not attempt to explain why a network exists, but looks to reveal how it is formed. It is argued though that SNA can be incorporated into ANT research, if it is done so in combination with qualitative methods. SNA can be used in this regard to quantitatively and diagrammatically show the network at work, whilst descriptive accounts can understand how the network came to be. Latour (1997) also proposed that ANT and SNA are incompatible because ANT incorporates artefacts, devices and entities. However it is a misnomer to consider SNA as simply people and social groups (although this is often the case), but SNA should also contain actors that are objects that represent people. Actors can be groups of people as in conference events, or social networks representing connections between people using certain technological devices. ANT maintains that these additional actors in the form of artefacts are important, as they are a mode of mediation in which a network may collapse. The role of artefacts in the network is sometimes contentious as many people find it difficult to attribute agency to non-human actors. Latour (1997) does acknowledge that social networks can be included in ethnographical description but they should “have no privilege nor prominence”. As such the following research uses SNA as a methodological technique and not a theoretical stance.

ANT seeks not to propose why a group or connection exists but describe that network and how those connections have come to be. In order to truly understand the research under question, qualitative analysis such as ethnography should be carried out to enquire as to how the network came to be. Similarly the ethnomethodological approach to field study is based on descriptive analysis rather the explanatory analysis. It is used to help form an understanding of feedback networks in order to accurately visualise them using software. In the following section the argument is put forward for this type of software engineering technique.

In the following detailed description of the field studies undertaken, the combined approach SNA and ethnographically informed techniques are used to *describe* the social networks of peer evaluation in a design studio in order to visualise what occurs so that a design may reflect on how they are socially influenced.

To summarise this chapter so far (before practical descriptions of the actual method):

- It has described various theories that have influenced both SNA and ethnography independently and as a collaborative effort
- It has argued for ethnomethodology or Actor Network Theory as a theoretical stance to guide the research
- The following case studies uses the theories of ethnomethodology and ANT to *describe* the exhibition of social construction in the design studio

4.3 In-depth description of the methodological techniques that were applied

The following sections outline the two case studies and the software testing process. All names of people and companies have been altered. All persons and companies have been given realistic but fictitious pseudo-names or names removed completely.

4.3.1 Case study 1: the educational studio

The educational studio case study in many ways repeats the research carried out by Ashton (2001). Firstly contextual observations (ethnographically informed) were carried out with 4 students as part of an inter-disciplinary project. Surveys were then given to three classes of undergraduate design students and whilst these surveys were given, ad-hoc conversations were had. In two of the three groups, photos were taken of their work, uploaded to a Virtual Learning Environment (VLE) and viewing pattern log files of their work captured. In the educational studio the contextual observation stage informed the Social Network Analysis. It helped to crystallise the questions that were posed, and support the claims put forward from the observational stage of the research. In the educational setting, the SNA surveys are the more dominant partner from the two kinds of approach. The ethnographically informed research however provides a back story to the SNA and the people involved. Greater detail about the research carried out in the educational studio appears below.

Ethnographic informed study of inter-disciplinary group project (see table 2 for more details)	4 students	6 weeks	• Video • Observations • Notes • Photographs
Social Network analysis of design studio group 1	20 students	2 weeks	• Questionnaires • Notes • Ad-hoc conversations (ranging from some people not saying anything during or after completing the survey, to having an hour long conversation with one woman in a cafe after they completed the survey.)
Social Network analysis of design studio group 2	11 students	6 weeks	• Questionnaires • Photographs • Notes • Virtual learning environment tracking data
Social Network analysis of design studio group 3	16 students	6 weeks	• Questionnaires • Photographs • Notes • Virtual learning environment tracking data

Table 1: Breakdown of case study 1

In table 2 a more thorough breakdown of the ethnographically informed study is given. The notes and transcripts from the video recordings are provided in appendix CD 1.

Session(s)	Date	Purpose	Equipment

1	10 February	Introductory session	-Digital Camera (still) -Notes
2	15 February	Precedence analysis	-Notes
3	17 February	Formal seminar	-Digital Camera (video) -Notes
4 - 7	17, 21, 23, 28 February	Informal meeting	-Digital Camera (still) -Digital Camera (video) -Notes -Dictaphone
8	1 March	Formal seminar	-Dictaphone -Notes
9	3 March	Studio session (full course)	-Digital Camera (video) -Notes
10 – 11	8, 10 March	Formal seminar	-Digital Camera (video) -Notes
12 – 13	13, 14 March	Informal meeting	-Digital Camera (video) -Notes
14	17 March	Final presentation	-Digital Camera (video) -Notes
15	17 March	Informal meeting	-Digital Camera (video) -Notes

Table 2. Breakdown of ethnographically informed study

The SNA questionnaires given to the students were based on a sample questionnaire within Robert Cross's (2004) book *The Hidden power of Social Networks*. This survey was used with some slight modifications to include specific questions about feedback. The questionnaire (which appears in appendix CD1 of this thesis) had three elements to it. Firstly general open ended questions required the respondent to list up to 8 persons who they felt gave them information, feedback and influence. The next section asked each respondent who, specifically from their course, they had sought for feedback and who had sought feedback from them. The second section also asked who they generally communicated with about their work. Finally the questionnaire asked them who, from their course, they communicated with about general information, who they were aware of and who they would like to communicate more with. Noting that in the first course, these last two questions were slightly redundant as the course were asked these questions in their final year and ultimately after 4 years together knew one another well.

4.3.2 Case study 2: the professional design studio

The professional design studio required a somewhat different approach than in the educational design studio, with some differences being practical whilst others more theoretical. In terms of the practical differences between the two sites, the professional designers were less forthcoming than their student counterparts. They had very little time to complete time consuming surveys (noting that the questionnaire given to the students took at least 30 minutes to complete). They were, however, more responsive as time passed and if the idea of the survey had been put to them at the end of the research they may well have been more willing. That being said, they were, in the most part, agreeable to being observed if it didn't interfere with their work. At the end of the study they were also willing to be interviewed (with a audio recording device but not video recorded). Other practical issues relate to assessment. The student design work was of course graded. In contrast there was no easily attributable factor that deemed a professional project as successful. Questions could have been asked whether the professional project was a commercial success, was it repeatable, good value for money, were the clients happy. All of these kinds of data were difficult to ascertain, needing a great deal of input from senior staff members and clients (who may be unwilling to divulge the information required). The ethnographical informed study in an educational context also informed research from the professional studio. Ethnographic research does not occur in a vacuum, the role, perceptions and biases of the researcher all have a bearing. This meant that lessons learnt from the educational studio were taken into the professional studio. For instance there was a framework (appendix CD2) applied to the professional studio which was not the case in the educational studio. Although this framework was intended to be open and allow for numerous notes to be written, it did mean that certain interactions between people were specifically noted.

From a theoretical angle, the professional studio case study attempted to move away from a two stage approach (surveys in one instance, and observations in another). The research in the professional studio was aimed at the ethnography leading the network analysis. In other words, the network being gleamed and transformed from the observational notes, as Johansen (2005) achieved with nomadic clans in Turkey. In contrast to observations being made and then questionnaires being given to qualify and to understand in more detail that which had been observed. Furthermore, the surveys allowed for a snap-shot in time, but the professional studio research sought to understand the dynamics of social networks in a design studio. These changing associations related to external pressures but also how influences that were specific to design and the design process. Although the educational studio and the professional studio cannot be compared like for like, the same research question was investigated in both as were the same research themes. In table 3 a breakdown of the research carried out at the professional studio is given:

Ethnographic study of professional studio	36 people	Approx 6 weeks (not including the ad-hoc days before the study started in earnest and some odd half days after the study)	• Network analysis based on observations • In-depth semi-structured interviews • Notes • Photographs

Table 3: Breakdown of case study 2

Session(s)	**Date (not including half days)**	**Location**
1 - 5	Ad-hoc days during	Old office location, mainly in the floor

	December, January and February	that house the ‘creatives’
6	6th March	Upstairs in the new office. Mainly graphic designers were located upstairs
7	7th March	Downstairs in the new office. Mainly interior designers and architects
8	8th March	Downstairs in the new office. Mainly interior designers and architects
9	9th March	Upstairs in the new office. Mainly graphic designers were located upstairs
10	10th March	Downstairs in the new office. Mainly interior designers and architects
11	15th March	Downstairs in the new office. Mainly interior designers and architects
12	16th March	Upstairs in the new office. Mainly graphic designers were located upstairs
13	20th March	Downstairs in the new office. Mainly interior designers and architects
14	23th March	Downstairs in the new office. Mainly interior designers and architects
15	24th March	Downstairs in the new office. Mainly interior designers and architects
16	30th March	Downstairs in the new office. Mainly interior designers and architects
17	31st March	Downstairs in the new office. Mainly interior designers and architects
18	3rd April	Downstairs in the new office. Mainly interior designers and architects
19	4th April	Downstairs in the new office. Mainly interior designers and architects

20	5th April	Downstairs in the new office. Mainly interior designers and architects
21	6th April	Downstairs in the new office. Mainly interior designers and architects
22	7th April	Downstairs in the new office. Mainly interior designers and architects
23	11th April	Downstairs in the new office. Mainly interior designers and architects

Table 4: More detailed breakdown of case study 2

In describing the two case studies and exploring the themes that were identified and investigated, an ANT framework put forward by Mcbride (2001) is used:

- Identify stakeholders (actors).
- Investigate stakeholders (actors).
- Identify stakeholder (actor) interactions.
- Build actor-network model.
- Identify irreversibility.
- Identify inhibitors and promoters
- Identify actions.

The two case studies contained intertwining of qualitative description and network analysis. The first two and fifth category (identify irreversibility) are discussed within the ethnographic stories. The other categories are addressed, in both cases, using SNA. Themes that were identified in order to be revealed using software tools, appear repeatedly between contextual observations and SNA.

4.3.3 Testing the software

After the case studies were completed, resulting prototype software was produced based upon the case study findings. This prototype software was then tested. Five designers were interviewed about the prototype software. The figure of 5 interviewees was decided upon as it would adhere to the argument Nielsen (1993) put forward, in which five is the optimum, most cost effective number to evaluate software. Of the five designers, one had a purely academic design background, one purely professional, the other three designers carried out a mixture of lecturing, and freelance design work. These designers covered both the educational and professional studios in which the software would be used. The interviews were semi-structured and the majority of conversations were through Skype (with the audio recorded). Analysis from the qualitative data and the views of the interviewees are grouped by key features. The interviews ranged in duration from 30 minutes to 1hr 10 minutes. The interviews began with a few questions about the designer themselves, their background, and experience of design teams. The second part of the interview related to the software specifically. Details of the questions asked are provided on appendix CD3. The aim of the interviews was to gain an understanding of key software features, how the interviewees interpreted these features, did the software represent networks within design studios in general and would the software be beneficial.

Conclusion

To understand the design studio, two approaches have been adopted, an ethnographic approach and a SNA one. The combination of these two methods aligns itself to a theory that needs both elements to make sense of a network of sociality like that in a design studio. The use of SNA and ethnography fits within the an ethnomethodological and ANT idea of:

> “a concern with how actors and organisations mobilise, juxtapose, and hold together the bits and pieces out of which they are composed; how they are sometimes able to prevent those bits and pieces from following their own inclinations and making off; and how they manage, as a result, to conceal for a time the process of translation itself and so turn a network from a heterogeneous set of bits and pieces each with its own inclinations, into something that passes as a punctualised actor.” (Law 1992 p6)

Essentially a combined methodological approach is used to describe the design studio (both professionally and educationally), and this is done to reveal the patterns of interactions and associations. Latour (2008) noted that

> “So here is the question I wish to raise to designers: where are the visualization tools that allow the contradictory and controversial nature of patterns of concern to be represented?... What is needed instead are tools that capture what have always been the hidden practices of modernist innovations: objects have always been projects; matters of fact have always been matters of concern. The tools we need to grasp these hidden practices will teach us just as much as the old aesthetics of matters of fact —and then again much more. Let me be clear – I am not advocating for another CAD design for Prometheus What I am pressing for is a means for drawing *things* together —gods, non humans and mortals included. Why should this prove to be an impossible task? Why can the powerful visual vocabulary that has been devised in the past by generations of artists, engineers, designers, philosophers, artisans and activists for matters of fact, not be devised (I hesitate to say restyled) for matters of concern?” (Latour 2008 p13)

This chapter has sought to justify the use of SNA and ethnographically informed techniques to understand peer evaluation and feedback in a design studio. It has also sought to position the research and methods used within wider sociological theories, particularly those that believe in describing the situation rather than explaining it. In light of this the following two chapters describe peer evaluation with both an educational and professional design studio.

5. Case study 1 – educational studio – contextual observations (ethnography)

Introduction

This first case study into informal evaluation occurs in an educational studio. To understand the social behaviour of students and the influences within an educational studio, a combination of SNA and ethnographic type observations are used. A case study is given of the studio (which always remained the same), with its various actors. Some of these were observed, some were interviewed, some completed questionnaires and others had photographs taken of their work. The framework and ordering of the research allows for the observations, ad-hoc interviews and photographs to be used to identify, investigate and understand the actors, their personalities and history. These descriptions are all written in an ethnographical first person style that refers to comments that were taken from my own first-hand experience. The first person style of ethnographic writing is a common approach, undertaken by numerous academics. One of these is the classic sociological text, *Street Corner Society* (Whyte 1943). Writing in the first person style allows for the researcher's voice to be heard and their impact and role in the research to be understood. In contrast, the identification of interactions, the building up of a social model of the studio, the inhibitors and promoters and the actions proposed are based on quantitative analysis and are written in the third person.

This case study is a narrative of a physical studio environment over four years, with three different groups of students, courses and projects existing within it. It does not present observations about every day of every month during those years, but insights at various points in time that reveal how students interacted within it. The research into the studio is a mixture of bounded survey results and reflective accounts with my own ethnographic take on the situation. Tedlock (2000) believed that personal experience is intertwined with knowledge and that ethnography is "located between the interiority of autobiography and the exteriority of cultural analysis" (2000, p. 455). I begin my story of the educational studio with my own reflexive account and my introduction to the studio itself.

* * * * *

I am not a designer. I come from a computing and social science background and as such I have undertaken an etic (outsider) view of the design studio. Pike (1967) coined the terms etic (outsider) and emic (insider) from his linguistic background in regard to sounds that do or do not have meaning to members of a given society. There is much debate surrounding the issue of etic and emic ethnographic perspectives (Headland 1990). Some claim that you can only really know if "you are one of us", you are an emic (Walcott 1999). However there is always a time when the insider was the outsider and everything was different. There is also always a point of transition, when the outsider becomes the insider. There is a case for an etic viewpoint though, particularly in the initial stages of ethnographic research. It can provide a fresh perspective, to see things innocently if you like. The etic researcher can highlight that which seems obvious to the insider. They can also make comparisons from the study to their own field of knowledge. I'm aware that being an insider gives a certain level of legitimacy to any claim, that insiders can justify what they see and observe with their own first-hand experience. This can also bring with it some biases. The insider can view the research with their own concept of what design is, the processes involved and the influences inherent, all of which might only be true for that researcher. I'm also aware that an insider's view may have a level of approval by the wider research community, which may or may not be legitimate. Law (1994) reminisces the following observation, which to some extent encapsulates the issue of the insider's view being accepted, sometimes without question:

> "I remember a member of the communist party talking about 'workerism'. Workerism is the uncritical acceptance of what a party member says because he has a correct class background. I paraphrase: 'You've got this room full of Cambridge professors, and there is this postman and every time the postman opens his mouth all the professors start nodding and agreeing with everything he says, even though it's a load of nonsense, because he's the only one who's a proper member of the working class'" (Law 1994 p39)

With this in mind, my research began nervously with my introduction to the educational studio being an empty space (perhaps this is analogous to my own research journey):

The B22 design studio was the setting for my first introduction to the project. The studio was empty when I first entered it, and the desks and chairs were arranged around the room, rather than in regimental rows. The room was also filled with work from previous projects. There were models and posters from previous years that dominated room corners and cupboards. There were also bits of card and material strewn around desks and shelving. It was in this setting that I was told about the Wembley project brief, the D&AD awards and the course in general.

My introduction to the students was in the same B22 design studio. This was the first formal studio time for the Wembley project. When I arrived in the room the students were already busy working. They had been given the task of creating a visual map of the world, which should take up the size of the room. The strewn material that had seemed so messy previously was now being used to make models of the Rocky Mountains and Great Wall of China. Predominantly British in origin, it struck me how extrovert the BDes students seemed as a group. They freely moved around and chatted with each other. They were friendly to me as well and while I set up my camera, they asked me questions and were inquisitive. The purpose of the virtual world was to facilitate conversation between the MSc students and BDes students and ultimately form groups for the rest of the project. The MSc students hadn't created the models and were exposed to the map and the BDes students at the end of the studio session. When the MSc students arrived they seemed a little hesitant. The newness of the studio, the course and large map of the world, seemed a little puzzling to them. All students were asked to stand on the map on a place where they had visited or wanted to visit. The students initially shuffled round nervously but then got into the idea. The room was very full and some areas of the map were very popular. The room bustled with conversation about where people had gone on holiday. I tried to make my way round the room but there were so many people that I become trapped in the Japanese corner.

5.1 Identify actors

This qualitative study was the first research study I had carried out, and was aimed at understanding an inter-disciplinary design project and the social influences involved. The project involved four actors: 2 MSc Multimedia and Interactive systems students (Mark and Jenny – not there real names) and 2 Design Futures students (Frank and Catherine – not there real names). These four students were the main focus for the observational aspect to my study into the actors involved during the design project. The research involved the entire duration of a project through all design process stages to complete an interactive installation for the Wembley Stadium Museum. The project itself is probably also worth discussing in more detail as it provides the context from which many discussions related. The brief for the D&AD interactive design – museum installation project was:

"Design an interactive installation for the Wembley Museum. Your concept will celebrate Wembley's rich and diverse history and present the new Wembley as an iconic landmark to inspire the next generation of fans and host the world's greatest players. This interactive experience should juxtapose a glorious heritage with the venue's future potential in a unique and engaging format.
Your design should concentrate on either:

1. The look and feel for the on-screen interfaces for the interactive installation. Focus on the users' interactive journey – how they explore and navigate, source and reveal past achievements and access information relating to future developments and events. When the installation goes live it will need to present a wide range of visual materials, including the new branding, both archive and current video and photographic material, audio clips and flat graphics. Your design should therefore be aesthetically engaging as well as simple and intuitive to use.
2. An integrated approach – how the interface will actually relate to the physical form of the installation. Your concept should take into consideration:
    - the physical structure and context of your installation and how this will impact on your screen-based design
    - the number of users who are able to use the exhibit at any one time – how will people interact with it?

Any graphic content within your design should reflect, where appropriate, the following elements from the new Wembley Stadium brand identity:

- The brand mark
- The brand values
- Tone of voice
- Colour palettes
- Typography"

The project meetings occurred in many different locations (many of which were video-taped and transcribed – see appendix CD1). The informal meetings of the project generally occurred in a University cafe, the formal meetings and critiques with lecturers occurred in the a University meeting room (referred to as the glass box), with some joint sessions occurring in the University computer lab and in the undergraduate studio. All individual sessions with just the design students all occurred in either the computer lab or studio. There were also occasional encounters and conversations in corridors and bars. All of these locations had some agency and influence over the team and their project. I had already couched my literature research in terms of a social constructivist model of design, and as a consequence of which it meant I sought to describe only the impact these locations had upon the social dynamics and the interactions.

The research into the inter-disciplinary project can be considered a micro study from a wider educational studio. The two students that I shadowed made numerous references to their course mates and had many conversations with people within the studio (many of which I was privy too). The entire course (including the 2 design students) from the Design Futures course were all subsequently given SNA questionnaires and participated in ad-hoc interviews while they completed their survey. A full list of all these actors is featured in appendix CD1.

5.2 Investigate actors

5.2.1 Frank and Catherine

Only Frank and Catherine from the Design Futures design course were shadowed, as it was my intention to have a very focused in-depth understanding of what they did as designers and how they were socially influenced. It was also impossible to study all of the students, all of the time. A caveat to the observational aspect to the research is that it concentrates on two individuals and how only they inter-relate to their project team and the studio as a whole. The emphasis of the field work is placed on the two design students, although the two MSc students Mark (mid 20s from Northern Ireland) and Jenny (early 30s from Scotland) are integral to the project.

The two design students were both from Scotland, with Catherine being 20 and Frank 19 at the time of the study. Both Frank and Catherine were outgoing and friendly. I had been advised to work with them because they were easy-going, popular and had also achieved relatively good grades in previous years. Both students were well-liked by their course mates and Frank spoke regularly to nearly everyone on the course. To understand Frank and Catherine's relationship it is worth noting that Frank and Catherine had known each other for three years prior to the inter-disciplinary project. The two students were close, and they had of course chosen to work together. They also socialised together (along with other members of the studio), and I often had the impression that they had discussed and progressed their work outside of normal university hours, when I wasn't around. Mark and Jenny were similarly close, they had also worked together on previous projects which resulted in banter, "in-jokes" and references about past work:

*Student **M:** Then I'm going to get into scenario and talk about future developments and what we could have done and then I was thinking we could put in our logo, rocket media productions.*
*[Student **M** and **J** laugh]*
*Researcher **S**: Are you trying to do a spin off company?*
*Student **J**: No, one of our other projects we have to urm…make a dvd from video and we've called ourselves rocket media productions and we've already got a logo.*
*Researcher **S**: Oh right*
*Student **J**: It's a flash logo with a rocket*
*Student **M**: It looks really good*

The student pairs were very relaxed in each other’s company and often interacted in friendly teasing. The following quotes are taken from one of those informal meetings between the post-graduate students:

Student ***M:*** *And then Jo’s going to get up and show what software packages we use*
Student ***J:*** *I should show it working, should show the thing working. That’s going to take…*
Student ***M:*** *We’re just….. I’m speaking….. jesus… you’re terrible for that*
[laughter]
Then later…
Student ***J:*** *Yeah, I was speaking*
Student ***M:*** *Eh? I know but you’re always speaking … I’m kidding*
Student ***J:*** *That’s on camera… see the abuse I have to put up with. The design students are lovely but he’s a pain in the neck.*
Student ***M:*** *I’m lovely too*

5.2.2 The team

The four group members worked well together and enjoyed each other’s company. During one informal meeting when only the masters students were present, it was asked how they thought the project had gone. Amongst other remarks, one of the MSc students commented:

Student ***J:*** *We’ve got on really well with the design students, as they’re really good students and we really like them.*

Analysis was carried out on the input each team member contributed during two particular informal meetings that were video-taped. One meeting was held in a meeting room, the other in a café. Figure 18 shows the meeting room analysis and figure 19 shows the meeting in the café. These two meetings were chosen because only the four-team members were present for the meeting duration (and there was no outside influence from other students or tutors). To achieve the figures below (figures 18 and 19), the number of comments made by each individual were counted.

It should be noted that the amount of time spoken per comment is not reflected. It could easily be the case that a student may speak infrequently but at great length. The figures 18 and 19 below also do not reflect the quality of that which was spoken. Some people may speak less but have more influence.

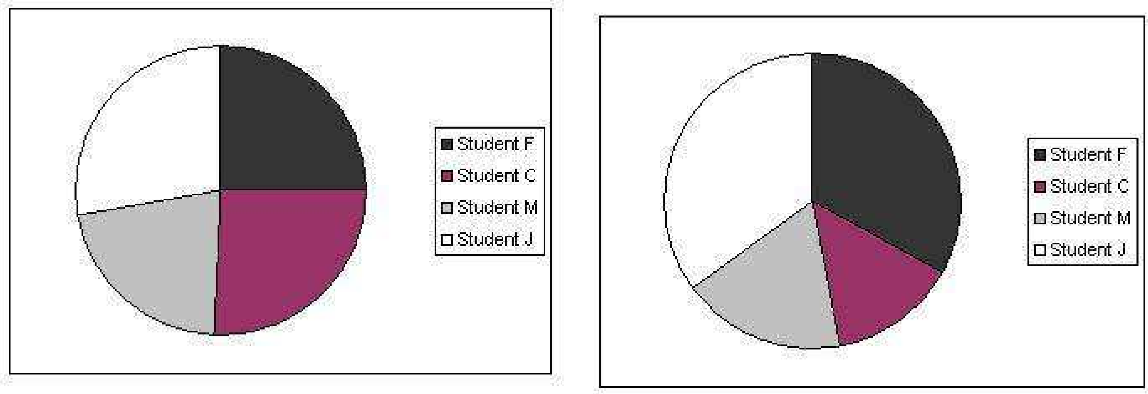


Figure 18 and 19: Student Input (Table1: Session 4) and (Table 1: Session 9)

Figure 18 shows that there was almost an equal level of input from all four students. However ten days later, in figure 19, there is a shift in input levels, with student **J** and **F** inputting more frequently into the discussion. On reflection, this second trend was generally observed for the rest of the project. Perhaps this trend would become more so, as time passed on the project and people became more comfortable in the team.

5.2.3 The studio

During the inter-disciplinary design project, Frank and Catherine received influence from a myriad of people, most prominently from the other members of the team but also from their university lecturers, family and friends including their course peers. All course students viewed and analysed each other's work and provided verbal feedback both formally and informally. The precedence analysis session, for example, consisted of students presenting their research to the course as a whole. The course students commented on and noted the work of others. I was quite struck by the level of informal reflection that occurred in the design studio. My own personal background from outside the design domain had not previously encountered the level of group reflection that occurred in the studio (and sometimes also in other situations). The students regularly referred to their course-mates' research, particularly that shown in the precedence analysis session. The following excerpt is taken from an informal meeting with all four team members and refers to a website shown during the precedence analysis:

*Student **F:** Like what was that thing like that student N…*
*Student **C:** That was amazing, I don't know. We'll try and get the website. It was an introduction to a design company on a website and it was like a film, it's just…*
*Student **F:** It was like a trailer*
*Student **C:** For a film and everything happening*
*Student **F:** It was like surround-sound like this [student wildly moves his hands around]*
*Student **C:** Coming from these two little speakers*
*Student **F:** It's on a website yeah. I'll try and get it. I can text it*

Catherine and Frank often asked other students in the studio for their opinion on their work. The following excerpt is taken from the studio session shown in figure 21 where Frank asks another student (James) his opinion on their project's title:

*Student **F:** A day in the game, but what do you think it is if I say 'a day in the game'*
[Another course student, James, replies but the audio is not picked up on the camera]
*Student **F:** Yeah that's it*
*Student **C:** It's a league table*
[The other course student out of shot from the camera]: I kind of had an idea
*Student **F:** I know, should I ask someone else? But I mean, I think with the visuals though. You know like by saying 'a day in the game' you're going to be in the game.*

Figures 20 and 21: Design students working in the studio 1 and 2

Catherine and Frank assessed their work against that of their course-mates. There were many occasions when they made reference to their course-mates and how they are judged and how they judge their course-mates' work. In one particular instance Frank and Catherine felt that students **J** and **A** both knew a lot about the subject matter, namely football, with the implication that their work will somehow be superior because of that prior knowledge.

The participant team, as a whole, compared their work to other teams in more complex social scenarios. Some of the references to other students related to people from the other course that Frank and Catherine knew. Other comments related to the interplay of other team membership based on their knowledge about the design student members of the team. There were also discussions about personalities from one course and the influence they had on the other course and other team in general. The following is taken from one informal meeting with all four team members present:

*Student **J:** Do you remember student L saying he thought he was meeting his students*
*Student **M:** I just walked past on the way back from having coffee and there are two design students so obviously one of our group didn't even turn up.*
*Student **F:** That's the thing we were only told yesterday*
*Student **J:** Because our lot didn't know, student L didn't know that he was meeting his ones*
*Student **F:** One of our groups got told by one of their girls that today doesn't fit in*

with their timetable so she won't be able to make it in time.

Catherine and Frank had a strong relationship with their other classmates, often meeting with them socially during evenings and weekends. Cliques within the courses were identifiable and the participant students went to lunch with the same sub-group of people. These cliques and sub-groups also played an important role in judging and assessing how well Frank and Catherine's team were doing in relationship to their peers from their clique.

During the field study of the inter-disciplinary team, issues came to light concerning the design course as a whole. It became apparent that there were divisions within the course, and these were visibly apparent by where students chose to sit. There was a "den" where only certain individuals "hung out" and this group formed a distinctive clique. Frank and Catherine, although not the most dominant members of the group, were loosely part of this clique.

This brings me to the physicality of the studio itself. Some mention of the room was made in the arrival story to this ethnographic research. The studio was a large open room that had a mezzanine floor (I didn't discover the original purpose for the mezzanine floor). This floor "den" separated the course of 20 into about 6 or 7 people (the clique) who sat for informal chats in the "den" and those who didn't. The studio also had sink area at the back of the room and one computer terminal. This computer was generally used to search the internet for quick answers. Most students, if they wanted to carry out in-depth computer based work, went to the University's computer lab. There were times when Frank and Catherine did exactly that. Moving from the studio to the computer lab for about half an hour and then back to the studio again. In a way, this stalled the feedback process. Students left the social atmosphere of the studio and went to the computer lab (a room with hundreds of computers with people from various course disciplines). While in the computer lab, Frank and Catherine didn't have their immediate peers sat beside them to aid them in discussing their work.

5.2.4 Outside the studio

The course tutors and lecturer often frequented the studio and so could arguably be considered part of the studio themselves, however the research refers to the studio as the Design Futures course participants. That being said the course tutors had an influential effect upon Catherine and Frank's work. Each week the students' work in progress was critiqued. A critique session is shown in figure 22.

Figure 22: The team participating in a critique session

The project was directly affected by these tutorial seminars. For example, the first tutorial seminar had all four students present with one of the design tutors. The tutor advised the students that a certain approach they were considering (augmented reality) might be difficult. The following excerpt is taken from that seminar:

Student ***M:*** *Ours is Future Media. So we started looking at stuff we can use for the future. We found a thing called Augmented Reality. [print outs about augmented reality are handed round]…. If you read through this [the print out] it will give you a brief idea.*
Student ***J:*** *The idea is to mix the real and virtual world. The examples that exist in museums that have show pieces and show cases. You can animate/activate them with this.*
Tutor ***P:*** *What about, um… have you read the brief and then read the brief and then read the brief again? Do you think…*

*Student **M**: What brief? The coursework support?*
*Tutor **P:** The brief for the project, for the Wembley stadium. Do you think they're looking for a VR solution or type of solution?*

After the seminar, the students had an informal meeting where the design students, those directly assessed by the seminar tutor, would not consider the augmented reality suggestion even though they personally expressed an interest in the idea. The following excerpt is taken from a follow up informal meeting later in the project :

*Student **M:** Did you read up on AR?*
*Student **C:** Yes I did*
*Student **M:** Did you read up on the stuff [student M shakes his head], tut, tut. They wouldn't even do one thing for us [said in jest].*
*Student **C:** The notes that you gave student F? I think it is good but I still… we should look at other things.*
*Student **M:** I think tutor P scared you off*
[student C nods her head]
*Student **C:** I believe if my tutor tells me it, I'm going to go with it as they're the ones who are marking it.*

To resolve issues, the students used the course tutors. In a studio session, for instance, the design students **F** and **C** discussed whether or not to include some photos. One student thought they should be included, the other thought they shouldn't. The following excerpt is taken from that session:

*Student **C:** Yeah, I just didn't like the pictures*
*Student **F:** We'll agree to disagree at the moment*
*Student **C:** Yeah*
*Researcher **S:** What do you do when you have conflicting, well not conflicting but…*
[laughter]
*Student **C:** We compromise*
*Student **F:** Yeah but we try and work it out, but I'm just not prepared to give in at the moment*
[laughter]

Student ***F:*** *I think when we say to tutor P or something*
Student ***C:*** *Yeah*
Student ***F:*** *But my ideas are generally better*
[laugher]

Indeed in the following formal seminar the issue arose and the question put to one of the tutors:

Student ***F:*** *Yeah I like that, but student C doesn’t. I’d quite like to do a group photo so they can see themselves next to their team name.*
Tutor ***I:*** *Maybe, maybe not. How do you find out whether that’s going to work or not for this project?*
Student ***C:*** *Some people may not like having their face plastered on a big screen.*
Student ***F:*** *Yeah*
Tutor ***I:*** *That’s an argument. How do you find out whether that’s true?*
Student ***C:*** *By asking people*
[Tutor I nods]

Friends and family were also used as a sounding board, such as testing concept ideas and presentations. Both design students referred to running their ideas and presentation past their friends and families. The approach was actively encouraged by tutors, and the following comment is made during a formal seminar:

Tutor ***I:*** *I would get these boards when you put them together and get some random punter who will sit and say ‘right what’s this?’.*

Friends and family also offered sources of knowledge. The following comment is made during a café meeting:

Student ***C:*** *I was speaking to my cousin at the weekend and she’s a high school teacher and they’ve got these things now, like blackboards, called smartboards. And basically you can type into a computer and move it around on the screen which is quite simple. So we researched that.*

Family members and friends, external to the course, were used to impart feedback. They provided a “fresh pair of eyes” and would view the work without knowing the project very well. In the studio session, both design students phoned their friends to ask them questions that directly related to their concept:

*Student **F:** When you’re doing design it’s quite good to get other people’s opinion. Some people think that design can be quite daft. You know like my mates are always saying ‘you look at things from a different point of view’. But they look at things from a different point of view from me. So they say you should do this and it’s a brilliant idea*

Similarly, in one informal meeting, Jenny commented that she was going to take her children to a museum to experience some of the interactive installations. One of the comments that student **J** made appears below:

*Student **J:** We’ll take them to the science museum on Saturday and we’ll see how they find it. They just love places like the discovery centre. We’ll do that and that will give us some ideas and we need to think about the interface again and we’ll look at some websites and see how we can get that interface*

It was clear that the students referenced family members to envisage concepts from different perspectives. Be it their children, as in the case above or their mothers. The case below refers to wearing a head-mounted display, part of a discussion in one informal meeting:

*Student **M:** I think it would be very popular*
*Student **J:** There are quite a lot of adults that wouldn’t do it*
*Student **C:** My mum wouldn’t do it…*
*Student **J:** Older people*
*Student **C:** It would mess up her hair*

To summarise this section:

- The impact of location and the bearing this has on the sharing of feedback
- The influence of friendship groups upon the designer

- Has shown the changing inter-disciplinary team situations, sometimes not with the full complement of students and increasingly centred around the patterns and personalities of team members

5.3 Identify irreversibility

When reflecting on an ethnographically orientated study with the four students, the passage of time in which the Wembley project took place can be seen as a series of instances which link together to form a story. In terms of the Wembley project, there is a clear demarcation of beginning, middle and end. In the context of an ethnographic study, this ending point is somewhat more difficult to define and of course there is “prequel”, the history behind the story. Prior to the research the two courses, MSc and BDes, were unknown to each other and they met as strangers. The two students from each course had their own history, projects they had a worked on, references and “in-jokes”.

The project was aimed at the D&AD awards, a design oriented honour. All of the students were aware of this, and the design students were particularly responsive to how their project would be perceived by the D&AD judging panel. They were also aware that previous inter-disciplinary projects from this module had been very successful, winning numerous D&AD accreditations. Through the design process, the design students looked through the work of previous D&AD winners in the published award proceedings. This ultimately had a major impact on the design work that was produced, as there was always an undercurrent of attempting to generate an end product that was in keeping with previous D&AD winners. Another influencing factor was the previous experiences of the team members. The two MSc students had completed university degrees, gained employment and then returned to full-time postgraduate education. This gave them a different take on the project. They were not so interested in winning design awards (although this would have been a nice bonus), but wanted transferable skills which could be used once their course was finished.

Collaborative projects, particularly involving people from different academic backgrounds tend to be very socially complex. The collaborative design project discussed here reveals multiple social influences. Each individual team member, for example, brings to the table a network of social factors that have a bearing on the work produced. Figure 23 shows the network of connections between students, their course, tutors and peer group. It can be seen that the MSc students mixed with the friends of their design teammates, but the reverse was not the case.

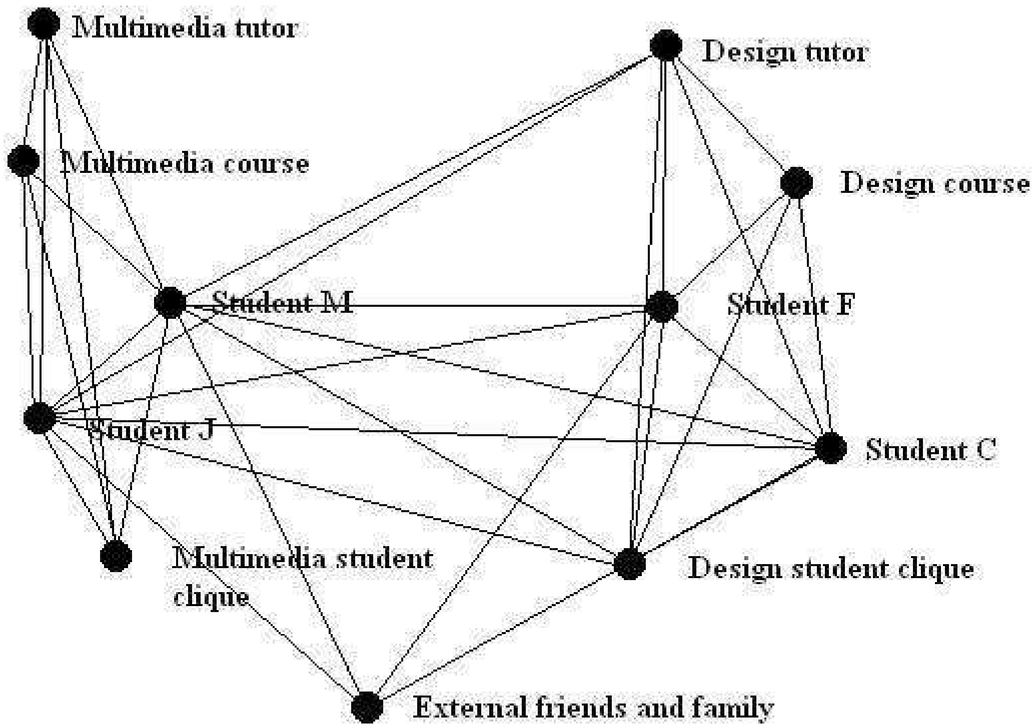


Figure 23: Connections between people and groups

Looking back on the Wembley project, the team were clearly influenced by each other, their tutors and family and friends. It is an open question whether the collaborative inter-disciplinary group was more effective in completing their project than an individual designer or a team of designers from the same discipline. Regardless of the creativity or output to the project itself, the benefit from this type of team is that a connection was made between individuals. A few weeks after the project had finished I bumped into Frank in the D36 Digital Media Laboratory. I was pretty surprised to see Frank in there as the lab was very much the domain of the MSc Multimedia students. We had a chat about what he’d been up to recently and I asked him what brought him to the Digital Media Lab. He replied that he was editing some video tapes for his new project and the MSc students were helping him with the Final Cut Pro software.

The social connections made during the Wembley project lasted beyond the scope of the project. Each team member's skills were being tapped into for future reference. Each inter-disciplinary team (assuming they worked well together and were friendly) increases the number of social connections an individual team member has and the number of resources available to them.

The history behind the courses in question can be seen as inhibitors or promoters. For example, the perceptions of tutors towards certain technology, and the resulting lack of acceptance. The precedent of the D&AD awards also influenced the design decisions made by the two students. Of course nothing can be produced in a vacuum and there will always be a history that will support or disagree with a certain choice, thus supporting the social constructivist stance of this thesis.

In summary of this section:

- It has discussed the role of pre-existing knowledge and context, and the impact of historical social influences.
- Shown the evolution of the network, how formal social connection remain and become strong informal friendship connections

Conclusion

The contextual observations of Frank and Catherine and the inter-disciplinary design project they were involved in, has shown the social influences faced by the two students. The project's status as a team project meant that it was going to be socially influenced in some way. Frank and Catherine had their own personal history of knowing each other prior to the study. They then had a social team setting of two other MSc students who also knew each other before the study. These two pairs with pre-existing backgrounds came together to form one project. The dynamics could easily have been "them and us", but in the study I carried out, the team were very cooperative with each other.

Frank and Catherine also had social influences from their tutors and their peers in the studio. Existing friendship groups had a bearing, although Frank and Catherine sought feedback from a wide range of peers but particularly those who sat close to them. These informal feedback conversations only occurred in the studio setting and not in the computer lab. Wider social influences were also apparent, Frank, Catherine, Mark and Jenny frequently referred to friends and family as sources of information, inspiration and reflection.

To strengthen the general understanding of the social influences of the studio upon designers, the following section relates to the Social Network Analysis surveys that were given to the course as a whole. The observations from the field study related to just two designers and as such the views of the course as a whole needed to be taken into consideration. The ethnographically informed research informed the structure of the social network analysis. The SNA questions were specifically asked to each individual design student and they were asked about each of their fellow students about their feedback sharing relationship.

6. Case study 1 – Educational studio - Social Network Analysis

Introduction

The evaluation and judgement of Frank and Catherine’s work by their course peers became the central argument of this thesis and a concept that fundamentally informed the Social Network Analysis research. The questionnaires given to the entire Design Futures course asked each individual to identify those fellow students from their course who they sought feedback from. This survey was replicated and given to the Design Futures and Consumer Product Design courses the following year. The work of this same group was also uploaded to a Virtual Learning Environment (VLE) and the viewing tracking patterns also used for network analysis. The three different survey responses were then analysed to understand the shape of the informal social networks in the studio.

6.1 Identify actor interactions

The following analysis is based on survey data taken from three different student cohorts. The first survey was carried out in 2006, with surveys 2 and 3 were undertaken the following year. All three surveys were completed by students from the same academic institution. The students who completed survey 1 were self contained. However, those who completed surveys 2 and 3 were very much inter-connected because their major project was carried out as a combined group. Consequently, they can be considered inter-disciplinary and the analysis is shared.
The following analysis is based on three areas of the questionnaire:

- Communication (non work related) between students,
- Work related information sharing between the students
- The sharing of feedback.

The latter of these is dealt with in more detail as it is the central argument. Comparisons are made between the three networks and in relation to open ended contextual questions that were asked at the beginning of the questionnaire.

6.1.1 Descriptive data

The students who completed the survey are described in table 5. It is worth noting that the students in question are not all following the Design Futures course. Furthermore, the numbers for each course are different and the ratio of males to females is quite different in each group. This has some bearing on analysis, as like for like cannot be accurately compared. However the difference in discipline is not considered an issue as the students are in the process of completing their final year project, and these projects are not specific to either the Design Futures discipline or Consumer Product Design discipline.

	Design discipline	**Year**	**Number of students**	**Gender**
Survey 1	Design futures	4	20	13 females and 7 males
Survey 2	Design Futures	4	12	6 females and 6 males
Survey 3	Consumer Product Design	4	15	5 females and 10 males

Table 5: Descriptive data for each survey given to case study 1

6.1.2 Open-ended questions

The first two questions of the survey were open-ended. Students could list any eight individuals who they felt provided them with influence and feedback about their work. These questions were posed to provide comparison to the closed questions that were asked later in the questionnaire and that involved a specific set of individuals. The initial questions also provided context to the concept of feedback and reflection. The open questions were designed to show who was important to the student and hopefully give weight to the argument that student appraisal was integral to their work.

6.1.2.1 Influence

Figure 24 shows the groups of people who are important to the student designers in terms of looking at their work or projects. This includes people that students may not communicate with, such as famous designers and people inside or outside the discipline or subject. The students rated designers and other creative individuals as the most influential. This group consisted of famous designers but also singers, actors and artists such as Banksy. These references were pooled as there were a huge range of individuals who could be deemed “creative”. However the concept, influence and significance remain the same. This influential group was quite an expected result. The second highest group of individuals who provide influence were friends. The students listed more friends than they did lecturers or even the work of previous students from other years. This reveals the importance of peers to the work of student designers.

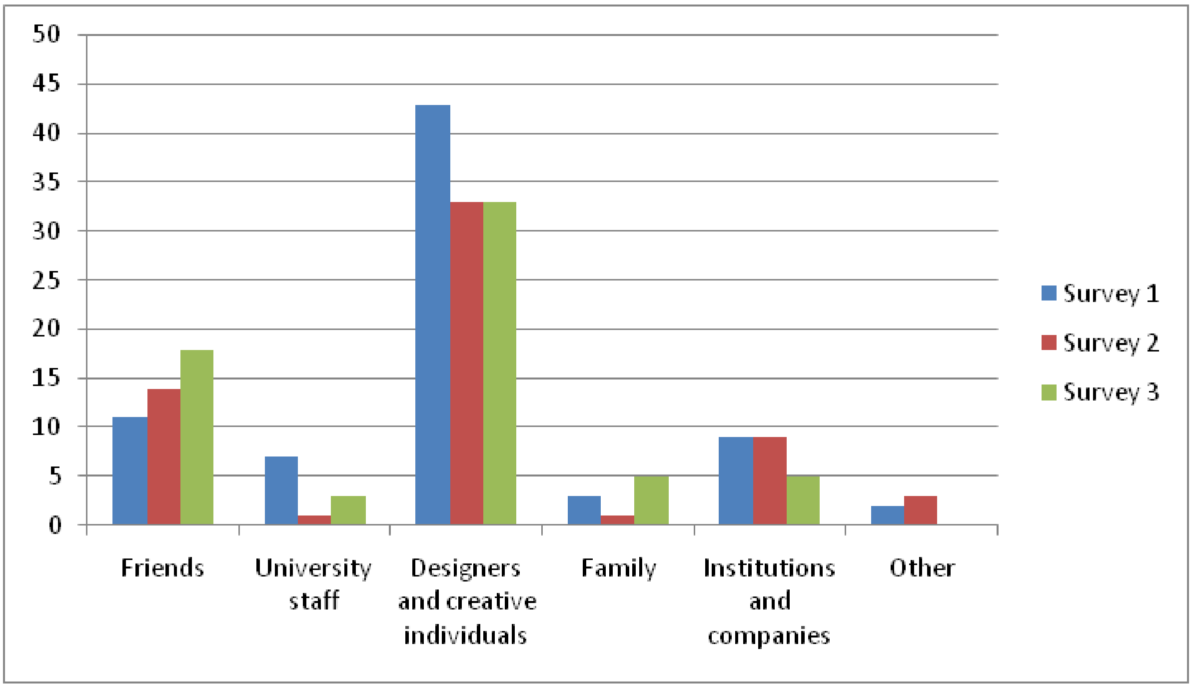


Figure 24: Influences to student work

6.1.2.2 Evaluation and feedback

Each student was asked to list people who were effective at providing them with feedback and evaluation. Figure 25 shows that students felt that their course mates provided them with more effective feedback than any other group. Notably students gained feedback from their course peers above that of their lecturers, even though students participated in regular formal critiquing sessions with their tutors. Figure 27 shows the importance of peer feedback and that it should be studied in detail. This should include understanding the impact it may have, particularly on the grade of a student.

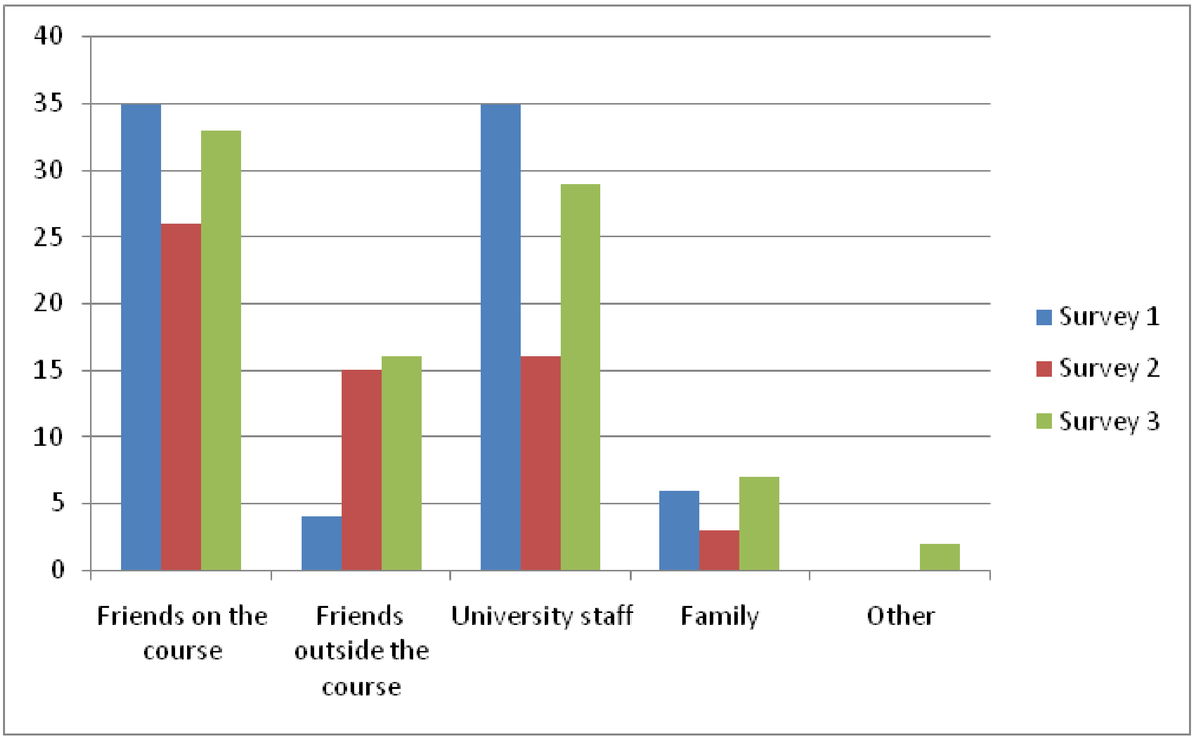


Figure 25: Who gives feedback to a student's work

6.1.2.3 Communication

After the open-ended questions, the students were asked to rate each of their course peers from 1 (never) to 5 (several times a day), for how often they communicate with their peers, receive work-related information from, seek feedback from and are sought for feedback. The networks that are discussed show relatively close connections, in that links are only shown if a certain person has rated another 4 or 5. This decision was based on the fact that all students would have some knowledge of all others, so only close connections are really of note (loose connections would, at best, only relate to occasional interactions)

Figures 26 and 27 both show the communication network for each group. It shows that in survey group 1 there are fewer connections to one another than in group 2 and 3. At the very least this shows that group 1 is less communicative than groups 2 and 3. It may also imply that they are not as friendly to each other. Considering that group 2 and 3 had only been brought together in their final undergraduate year, this may seem surprising. However qualitative evidence supports the fact that group 1 had some hostilities to one another. Although in terms of information sharing (figures 28 and 29), this hostility is not so present and both group 1 and group 2 + 3 are quite similar in their relatively high density. Perhaps students in group 1 are more selective about who they generally chat to, but in finding out about certain work related information, such as when a piece of work is due in, they are willing to talk to many more people.

Figures 30, 31, 32 and 33 show the feedback/appraisal networks for each group. The networks show in both group 1 and group 2 + 3 and for both seeking and being sought for feedback, that students are much more likely to be negative about their peers (compare figure 33 to figure 34, for example). The low rated network for each shows students rate 1 (never) or 2 (rarely) out of 5 for many of their peers (figure 34). It seems surprising that in a group of 20, there are many students who do not speak to their course at all or only infrequently. In comparison the high rated networks show far fewer people rating their contemporaries highly. This reveals that students are very selective about who they choose to give and receive feedback to and from, which has connotations of close connectivity and trust.

The visual network in figure 35 reveals how students in groups 2 and 3 view other students' work. Although they are not giving feedback explicitly, they are in a sense placing their own work in relation to other's that they have seen. It is therefore an aspect of the reflective process but a much more subtle one. The visual network in figure 35 is far more evenly spread and there are far more connections. It is proposed that students are far more likely to view their fellow students' work, particularly those students they don't know, when they do not need to interact. Again this relates to the idea of trust and the impact it can have upon students giving feedback and considering each other's work.

The low density figures of the highly rated people in the feedback network can be explicitly seen in table 6. Table 6 shows that communication has the largest number of connections whilst seeking feedback has the lowest. It is this small number of connections between people who share feedback that is ultimately explored in more detail. The following research aims to understand the impact a tight knit group of peers who provide feedback to a student has upon their design work.

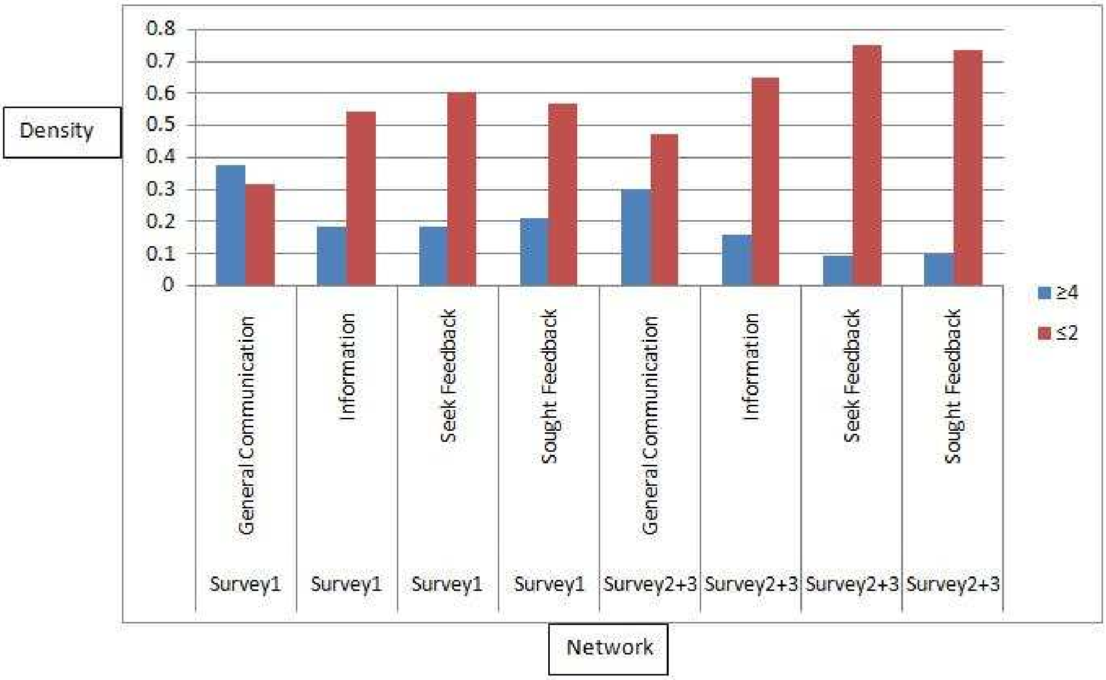


Table 6: Network densities for all survey questions

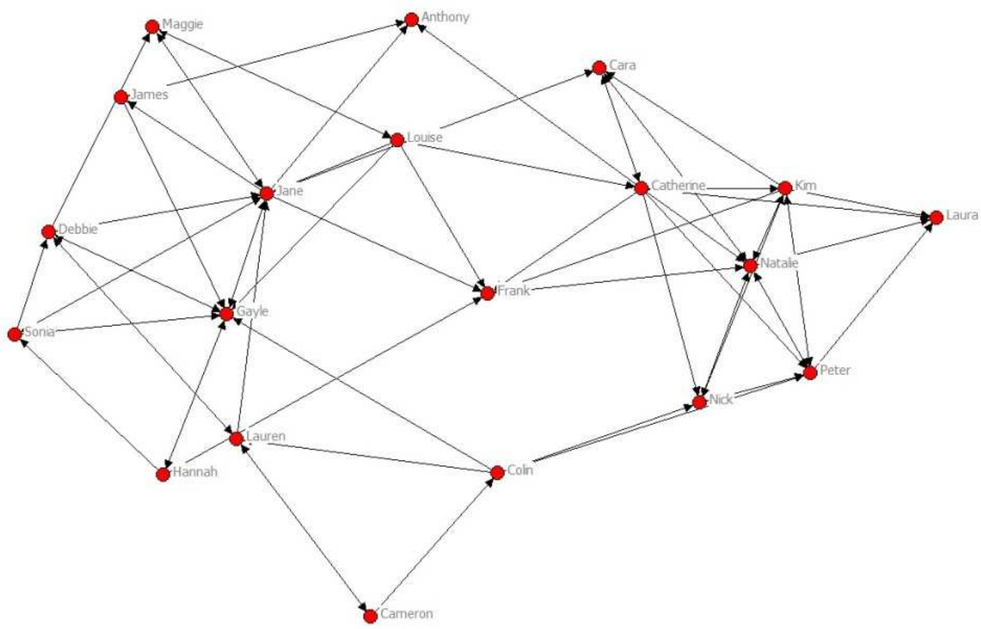


Figure 26: Communication network of survey group 1

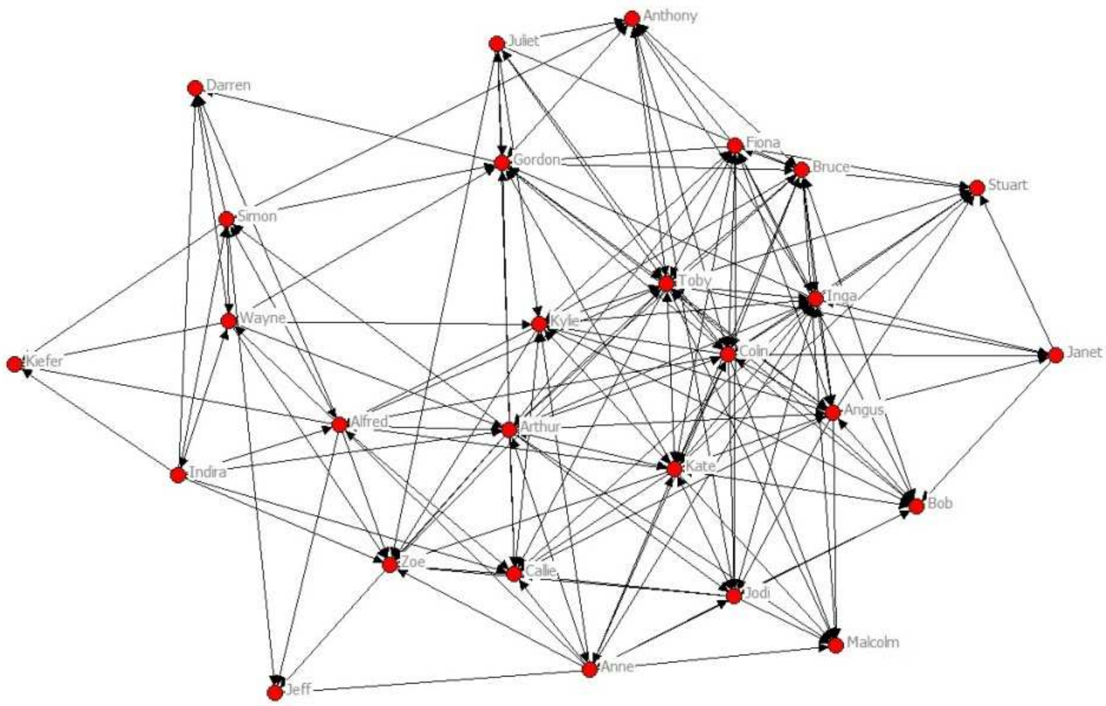


Figure 27: Communication network of survey group 2 + 3

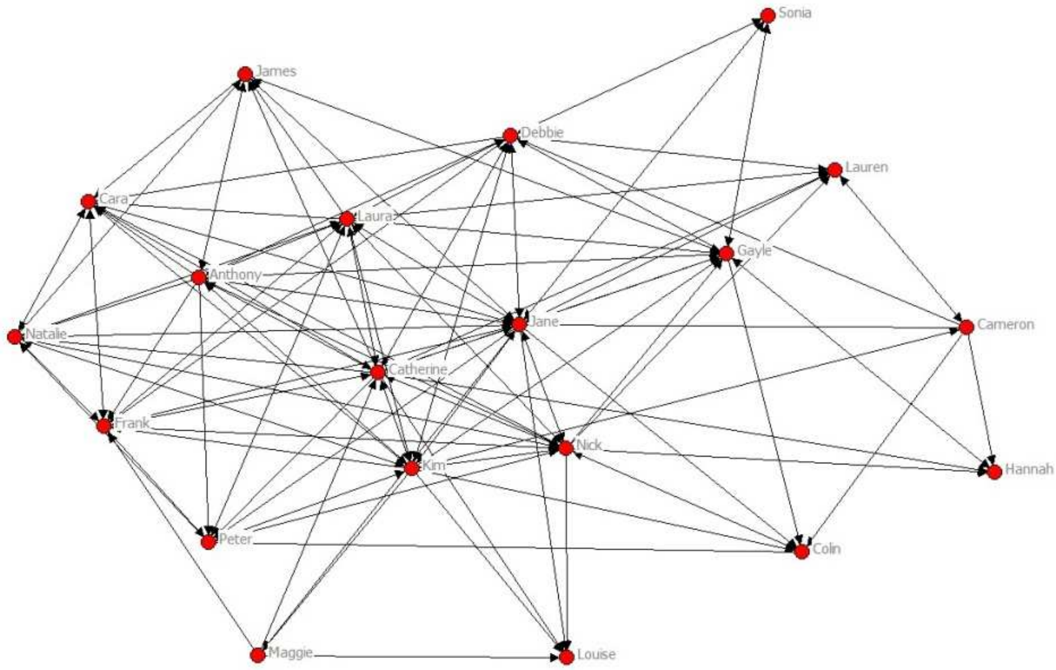


Figure 28: Information network of survey group 1

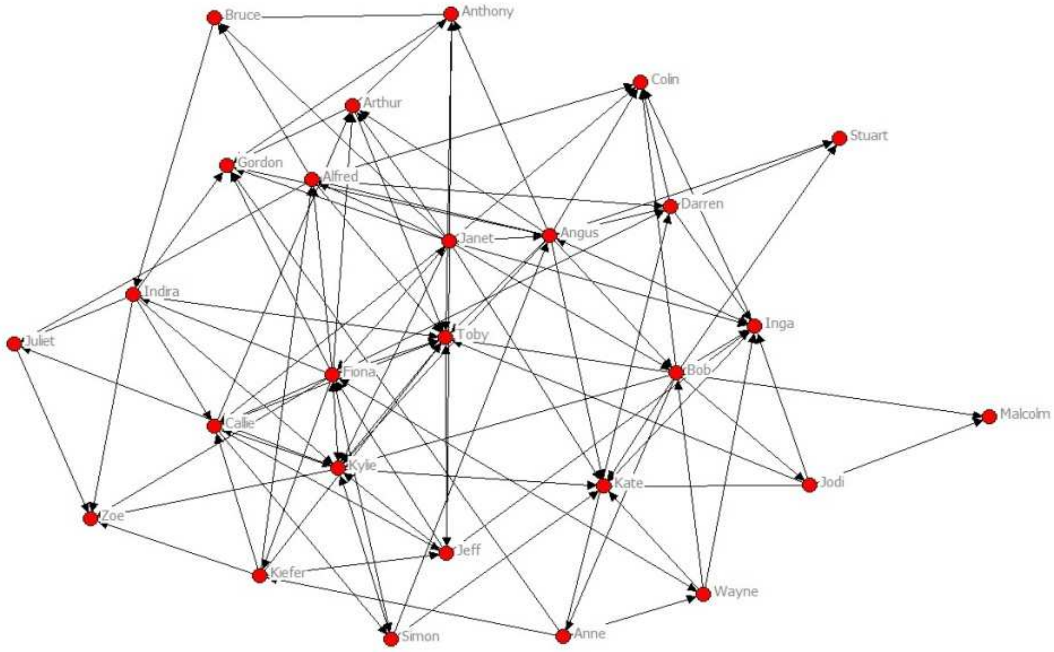


Figure 29: Information network of survey group 2 + 3

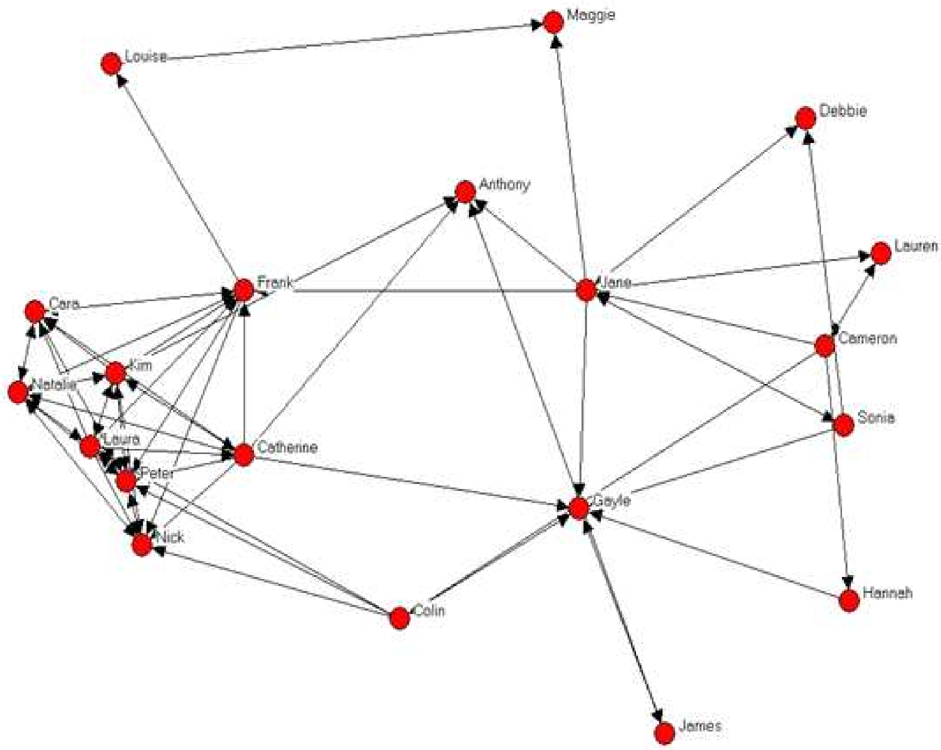


Figure 30: seek feedback network of survey group 1

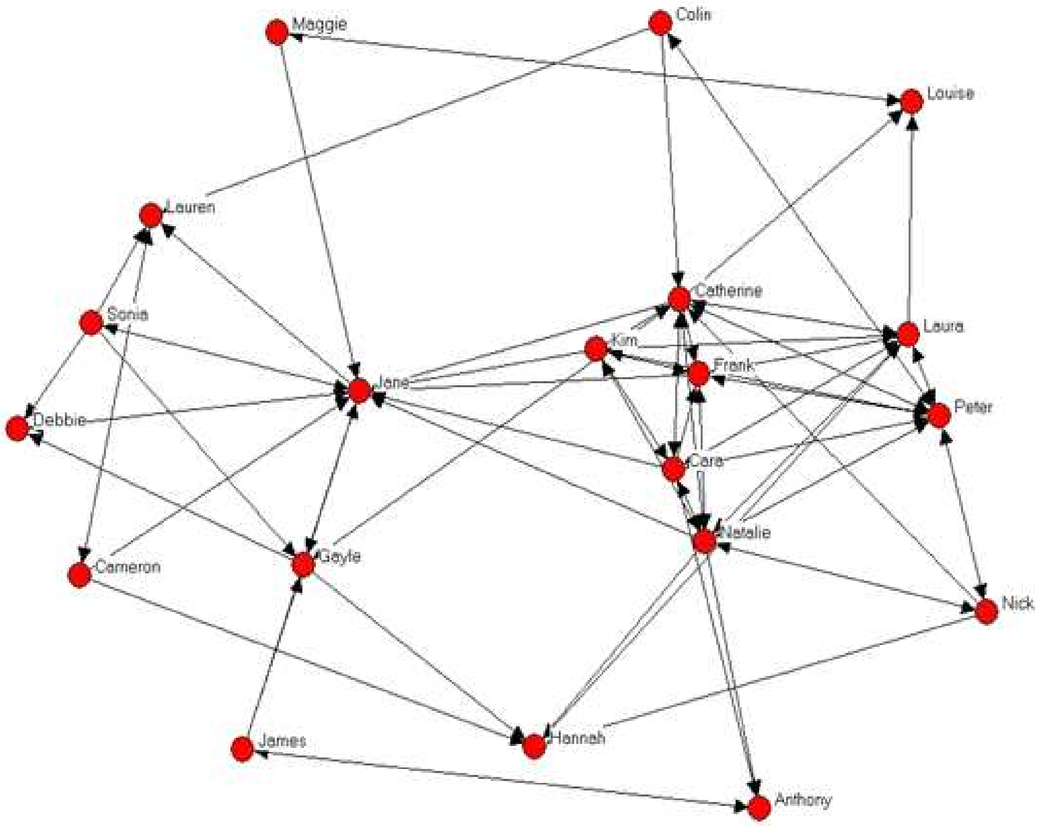


Figure 31: Sought feedback network of survey group 1

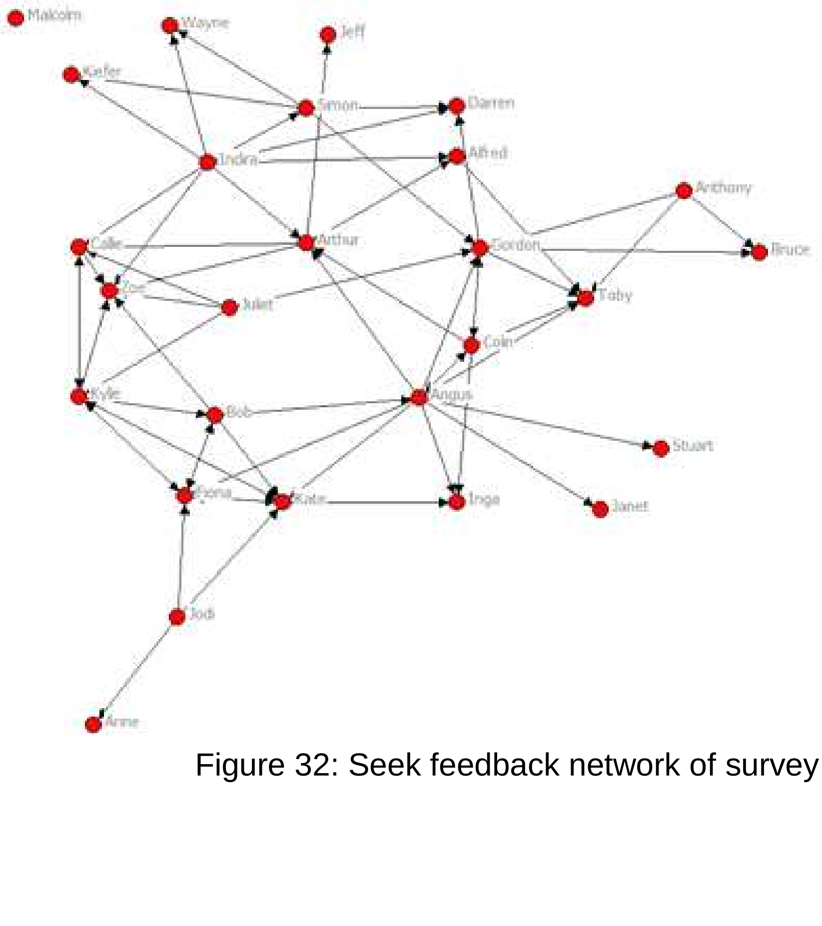


Figure 32: Seek feedback network of survey group 2 + 3

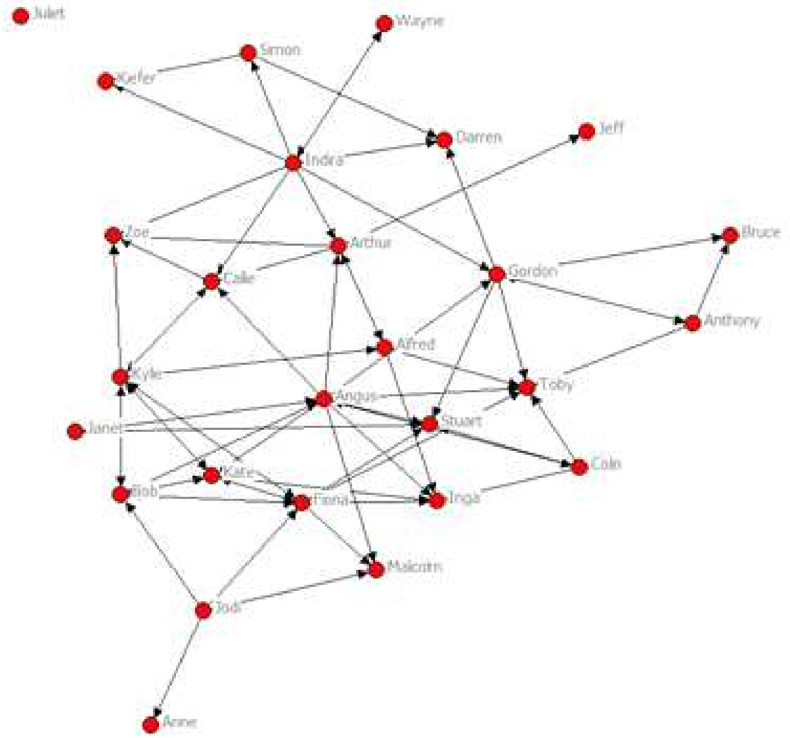


Figure 33: Sought feedback network of survey group 2 + 3

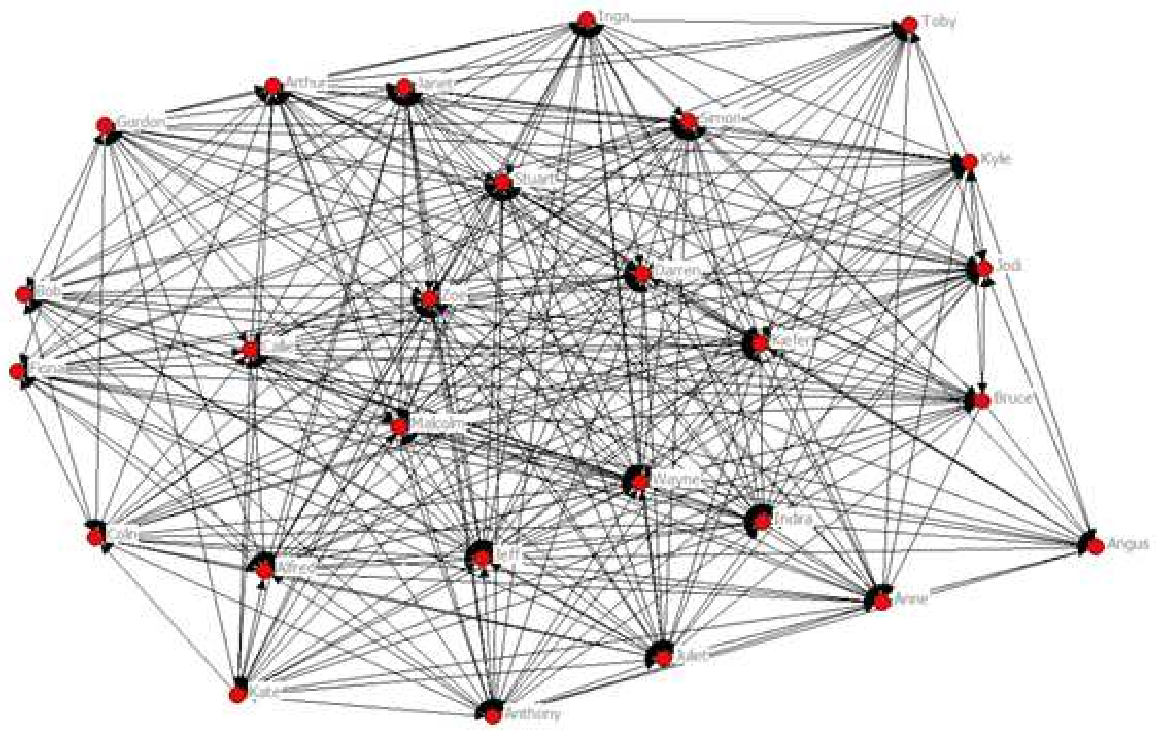


Figure 34: “Who have you not (or rarely) sought feedback from” survey group 2 + 3

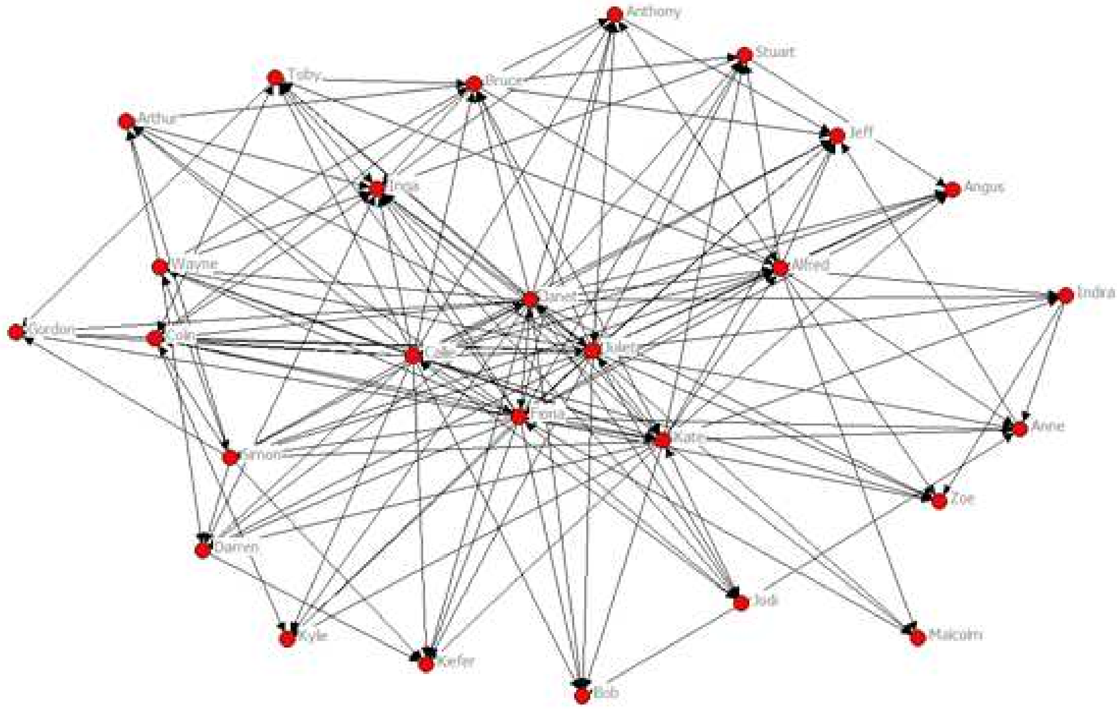


Figure 35: Visual tool viewing network survey group 2 + 3

To summarise this section:

- It has shown the importance of course peers and friends in influenced and providing feedback to student designers
- Shown that the network results map to the qualitative accounts of each group
- Shown that the visual observation network was much more evenly spread than the survey responses about feedback sharing
- Shown high levels of feedback sharing occur with a small number of people (those they trust?)

6.2 Build a network model

The network of seeking and sought feedback (figures 30, 31, 32 and 33) reveal that actors ask people for feedback far less than they do for general conversation (about both work and non work related items). This is shown in the network diagrams but also the density figures (table 6). The range of people that actors asked for feedback was also less. Although the ethnomethodological principles applied to the research take the stance that ethnography should not seek to explain but instead describe, it is difficult not to ask a few hypothetical questions about the network visualisations. Why do people seek feedback from certain individuals? Why are the number and range of people that are sought smaller than general work related and non work related communication? One possible reason is location. People ask others for feedback if that person sits close to them. In figure 36, the diagram shows people if they sit in the same room. This shows, to a certain extent, that people are closer to those people who sit physically close to them.

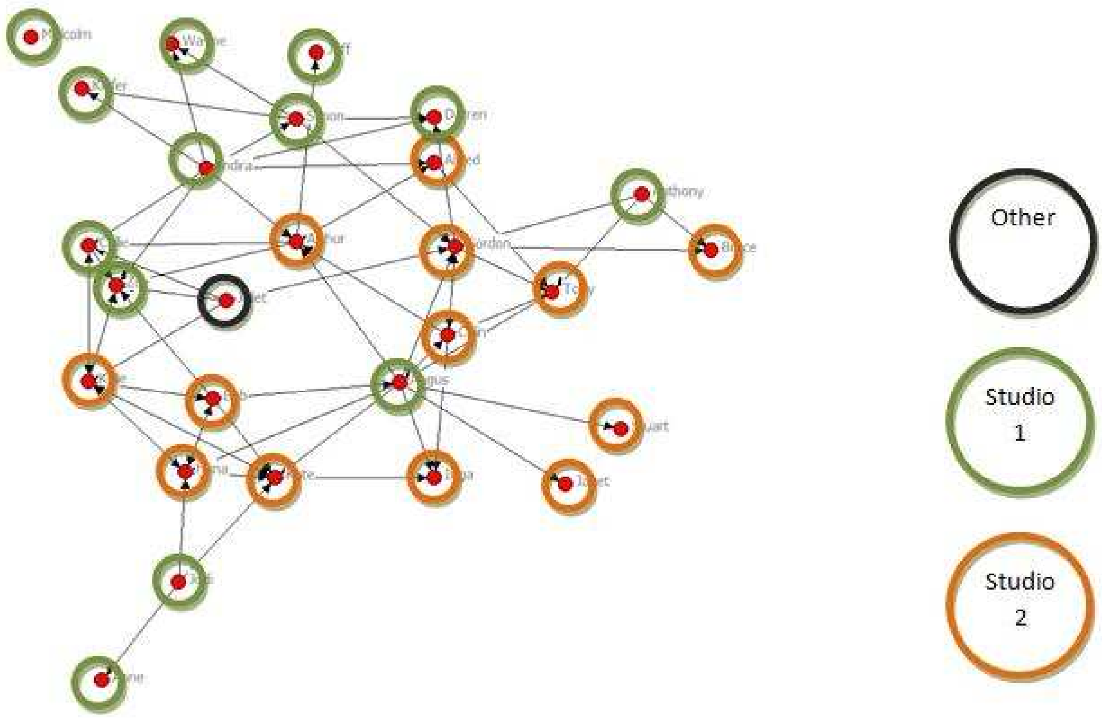


Figure 36: Student network with studio room

Another possible reason is pre-existing alignments. For instance, alignments existed among students in groups 2 and 3 based on the course that they were registered to. Those on the same course are highlighted in figure 37. Again there is some evidence that people are connected to other people who are the same course. People from the same course could ultimately sit in the same physical location.

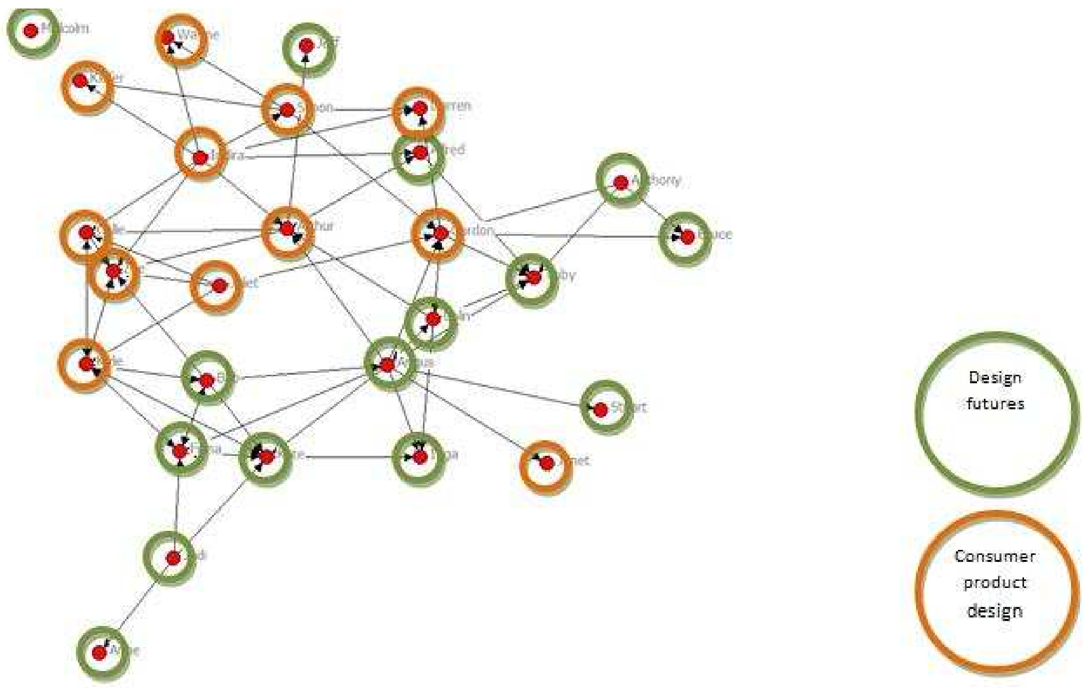


Figure 37: Student network with highlighted courses

Alternatively, friendship ties are one reason for actors seeking certain individuals. It is difficult to visualise this through the network diagram because it would only reveal the same configurations as the seating arrangement. As this was their final year, students sat together with friends (although this is less so in the groups 2 + 3).

Finally it might be the case that students seek feedback from the students who have the highest grades. If this is the case there would be a relationship between centrality and grade. This possibility is explored in the inhibitors and promoters section. Being highly centralised gives actors a privileged position of being a promoter in the network. They can essentially promote ideas, and those ideas can subsequently spread through the network because of their endorsement.

6.3 Identify inhibitors and promoters

This section argues that the histories and perception of key individuals in the network are all the more important because these views can spread throughout the network. It is proposed that those listed as go-betweens or having high centrality scores (Jane in group 1 and Angus in group 2+3 as shown in figures 39, 40, 41 and 42), have a greater ability to influence the rest of their course. If any technology introduced to each of those courses was accepted by these two individuals, it is possible that the technology will be accepted by the rest of the course.

In addition to comparing the communication, information and feedback networks with each other, specific network roles are identified. It is proposed that being a certain network role in a course has a bearing on the success of the student. It is also proposed that a more centralised student a go-between, for example, produces better design work, while a clique member produces average work and an isolated student produces work of a poorer quality.

6.3.1 Highly connected students (centralised and go-between students)

To understand the centralised student role, two network measures are used. These are degree centrality and betweeness centrality. Degree centrality is a simple count of connections to a person, whilst betweeness centrality is a count of connections that allow a person to be a go-between with two other individuals. For example, in figure 38 person A has a degree centrality count of 4, but is not a go-between because the connection goes from A to all four other individuals. If the connection to person C was reciprocated, person A would then be a go-between from C to B, D and E.

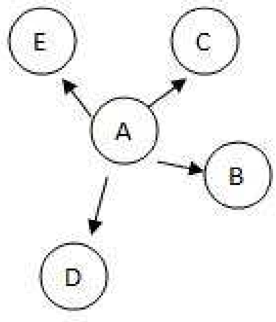


Figure 38: Example centrality diagram

In comparison of degree centrality and betweeness for the student groups, figures 39 and 40 (betweeness) and figures 41 and 42 (degree) show far greater number of connections for degree centrality, as would be expected. Degree centrality values are also much higher for the communication network, in both group 1 and group 2 + 3. The information network provides the most number of connections in the betweeness centrality figures for both group 1 and group 2 + 3. This may imply that people are willing talk to a large number of other people about general chit-chat, but will go to specific individuals to gain information about work. These individuals are therefore in an advantaged position in the network and are deemed go-betweens.

The feedback networks show much lower centrality figures for both degree and betweeness measures. However there does seem to be a pattern in that those people who have high centrality measures for other networks, will have relatively higher centrality for the feedback networks as well. Take Jane for example, in figures 39 and 41 she has consistently high centrality ratings for all four networks.

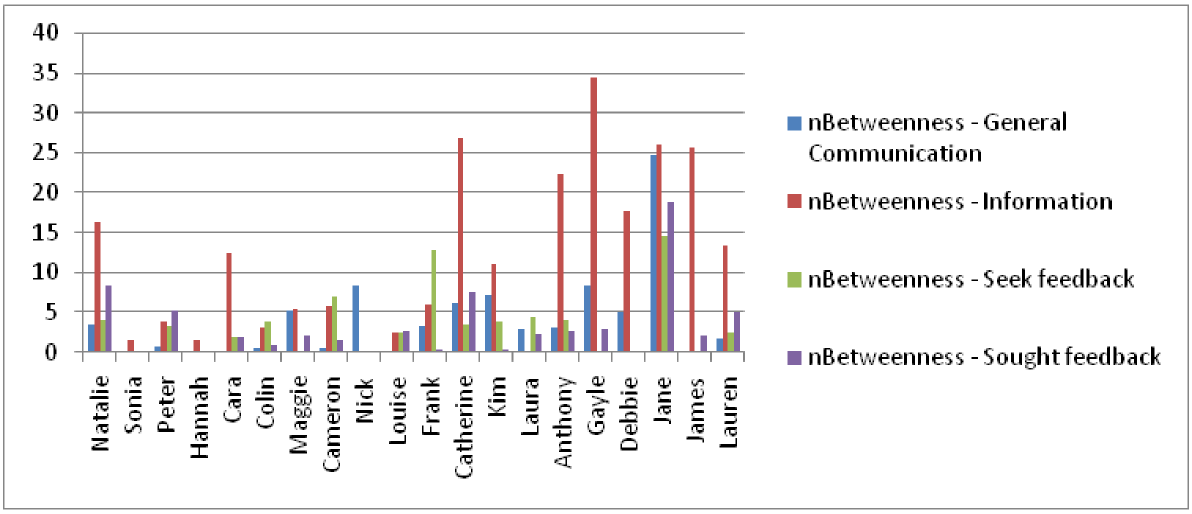


Figure 39: Betweeness centrality figures for each student in group 1

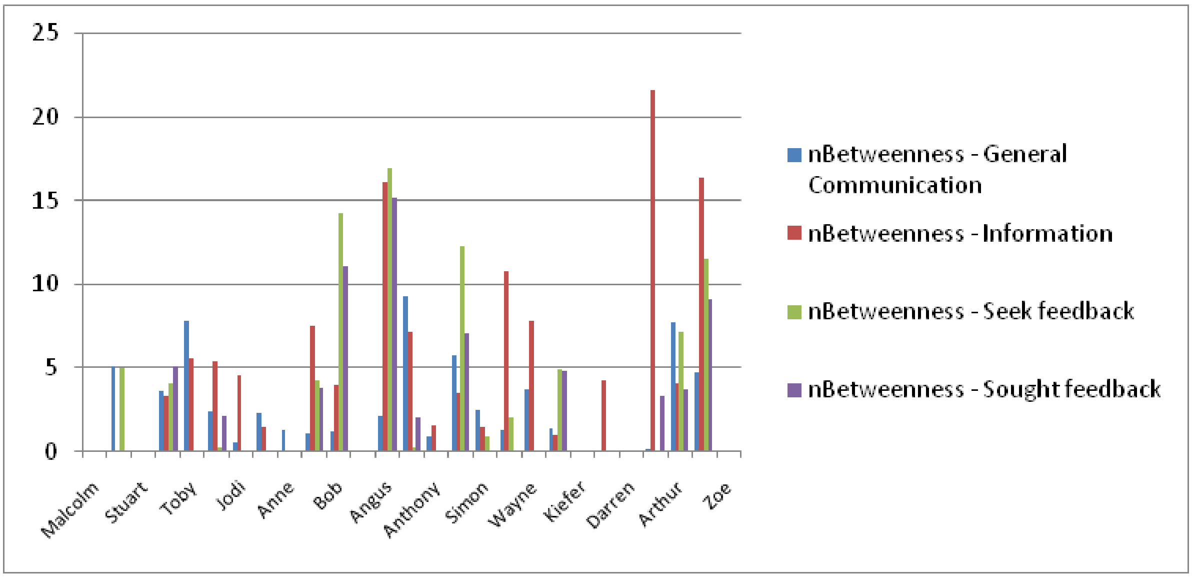


Figure 40: Betweeness centrality figures for each student in group 2 + 3

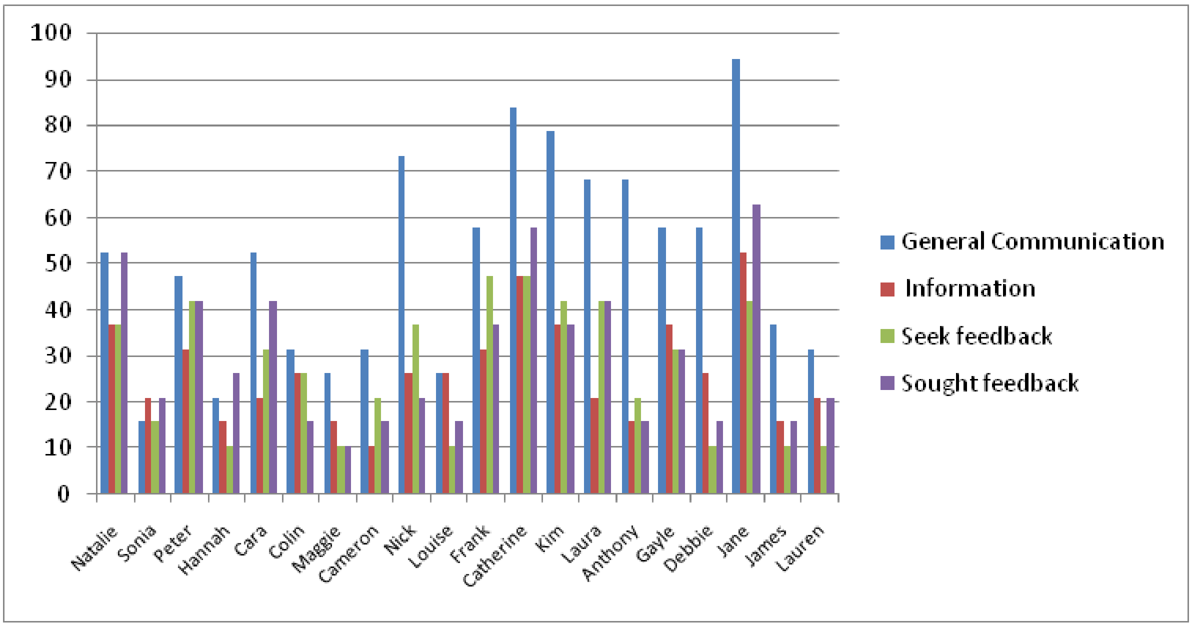


Figure 41: Degree centrality figures for each student in group 1

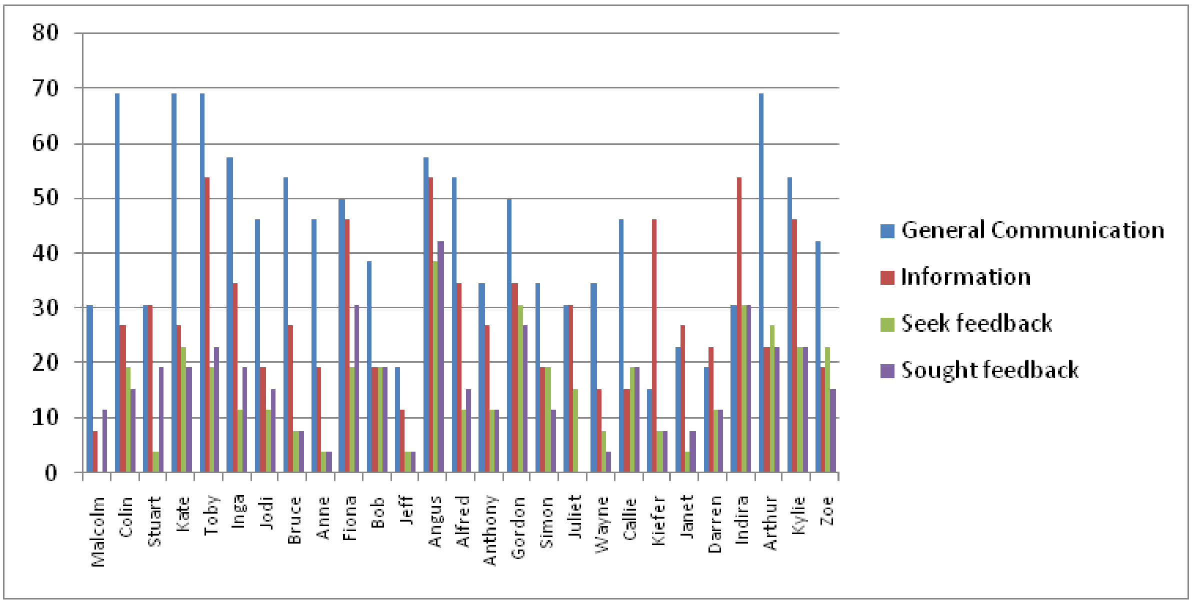


Figure 42: Degree centrality figures for each student in group 2 + 3

To understand whether being a go-between student has any relation to grade, T-test analysis is carried out. The result of this is shown in figure 43. In group 1 there is, in general, a positive relationship between grade and go-betweeness. It could be proposed therefore, that go-between students do produce better design work. However in group 2 + 3, the reverse of this is the case. The relationship between grade and being a go-between student is negative in two of the four networks. Hence this research does not show any relationship between grade and being a centralised role in a network. Although there does seem to be a link between grade and connectivity in the visual network. This may imply that students who look at the greatest number and range of their peer's design work (without leaving written feedback) do gain higher grades. This test would need to be repeated, to strengthen the argument.

6.3.1.1 Grade and centrality

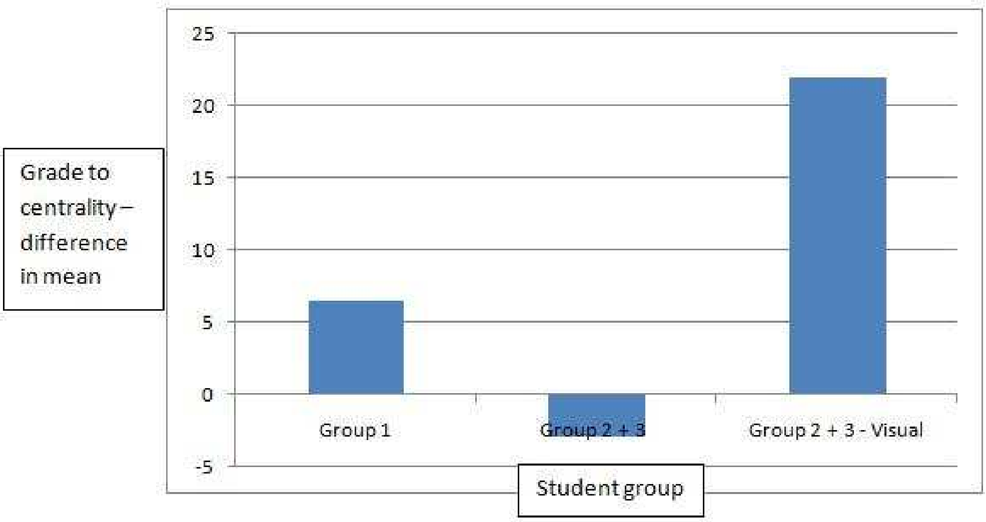


Figure 43: T-test comparison of betweeness centrality and grade

6.3.2 Reciprocal ties, cliques and sub-groups

The next network role to be looked at is the clique member. A clique has a very specific definition in that all members of the clique must be connected to one another. For a clique to exist all ties must be reciprocated. To gauge whether a group will have many cliques, the network analysis (figure 30, 31, 32 and 33) can be looked at. These show that there are many possible groupings. Furthermore, the level of reciprocity of any network can be measured. Any high levels of reciprocity may imply close connections between people and a greater likelihood of cliques and groupings. Figure 44 shows the reciprocity levels for the four networks. The figures seem relatively high, with communication in group 1 having 50% of all ties being reciprocated.

Figure 45 shows the number of cliques for each network. It shows that communication does indeed contain many cliques. For the feedback networks and information network, there are more cliques in group 1 than in group 2 + 3. This is surprising as group 1 is half the size of group 2 +3, and further reveals the "cliquey", segmented nature of group 1.

Figure 46 looks at the feedback networks in particular as well as the visual network. The number of cliques in the visual network is higher than in a face-to-face feedback network. The four cliques revealed in the visual network may reflect the four project groupings that existed, and students may be looking at the work of their peers from their own project team. Perhaps this was not apparent in the face-to-face network because some students were from different courses, but they were on the same project theme, even though they may not know each other well.

The clique definition is very specific, and is often criticised for being too rigid. If a person is connected to all but one of the individuals within a clique, it would be thought that they would also be a clique member. However within the clique definition they would not. The technique of n-cliques can be applied to rectify this problem, with n being the number of connections away from the clique. Within n-clique analysis (figure 47), group 2 + 3 now has more people as clique members than group 1. This suggests that the cliques are very tight in group 1, but group 2 + 3 has looser clique connections.

There can be many overlaps within clique analysis, which often results in people being members of two or more cliques. It may well be more logical that that person may be part of a block of friends that contains those multiple cliques. A block exists if it can be separated from the rest of the network if a cutpoint person was removed.

Figure 48 shows the blocks contained in each network. These block levels seem quite high, especially for the sought feedback and information network. Block component analysis goes against the trend with clique analysis. In the clique analysis, the feedback networks have far fewer cliques but in the block analysis, they have a higher number of blocks than in the communication network. It is possible that in the feedback networks, there are loose connections of friends that the students turn to. These connections are not however strong enough to form cliques. In the communication network meanwhile, there are tighter clique member groups rather than broad blocks.

Finally it was proposed that clique members were more likely to receive average grades. Table 7 shows that for each network and for both group 1 and 2 + 3 the grades of clique members are close to the average for the entire course. The communication and information networks are ever so slightly higher than average, but the feedback networks align very closely to each group's mean.

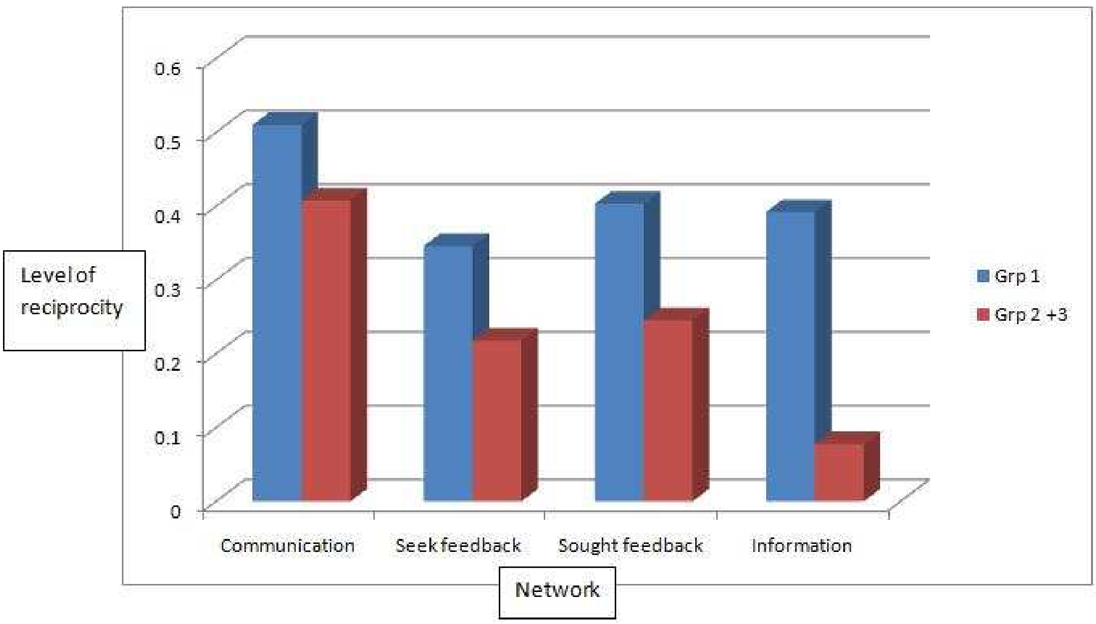


Figure 44: Level of reciprocated ties for each network

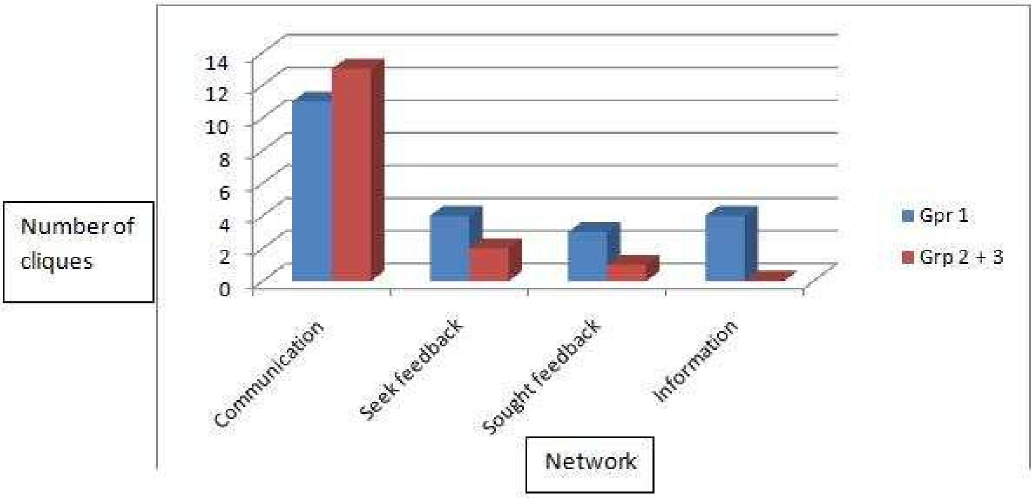


Figure 45: Number of cliques for each network

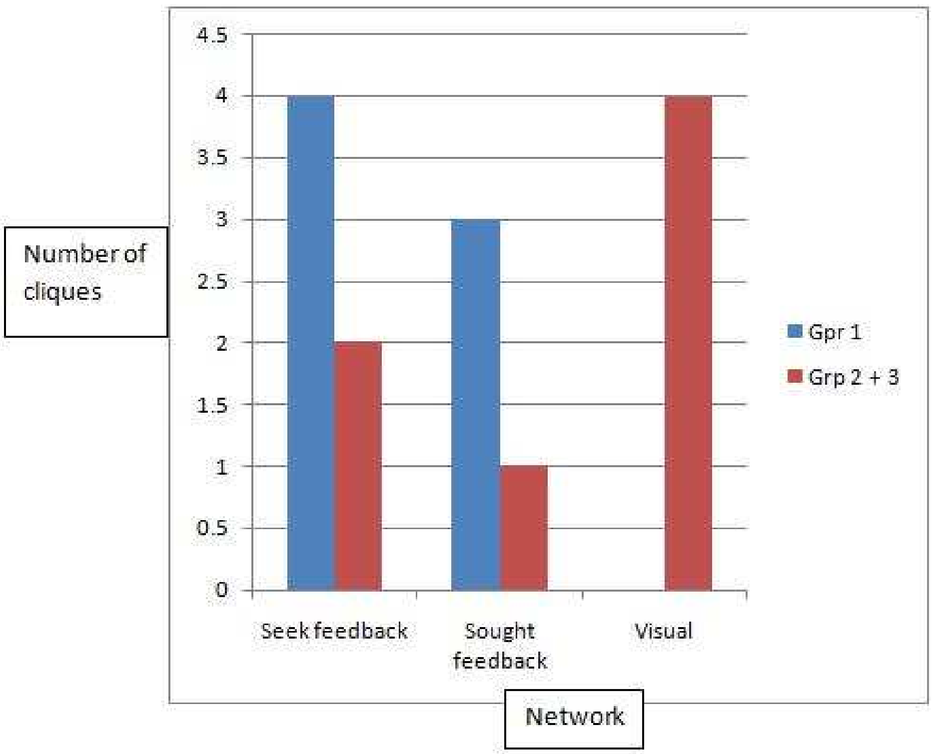


Figure 46: Number of cliques for each network

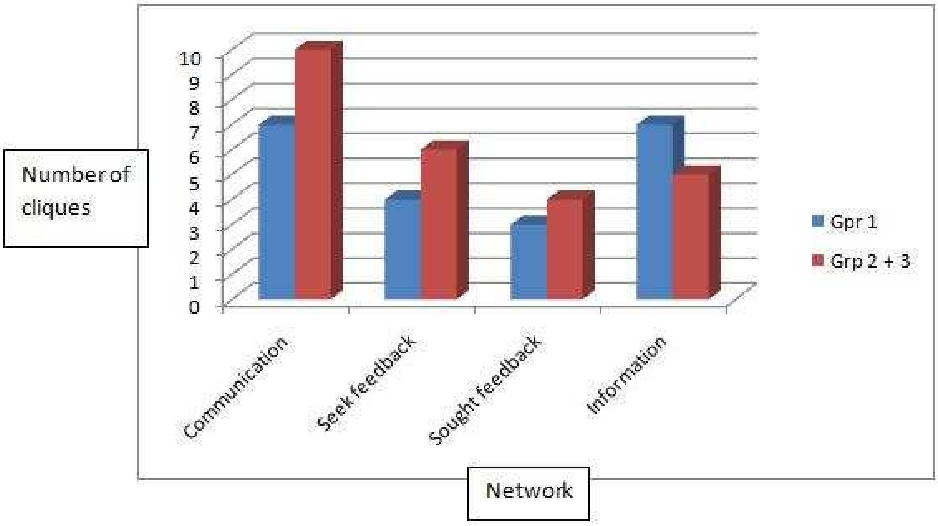


Figure 47: Number of n-cliques for each network

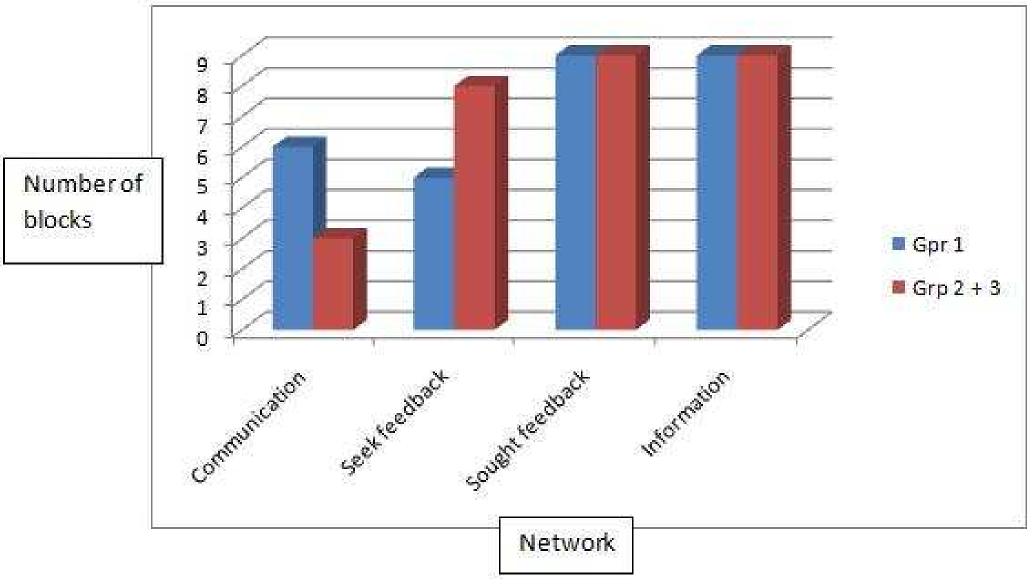


Figure 48: Number of blocks for each network

Network	Avg grade for clique members	Avg grade in the course overall
Grp 1 - Communication	62.7	58.61
Grp 2 + 3 - Communication	62.6	59.96
Grp 1 - Seek feedback	59.4	58.61
Grp 2 + 3 - Seek feedback	61.8	59.96
Grp 1 - Sought feedback	57.9	58.61
Grp 2 +3 - Sought feedback	63.7	59.96
Grp 1 - Information	63.7	58.61
Grp 2 +3 - Information	N/A	59.96
Grp 2 + 3 - visual	69.77	59.96

Table 7: Average grades of clique members in comparison to the average grade of students in the course overall

6.3.3 Isolated students

The final network role that is focused upon is that of the isolate. An isolated student is one that does not have any connections going to them or from them. There were very few isolates identified in any of the networks with either group. However, one isolate is identified for seeking and sought feedback in group 2 + 3. The lack of identifiable isolates is probably due to the fact that the students on the course on the whole knew everyone else, particularly in group 1 which was comprised of only 20 individuals. Due to this, a less stringent concept of isolation is used for analysis. The research looks at people who only have 1 connection to them, as these people have very few peers who rate them highly and are therefore the closest to isolation. Figure 49 shows that there are far more close to isolation students than purely isolated ones. Figures 49 shows that there is a general pattern that in the feedback networks there are more close to isolation students than in other networks for both group 1 and group 2 + 3. To understand the impact of being close to isolation in the feedback network, the grades of those students are averaged and compared to the average for the course overall. Table 8 shows that students who are close to isolation are well below the course grade average in both seek and sought feedback for both course groups.

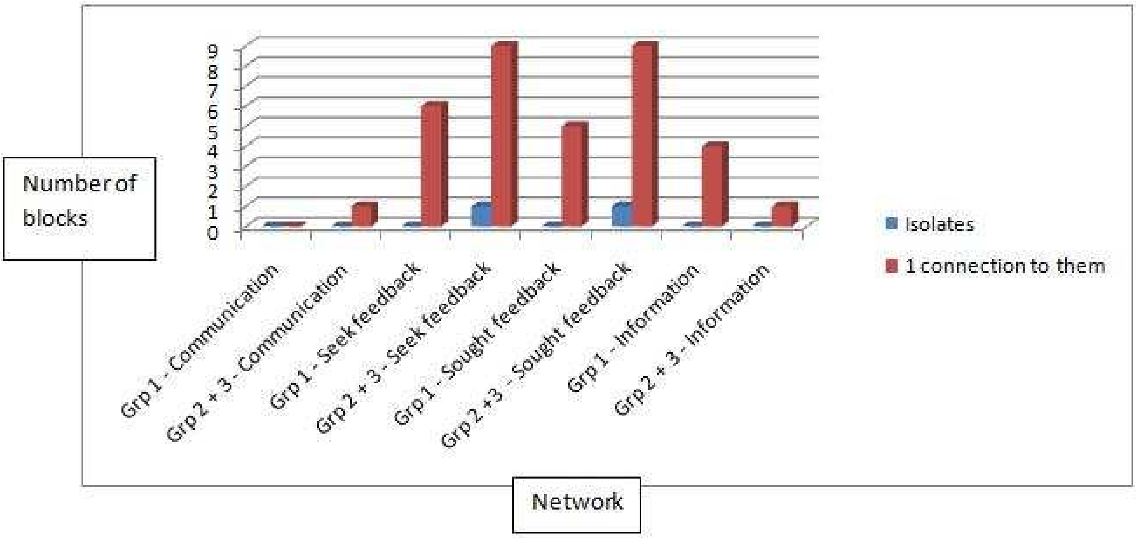


Figure 49: Number of isolated persons and persons with only 1 connection to them for each network

Network	Avg grade of persons with 1 connection to them	Avg grade in the course overall
Grp 1 - Seek feedback	53.5	58.61
Grp 2 + 3 - Seek feedback	54	59.96
Grp 1 - Sought feedback	48.48	58.61
Grp 2 +3 - Sought feedback	53.1	59.96

Table 8: Average grades of persons with 1 connection to them in comparison to the average grade of students in the course overall

In the visual results, those students who did not partake in visually looking at their peers work have not been analysed. It could well be the case that those students form an interesting group in their own right. However looking at the results in totality, there were no isolated students; indeed there were no students who had only one connection. Each person, no matter how poor their grade, had at least two people view their work. This could potentially be a result of access. If a student does not attend studio sessions, there is no opportunity to view their work face-to-face, or for that student to view the works of their peers. Visually available, through a Virtual Learning Environment, poster, or publication, each student has access to everyone. The second issue relates to attendance and trust. Although there is an inter-relationship between attendance and access, there is also one between face-to-face interaction (through studio attendance, but perhaps not exclusively) and trust. It is proposed that a student would only allow another student to review their work if they trusted them and similarly would only feel confident in giving feedback if there was a strong bond of friendship. In viewing graphical work, the reflection and reviewing process can be anonymous (if the student does not leave written feedback) and does not need the same level of trust as in a face-to-face scenario. A student, for example, could reflect on another student's work that they have never met. It is proposed that the lack of trust needed when simply viewing work, may help students to reflect on the work of students who are completely outside their circle of friends. This widens their social network and strengthens their role in the whole course network. Another possible reason for the displayed pattern in the visual network was speed and ease of use. Students can rapidly flick between the visual work of their peers, whereas in the studio oral feedback requires a conversational interaction that takes longer than simply looking at a design. Although a student could view a design for a long period of time, they have the option to view a design quickly, whereas a face-to-face conversation requires a minimum input requirement from each student.

In summary, there seems a mixture of evidence that more centralised students produce better graded design work in regard to verbal acknowledged feedback sharing. However, there is some strong indication that those students who reflect on the visual images of their peers, do gain higher grade values. There is also some evidence that clique members have bounded (average) grade values. As well as some evidence that isolated students produce lower graded design work. Finally it was discussed the role of visually reflecting on design work and it was proposed that students are able to access a greater number and wider range of student work to review

6.4 Identify actions

The research firstly looked at the open-ended questions which showed the importance of friends in influencing students, and in particular in providing appraisal to their course peers. This result gave weight to the significance of the feedback network in a student design studio. The analysis then focused upon 3 areas: the communication network of students, the feedback network (both seeking and sought) and the information sharing network. A comparison of these networks showed how people refer to far fewer individuals to provide them with feedback than both communication and information. This was seen in both student group 1 and 2 + 3, and showed that feedback potentially requires a high level of trust and bonding between people.

The research then concentrated on three network roles and their significance on a designer's work. These roles were: the go-between student, the clique member and the isolated student. The analysis found that there was a mixed response to whether being a go-between student improves their design work. Although there is some indication, especially when taking into account the visual reflective network, that this is the case. Being a clique member does seem, on average, to restrict a student to a bubble of a certain average grade boundary. Although to strengthen this argument, data would need to be taken over a long period of time (before, during and after clique membership). Finally the research has also shown that being an isolated student, or more to the point a student who is close to isolation (with only 1 connection), is linked to poorer grades.

It is important to identify the isolated student, as they may fail a course, drop out or not meet their own potential. Isolated students may not be attending studio, and their lack of social influence in the design could be a consequence of that. It is also important to identify cliques, so people can be aware that they may potentially sit within a grade bubble that could be improved. Although the data did not provide clear cut evidence that being a go-between student is linked to higher grades, go-between students should still be identified as they are hugely influential in the studio. They can promote or inhibit new technology as well as dominate perceptions within a course as they can access more people. Go-between students who have lower grades will be influencing students with a certain perception that may not be ideal.

The network analysis can be seen as complementing the observation data which also revealed the fluidity in the social influence of peers (and the difficulty in mapping it). The inter-disciplinary design project highlighted how the network and the influences within it existed far beyond the remit of the project and the analysis that was carried out. The role of lecturers and friends outside university, for example. This section has specifically focused upon designers from a set course, and does include broader network references that emerged from the contextual observations.

Conclusion

This case study has looked at an educational studio, and the physical location of a design studio has been the focus for a series of investigations into how students interact. In particular how they give and receive feedback to one another and how this compares to the general communication networks and information sharing. Part of the research looked at the concept of roles within design networks such as isolated students, clique member and being a go-between in the network. The theoretical framework itself puts forward the idea of inhibitors and promoters and this can be equated to the idea of the go-between or highly centralised student. A mixed picture was revealed in relation to grade and being a certain network role. If there was a strong connection of being a certain role and gaining a certain grade, identifying those roles would be all the more important. The mixed picture put forward means that the identification of roles is not so clear cut, if you require an understanding of who is the highest graded student. If, however, interest lies in who may influence the other students, role identification is still important.

The location of the studio was seen as integral to the design studio. However, the studio location morphed depending on the type of project, and the courses involved.

In the ethnographic study, the location was consistent for the two design students, but the other two students (MSc) only dipped into the studio setting, with most meetings taking place in the University cafe. The first group of students took over the entire studio and its associated mezzanine floor (that was occupied by a certain group only). The final two courses occupied the main studio and another studio room.

The history of the students and friendship patterns also had a bearing, as did time. The changing network over time, however, varied depending on the type of research method. The observation process followed an entire design process, for example, whereas the survey data was a snapshot in time.

The presence of a research had an influence. Some ethnographic research was ruled out because some students did not want to participate. In the main however, the students were very helpful and forthcoming. They took time out from completing their final projects to complete the complicated and time consuming surveys. The case study of a professional design studio would require actors who had far more to lose from participating in the research (time, money, potential implications for their role in the company)

Some of the findings put forward in this chapter seem very specific to an educational setting. Assessing a network role against degree grade, for example, can only be achieved when design work is objectively judged. In the professional studio, these measures cannot be used and as such modifications to the research must be applied. The next chapter looks at a professional studio. The methodological approach, although modified to accommodate the practical and theoretical differences between educational and professional context, still attempts to understand how designers interact with one another and how that can inform the development of a prototype to visualise those interactions.

7. Case study 2 – Professional Studio – Contextual Observations (ethnography)

Introduction

This second case study exploring peer evaluation occurs in a professional studio. The ethnographically orientated aspect of this study was carried out after some significant features of the educational studio field research had been completed. Ethnographically informed research into an educational team project had already been concluded, and this greatly influenced the following research. In light of the influences from previous studies, it's worth noting that I went into the professional studio with more pre-conceived ideas than in previous studies and also with a set framework in place to aid in my ability to model the social interactions in the studio. No research can, of course, be carried out in isolation. The researcher themselves has a bearing on any field work, a discussion which some believe is central to the modern sociological project (Gibbens 1991). I begin this chapter therefore, in the same manner in which I began the first case study: in a self-reflexive mode. I begin with a discussion of my role as a 'social self' (Burkitt 1991) in the field study setting but also as an outsider.

My first exposure to the company, who we shall fictitiously call Extricate, was most definitely that of an etic, an outsider. Even though I had studied student designs in the studio, this did not make me feel like any more of an insider to the world of professional design practice. In fact my exposure of student designers had made my own knowledge of software design seem even more removed from the creative design process, and this made my introduction to the company a nervous one. The following introduction to the company has been broken down into two introductory stories as there were two 'beginnings' to the research: one in the "old" office and one in the "new" office.

* * * * *

The [old Extricate] office seemed in some back alley, down some roads, through an archway and into a mews-type area. It seemed tucked away, small and I thought I'd never be able to find my way to it again (perhaps that was my lack of geographic knowledge about Glasgow). There seemed to be lots of corridors, not in the traditional sense but there were lots of partition boards. The general communal area was a larger area that was partitioned off with some seats. There were books, and models and lots of pictures along the wall. There were bits and pieces from various projects everywhere.

In comparison, the introduction story to the "new" office was thus:

I hadn't been to the [Extricate] office for quite a while and since my last visit they had moved offices. The move had left me with lots of open questions, why they moved, what would be the implications, how was the office arranged? Some questions, to a certain extent, had already been answered, mainly from second hand information from my supervisor. I knew for instance that they had merged with another company and I pondered on this point and how this would affect my research as I walked to the new offices. I approached the new office location and was immediately struck by how grand the building was. It was a distinctive office, Victorian in architecture, in a very prominent location. The office building was shared with other companies and in the very imposing entrance was a receptionist who represented the entire building. This is where we sat until Dennis came to meet us.

7.1 Identify actors

I went into the research in the professional studio with a naive notion that I wanted to replicate the study of observing four people carrying out an inter-disciplinary design project (a micro analysis). I felt that I could achieve this by looking at a specific project or by researching the graphic designers from Extricate and how they potentially worked within an inter-disciplinary team and the social influences within that. This would address the question of who I should talk to and who would be excluded. However, it soon became apparent that the politics within the company, the availability of people and projects, the personalities involved, all meant that there was a self selecting process of who was integral to the study and who was not. Latour suggested that in order to solve the problem of selection, the researcher should "follow the actors", and let them determine where the researcher goes and what data should be collected (Latour 1996). Belk et al (1988) also proposed an emergent approach, that was sensitive and reactive to the participants involved in the study, with the researcher being an instrument through which data gathering is channelled.

Although the selection of the actors was a response to my own adaptations to the field site, the actual site selection was, in a sense, a setting that was provided for me. The choice of site was really based on "who you know", as one of the directors of the company was a friend of one of my supervisors. The inter-disciplinary nature of the company was ideal for studying peer evaluation across multiple design disciplines. It originally employed graphic and interior designers as well as architects and during the study it also merged with another company that employed software developers and advertising executives. It truly was an inter-disciplinary creative company and one which was located in Scotland. It housed multiple design disciplines and the directors espoused how they wanted to target projects that could utilise their respective talents. The state of flux, with office moves and mergers also made the company an exciting (if daunting) prospect.

The selection of actors during the research changed, partly because of the new office location, changes of seating arrangements and also general office politics. When I originally started the research, the 'creatives' (as one member of Extricate staff called them) sat in one area whilst management and administration staff sat in another. This was a much more attractive arrangement for my research as I could locate myself on the floor with the 'creatives': architects, interior designer, graphic designers and art workers (see figure 50 and 51). With the move to the new office, the architects and interior designers sat on one floor whilst the graphic designer and art workers sat on another floor (now with the addition of software developers and advertising executives). The management and administration staff was also split between floors. Two of the company directors sat upstairs with the graphic designers and one of the directors sat downstairs with the architects. Administration and accounts staff were also separated depending on which type of accounts they were working on (see figure 51).

Once I realised that the ‘creatives’ were split between floors, I began my research in earnest by sitting with the graphics designers. My previous ethnographic type research had looked at Design Futures students who were a loose combination of product and graphic design so it made sense for me to observe the professional graphic designers in action. However they were very reluctant to be part of my research and as a consequence I moved increasingly downstairs to sit with the interior designers and architects as they were far more accommodating.

In my identification of actors I could list everybody that worked for Extricate. In appendix CD2 I’ve listed all those individuals that worked for Extricate prior to the merger. I didn’t include the names of people from the company that merged with Extricate, as I only spoke to a few people (software developers) from that company. The list of actors in appendix CD2 is simplified into the following categories:

- Architects (10 persons)
- Interior designers (6 but 2 of which left during the research and 2 were students who only participated in some of the study)
- Graphic designers and art workers (7)
- New media designers (2)
- Other (7)

The management of the company, the three directors, all had their own background discipline. Simon and Stuart were both from a marketing and graphic design background and they sat with the graphic design team in the new seating schema. Dennis was an architect and he sat downstairs with the other architects. In the above list, managerial staff have been incorporated into their design discipline rather than as a separate category because they still carried out some design activities (particularly in regard to client meetings), as well as their managerial duties.

Other factors that were of influence to the research and should also be deemed as actors (or as Latour refers to them, actants), are the building, the seating arrangements (figures 50 and 51), the computer hardware and software, and the models and diagrams. It has already been discussed how the building and seating arrangements impacted on the research and consequently on the Extricate personnel. The computer hardware and software should also be referenced. Every person within the company had a computer to work with and they also worked on computer software (using general software packages such as word, but also specific creative packages such as Illustrator and AutoCAD). Models and diagrams were also an important feature of the design studio. They appeared everywhere in the 'old' office but with move to the new premises came a 'spring clean' and many models never made the move. The diagrams that made it onto the wall of the new office represented the work that was currently under way or that they were particularly proud of. The diagrams that featured on the walls of the studio were not very old.

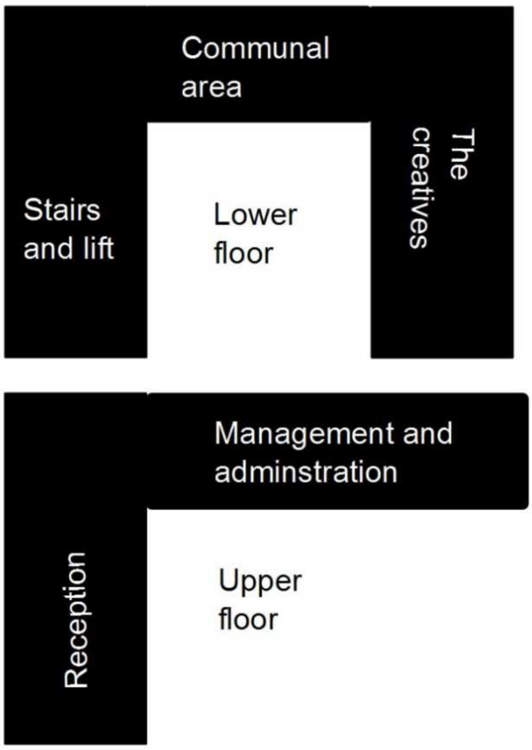


Figure 50: Extricate old office layout

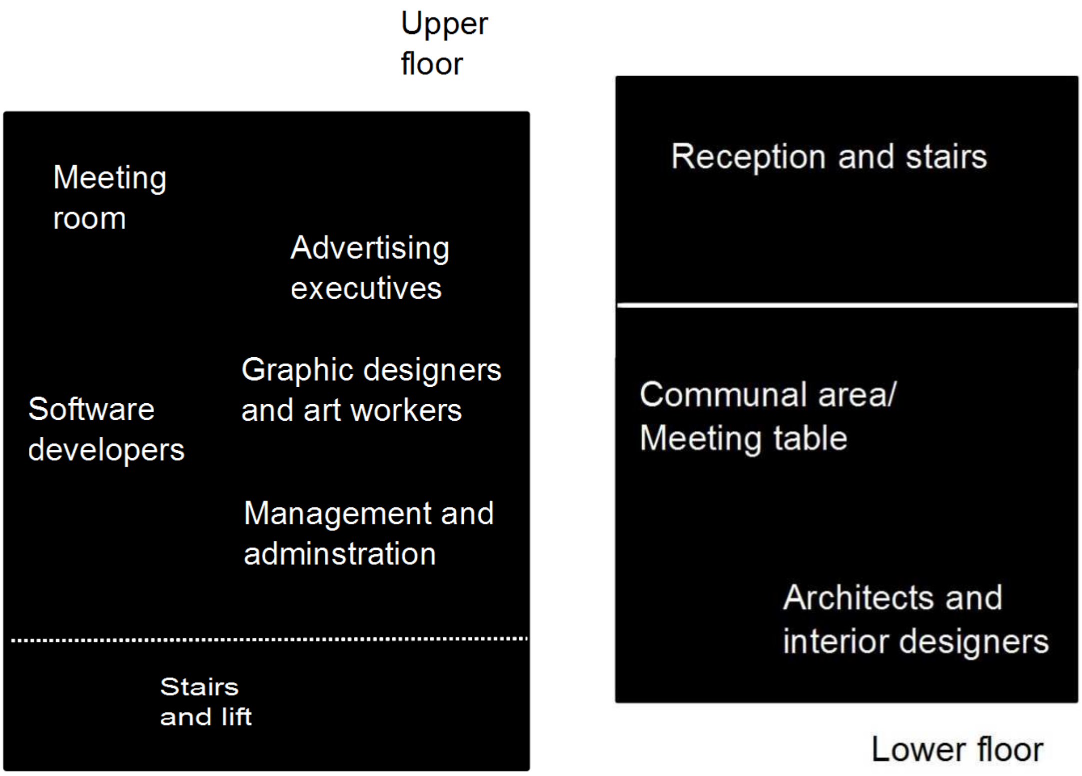


Figure 51: Extricate new office layout

In summary this section has identified the actors within the company, noting the difficulty in this identification due to:

- the changing office arrangement
- reaction of staff members
- changing personnel

7.2 Investigate actors

The following section investigates the actors identified above. Law maintained that "ethnography is an exercise in ordering" (Law 1994 p39) and much of the following investigation into the actors is achieved through the ordering of observations and notes made during the research. Law (1994 p 52) also noted that "stories are part of ordering" and the many ad-hoc semi structured interviews that were carried out with the actors all contributed to building up a story about the company and its history and the motives and dynamics of the people employed within it. The interviews and taped conversations were intended to be informal, often occurring during coffee breaks to make the interviewees feel as comfortable as possible. These interviews ranged in time from 5 minutes to half an hour and covered a spectrum of subjects. A few guiding principles were loosely followed in order to find more out about the individual, their role in the company, the projects they have worked on, the network of people they have worked with and the influences they have. Consequently, this section aims to give an overall understanding of the people and personalities who work at the studio.

7.2.1 Histories: stories and time

Extricate was originally formed as a marketing and design company by Simon and Stuart in 1997. Simon and Stuart had studied Marketing together at Paisley University and after leaving university they both were employed as marketing executives for a range of clients. They always held an ambition to start their own company however:

Stuart: We really did not know just what it was we wanted to start. We looked at the possible opportunities with eating, drinking and nightclub venues, record companies and many other ideas that did not pan out for one reason or another. What we did know is that we did seriously want to start something of our own

The above quote was taken from a document that Sonny gave to me. Much of the information about the company's inception was gained from the histories, stories, second hand information and recollections from Sonny. Sonny was a KTP student at Glasgow Caledonian University, Greek in origin and embarking on a PhD programme as part of his KTP. His role at Extricate was to look at the company's "communication, clients and strategy"; the latter of which he particularly enjoyed and wanted to continue. Sonny gave me my initial insight into the structure of the company, how it developed, how it had changed to incorporate architects and interior designers:

Sian: How long have you worked at Extricate?
Sonny: About six months. Oh I should tell you about the structure of the company. There are three directors, Stuart, Simon and Dennis. Stuart looks after finance and

staff. He deals with public sector clients. Simon generally manages the whole company. Dennis has authority over the architects but is getting more involved with interiors now. We've had a few changes in the last few weeks. Connor has now joined the company and he heads the graphics side. He worked for the company for a few weeks previously.

Sonny was a very good source of information. He knew many of the 'creatives', a term he coined, and worked closely with the management and administration staff. I spoke to him on several occasions prior to the office move (one of which I transcribed). However once the company moved into its new location, Sonny sat with the management and administration staff and my conversations with him were far more brief.

Another useful source of information from the old office was Di. Di was the receptionist but she was also a Jewellery designer, gaining a first class honours degree from Duncan and Jordanstone at Dundee University. She gave me insights into many connections and associations between people. I also never got the impression that I was wasting her time. When the company moved offices though, the new office had a receptionist that covered the entire building. I was never told that she had been made redundant or sacked even, just that she had decided to go travelling. She'd mentioned her desire to do this herself when I interviewed her:

Sian: What would you like to do next?
Di: I'm going travelling in February. Round the world, South America, Rio for the festival, Fiji, Australia and New York.

Perhaps it was a fortuitous coincidence but looking back now, Di probably knew that the company was going to move, with the place they would be moving to already having a receptionist. She was in a very good position to know a lot about the "goings on" within the company. People spoke to her informally. If you needed to traverse the two floors you would need to pass Di and as such she probably became a gatekeeper between the creative floor and managerial floor. She probably knew a great deal more than she told me (in the December I didn't know the company was intending on merging and moving office in the February, for instance).

The history of the company is inextricably linked with the history of the connections between the people within it, their backgrounds, where they've come from, and the networks they built up. The company itself was built from an association between Stuart and Simon and this dyad then expanded to include other people within their personal network that formed the cornerstone of the company.

Sonny: Some people have known each other before. Like Simon and Tim grew up together. Simon and Stuart met at Uni. They graduated in 91 I think.
Sian: When did they set up the business?
Sonny: Six or seven years ago I think. Oh and Jackie comes from East Kilbride which is where Simon is from. Did you know that Lara is Simon's sister.

The personal networks and groupings existed together without formal hierarchical structures and project ties. There was a group of architects who had worked together previously, junior architects who had gone to the same university, and graphic designers who had networks of earlier associations. Sonny got his job through knowing someone already employed by the company and Di also knew Edward and Kim previously.

Sian: How did you get your job here?
Di: I got the job through Kim (I knew Kim before). Got Edward his job, he put his CV in a few weeks before I started.
S: How do know Kim and Edward?
Di: Kim I knew from School, and Edward from Uni. Edward did graphics and I did jewellery design.

Similarly Alastair, an architectural technician, had worked previously with Dennis, Jay, Karl and Brian.

Alastair: Eventually ended up with GRA. I had 3 years with GRA and it was absolutely superb. Dennis was there as well, Karl. It had a good social life. One of the things about architecture is the social life tends to revolve around your work mates. In this trade you walk your work and you sleep your work

Alastair: We knew everyone within the trade and they all met and worked together continuously. And I always said in those days, when you get older don't forget your Uncle Alastair. And sure enough, after the firm went down the tubes and we were all made redundant and it was two years before the trade picked up and the first people who contacted me was the one of the juniors. They phoned us up and got us back and from that I entered into a new side of architecture. I was now the elder and the juniors were my bosses. There's a whole new crowd, a new theme of young people which started me back up again. All of my older crowd way back in the late 80's to the early 90s are all married. The friends I have now are all younger like Dennis. He was one of the younger crowd who I've regenerated a connection with.

The younger architects also had a previous network of connections that was earlier than and separate to the company as a whole, yet formed an integral group within it. Roland, Edgar, Francis, Lotti and Wyn had all attended Strathclyde University. Roland, Edgar and Francis had even travelled to the Czech Republic together as part of their degree course and had very strong connection.

Edgar: Me and Francis, one of the other guys here, we tried to hitch [from the Czech Republic] to Slovakia one day. We had been up drinking wine all night and we were like yeah let's go and we're travelling down these train tracks until we got to the motorway. We tried to thumb a ride for ages and the police pick us up and they're like 'get out of here'. They left us and we turned out and tried to hitch again and they turn up again. Eventually we got a lift in a BMW, it was gorgeous. We got to the border of Slovakia and the guys are like asking for our passports and we only had our student cards. It was hilarious. We were so close and we had to bail out. The border guys were in a minor road in the middle of nowhere not on a motorway. And we're stopped by this guy who had given us a lift and it's Easter Monday. Nothing happens in the Czech republic on Easter Monday... They have guys who go round with sticks and hit women. They have these big woven sticks made out of sapling. Apparently if you fancy a women you go and hit her with a stick. It was mad. But yeah we ended up walking for miles. We couldn't even buy any water and stuff. It turned out to be a complete nightmare. We eventually got back to Bernow about 10 o'clock that night. It was a nightmare. We got up to some escapades. We got a lift from these two lads, one of them seemed to be the village idiot. He was completely phonetic and mental.

As soon as we got out the car, we're like 'why did we do this?'. They were driving like complete loonies. They tried to take us out to go drinking with them and stuff. We're like 'cool guys, see you later'. I don't know it was funny.

These personal connections between people made up the sub-groups within the company. These associations occurred in tandem with formal project ties and formed one level of group connection. The senior architects had one group, the senior graphic and interior designers another, and the junior architect another level of group connection with their own distinct stories and reasons for the association. The team relations were then another overarching level. The project work within the company was quite separate as actors weren't, in general, assigned to the same project as someone they had a close friendship tie with.

An exception to this was an architectural competition that three of the junior architects were working on. The competition was a project not assigned to them by the company. It was a competition project that was kept, to some extent, secret except for a few lunch time conversations with those involved. Wyn, one of the competition entrants, eventually told me a few details about the project, and their desire to advance their career by entering it. He felt that although this kind of project was formally encouraged, it really meant that those involved were ambitious to do more than the company could offer. Those involved were not overt in their planning of the project and always kept project related conversations outside of working hours. This project relied on friendship and trust.

These friendship ties and the stories of associations helped formulate a history to the social network within the company. The history to each sub-group within the company evolved and strengthened as changes happened over time. Redundancies, hardships, and movement of staff all affected the connections that existed. Alastair maintained that the connections between people made them like a 'family' through bad times and good. The studio, with its friendships and projects evolved over time.

Sian: do you find it good that other people know a project so you can bounce questions to them?

Alastair: it’s not a case of good, it’s a necessity.... Somebody must know something . You don’t need to know about all of the jobs, as long as there is someone who knows 50% about each job. We always ensure that someone who knows 50% and if that person is off, we never allow two people who knows the one job to be off at the same time

7.2.2 Networks and actors: projects and people

The evolution of the project was an accepted element within the studio, even if the project took many years to complete. The repetitions of projects, and particularly those that were essentially the same project that were redesigned were all part of the course. Jay, a senior architect was quite nonchalant about this:

Sian: … that’s really interesting actually. The range of experience that you’ve got. Looking back, are there any particular projects that you’re proud of, that were particularly good that you really liked working on?”
Jay: Getting the planning consent for [removed for IPR]. Which was about ten years before it actually got built because there was a recession and it took a long time for investors to come back to it. So that was more of an urban design plus a planning exercise on a bigger scale. I could incorporate my urban design training into that. I like those schemes that includes other schemes like that. [Removed for IPR], which was really taking miles of the old docks and come out with a master plan of a building which was done 20 years ago and is only now getting developed. So it’s been long terms stuff where you’ve got to imagine that in the future and how’s that going to look, set down rules, pick off the sites and see if developers can come in and build them out. That can take a process of decades sometimes. And other schemes like that which I’ve been involved in shopping centres, in Dundee, in London and other places where it’s very fast track, large projects. Where there is maybe 8 staff involved for about 6 months to get the design developed quickly and then it’s built quickly. So that’s an example of a very large project that can happen very quickly. After 5 years they refurbish them again so you actually only see your work for a number of years and then it’s knocked down and changed.
Sian: How does that feel? Do you find that frustrating

Jay: No, well you learn that that is the commercial way of the world. It means that if that happens then there is more work for architects because you have to redesign them again. So it comes round full circle.
Sian: Do you ever get asked to redesign something that you've worked on previously?
Jay: Yes, that happened with some of the shopping centres. And after 5 years, things have changed anyway so it's quite easy to say that was the print for the time and we can bring in new ideas. So it helps with the creativity to say well we did make some mistakes there and we can correct them 2nd time round

The project was seen as a kind of living organism, an actor in its own right. It had influences from the various people who worked on it, and those influences would vary depending on the specific personnel involved. It was influenced by the work of those designers and the projects they had previously worked on. It also was influenced by the clients that commissioned it. Karl, another senior architect commented that:

Karl: It's the client's primary thing is to finish on time in order to make money on it. That's the two most important things probably. If you finish on time, they're going to come back and use you again. If you give them the most beautiful building in the world but it cost twice as much, they're never going to come back. So it really depends on the client and what his brief is according to him
Sian: Do you think having a good relationship with a client is the ultimate factor?
Karl: That's the thing, you can have a good relationship with a client on a personal level but if you can't produce what he needs.... You can find some people who are difficult to work with but if you can deliver the goods for them, for what they want, they will still use you

The dynamic of the client and designer felt like they were nurturing the project, with both having a vested interest in the project's success. If the relationship isn't a good one, the project can be difficult but both parties can walk away at the end of it. If the connection between the client and designer is based on friendship then more is at stake besides the success of the project (the continuation of the friendship for example), but it can open up more opportunities. This situation was discussed by Wyn:

Wyn: Um project wise here. I think the [removed for IPR], which I've told you about as well. I was taken onboard because the client I already knew. I was pretty proud of that. To be given the chance because there isn't many people of my experience be given a job to run themselves. From pitching the job, researching feasibility and stuff like that and seeing it through to completion.

Other influences to the project relate to the designer's perception of it, if it's close to their heart for instance. Wyn, for instance, when describing a favourable project, referred to projects that he had a strong personal connection with as those he was most affectionate to.

Wyn: *the next one, is spread apart a bit, it was probably in the 5th year at Uni, which was part of my 5th year project. We were told in the 4th year that we were given an area that was being re-developed by the Glasgow city council. Basically it was poor areas and stuff like that. We weren't told where it was when we started the course. We were told it was the Gallowgate area which is where my family came from basically. My mum was born there and my Gran lived there for years and my aunt still lives there. That's where my school was sort of thing. It was a bit closer to me than any other project because it was real people we were dealing with. It brought it home what my job was. Um... it was nice to have a real element to it before I get into practice. People from outside Glasgow were studying at Strathclyde. People from different social backgrounds. Wealthier social backgrounds were unused to the areas we were working in. They were quite disillusioned about why people were there. Outsiders looking in and thinking, 'why would you live there?'. From an insider, and me knowing these people who lived there, and at one stage there was a real sense of community. On the surface it's lost now. It is there are a deeper level. It highlighted how deep my involvement should be as an architect in something like that. It was a good lesson. And other people's impression and what residents wanted in poor areas. For me that was a pretty big project just because of the ties back to my family and growing up there and stuff.*

The other stuff I've done has been charity work and event stuff. One of my friend's baby died at 12 weeks. I DJ quite a lot and did events to raise money for the ward to buy incubators and stuff like that. Nothing to do with this job but it was something kind of...

This section has shown how the company was up through a history of connections. That it also had many informal sub groups based on pre-existing ties (same university for example). Projects had a "life of its own" with influence from the team within it and the clients commissioning it. That the connections and associations were compared to being a family: through bad times and good

7.3 Identify irreversibility

The descriptions and analysis so far have related to a network of associations at a snap shot in time. Of course the network itself is very fluid, changing from one week to the next as people join the company and leave it. For instance, the Friday before I started the main part of the project, two of the interior designers had left the company (under dubious circumstances). Vera and Simeon had left the company taking the project they were working on with them. Although their project was self-contained and other designers didn't need to be brought in to cover their work, long term planning and the allocation of people to projects needed to change. In addition to people leaving the company during the research, Lois also joined the company. Although she had a computing background, she was brought into the interior design team to work on 3D visualisations.

People also joined and departed projects, with projects shifting personnel during the design process, allowing differing people to be brought into the project to meet a specific need.

Sian: is the work that you're doing at the moment, is that individual or is it a team project?
Alastair: no, no this is individual because of the nature of the project. This is an old church. It's called Kelvin grove church. They're turning it into 18 flats. It started off with Kenny and I as a team but then Albion street became a priority so Kenny came

off and I took over. Then Lotti was brought in to help me as pressures became critical. Then Lotti will move on to help Jo and Kenny will be on Albion Street. So I'm left to do this specifically. What happens is that once the pressure is off then the team comes back. Kenny was away for a month at Christmas and there was no one to do Albion Street and I took over responsibility and kept Albion Street flowing so there was no drop. The client didn't see anything. That's what happens on all the jobs. Somebody can step in and take over.

Even during the field research, a great deal of modification occurred within the company. When initial introductions to the company began in October 2005, the company resided in a completely different office. The picture (figures 52) is taken from these offices. However, once the research began in earnest (Spring 2006) the company had moved to new premises. The shift in office building meant that whereas previously all the "creatives" sat together, their new location resulted in architecture and interior design sitting on one floor and the graphic design team sitting on another floor. Moreover, the move to new premises coincided with Extricate merging within another company. This new company contained software developers and advertising executives, who sat on the same floor as the graphic design team.

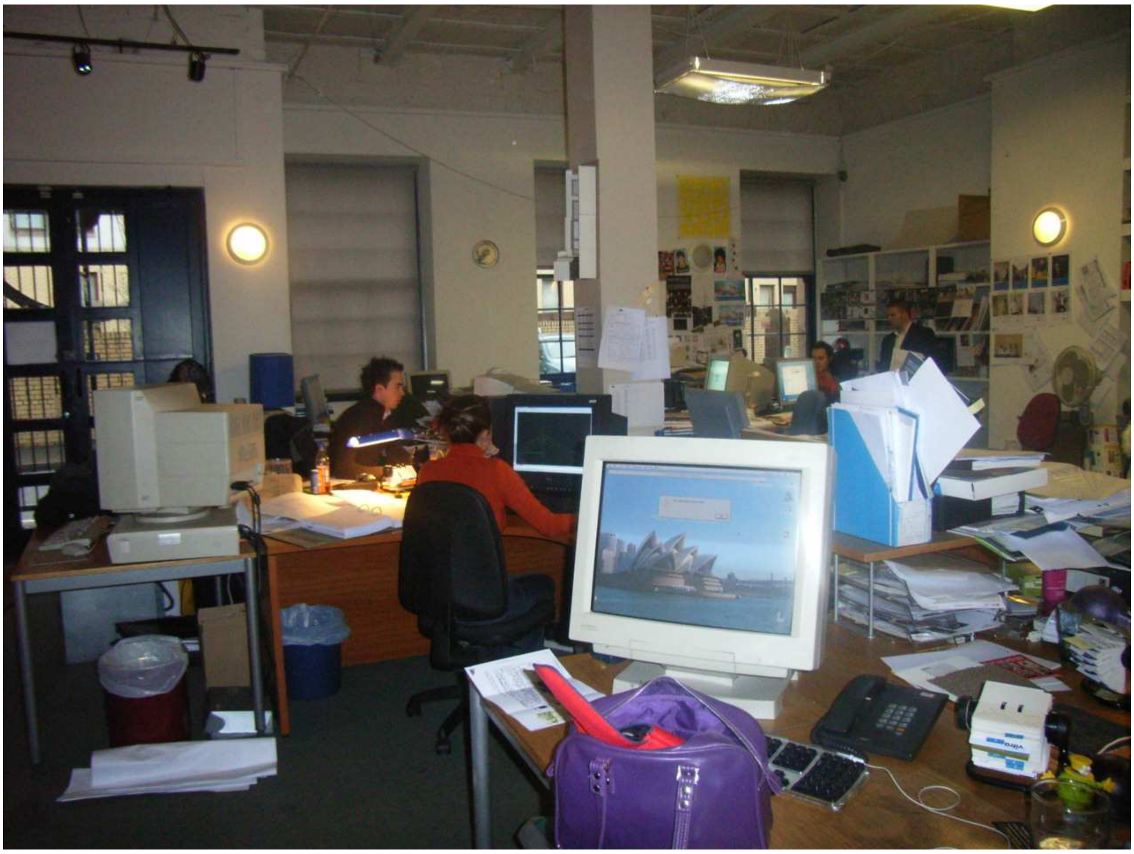


Figure 52: Photo from old Extricate office

The move to new offices, the merger of the company, and the decision by two key interior design personnel to leave the company, all resulted in an atmosphere that was in flux and this was particularly the case in the upper floor which housed the graphic designers. This was highlighted by a dispute between the advertising executives and the graphic design team. In their new location, they sat close together. The graphic designers were all a lot younger than the advertising executives and had been used to relaxed culture where music would be played in a studio setting (as had been the case in the previous office site). The advertising executives did not approve of having music played and asked for it to be turned down (which the graphic designers did). However the music was still too loud and the graphic designers' "constant chatting" infuriated the advertising executives. So much so, that one advertising executive physically turned the music off and shouted at the graphic designers. A few graphic designers responded but the main reaction was an uncomfortable silence. The atmosphere in the area was very awkward.

All of this had a significant influence on the interplay of associations between the disciplines. People would need to physically go to another floor in order to work or speak to an individual from another discipline. The designers felt uncomfortable with the new situation and company move, and rumours of financial difficulty abounded. The Herald article referenced below (as well as a previous article) became common knowledge to the staff of Extricate, resulting in many staff members questioning their long term position in the company.

The Herald Article – Friday March 24th 2006

Use of Extricate name raises difficult question

"Plans to merge Glasgow creative agency Extricate with city rival Cxxx group have been thrown into doubt by the interim liquidator acting for the former company's creditors.

Maureen Leslie told Extricate founders Stuart and Simon yesterday that they may have to pay for the privilege if they want to call the combined business Extricate Group. The pair are "considering their options", she said.

The Herald revealed on Wednesday that Extricate Ltd, once ranked among Scotland's 20 most promising young businesses, was placed into liquidation by Stuart B and Simon H last week – only to be immediately reborn through a link-up with local advertising and new media rival Cxxx. The development has left a trail of anxious creditors, a number of whom have already contacted Active Corporate's Leslie.

According to a press release issued by the putative merger partners, about 20 Extricate staff have transferred to the Cxxx's office in Waterloo Street, creating a business with 58 employees and annual sales of more than £7m. Their intention is to trade as ExtricateGroup.

Leslie cannot yet put a figure on the debts left by Extricate Ltd. However, she has been able to establish that no merger has in fact taken in place . Extricate staff are operating alongside Cxxx through an unincorporated partnership. She is now examining the potential value of ExtricateGroup name, which she believes could produce a return for the liquidated company's creditors.

"In my view there are difficulties in them trading as ExtricateGroup. Insolvency law say you can't continue (trading) with a name very similar to that of the previous company."

Extricate was formed by Simon H and Stuart B in 1997 as a graphic design company. It evolved to become Scotland's fourth largest creative agency, with clients including the Scottish Football Association and Glasgow City Council." Paul Rogerson

This section has shown:

- the evolving nature of the networks within the company and the project worked on

- the issues associated with a changing network of projects, teams and company personnel
- the impact the physical change of office had upon the inter-disciplinary nature of the company
- the issues and impact of a “negative atmosphere” upon the research and analysis of connections.

Conclusion

Extricate was a company in flux, and as such it was a moving target. Office moves, changes to seating arrangements, personnel leaving and joining all impacted on the company, its staff and atmosphere. The rich descriptions of the contextual observations provide a broad understanding of the history and background to the company and the people involved. To understand the interactions of staff, particularly how they evaluated and reflected on each other’s work, the following section applies Social Network Analysis to observed interactions between the inter-disciplinary designers.

8. Case study 2 – professional studio – social network analysis

Introduction

This chapter looks specifically at the observed interactions between designers when they share feedback about their work. It takes a different methodological approach to capturing SNA data than the educational case study, as the numerical data is based on observed phenomenon. Partly a consequence of designers not having the time to complete lengthy SNA surveys, it is also a decision to apply the combined SNA and contextual observation technique similar to White and Johansen's (2002) approach. In this approach, observations provide the SNA data rather than contextualising the survey data and as such the network analysis is not a result of how the actors perceive the situation. Instead, the interactions are observed and are formulated by the researcher and their own perception. It is also the case that designers may not recognise they are reflecting on the work of others (and subsequently not accurately respond in the survey), but if that interaction can be observed and then becomes part of the network data. The following analysis relates to the identification of actor interactions and building a network model of how designers socially reflect in a professional studio.

8.1 Identify actor interactions

In order to identify the interactions between the actors, a matrix was formed which charted when someone communicated with someone else, and the type of communication that was involved. There are many caveats to this matrix of observations. The time involved in the conversation was not recorded; there was probably more bias towards people who sat closest to the researcher; more acute notice was taken when someone got up and walked to a colleague's desk; and finally it was difficult to capture conversations that started at the same time or when there was multiple conversations at once. Many historical anthropological social network analyses were based on observation, such as the Blau (1964) study into a telephone exchange. However, recent focus has been on numerical survey based network analysis.

The following investigation into actor interactions it designed to be an example, and to show an idea of what was occurring. It was envisaged as a way of discovering potentially hidden patterns of interaction and to chart the changes to the network. A fragment of the framework appears in table 9.

Communication Number	**Time Started**	**Type of communication**	**Actors involved**	**Who instigates**	**Notes**
24	11:09 am	Informal	Lotti Wyn	L -> W	They are discussing the interview that the researcher carried out with Wyn
25	11:10	Work related	Stuart, Simon, Tim and Sally	?	The conversation was started upstairs and it is continued as they walk through the room.
26	11:20	Informal reflection	Lois and Sally	S -> L	Sally is looking over Lotti's 3D CAD drawings

Table 9: A snippet from the matrix of interactions occurring in case study 2

The matrix of research (as shown in table 9), formed the basis of the figure 53 and 54 below. Communications of informal and formal designer evaluation between actors are specifically shown in the figures 53. Figure 53 shows the combination of "informal" and "formal" feedback conversations. The two types of feedback were amalgamated as it was very difficult to differentiate between these two feedback types within the professional studio. Often it was a judgement call, a tone of voice, or the manner in which the conversation was started that dictated how it was documented in the SNA framework. All informal and formal reflective conversations referred to specific instances of work from a project. By always being work related, they were in a sense always formal feedback associations. On reflection, formal and informal feedback could be distinguished by the ownership of a project. If both people involved in the conversation had some kind of collaborative ownership of the project i.e. it was their project, then feedback would occur in a formal sense. In contrast, if feedback was being given by one person about another person's work without any level of ownership it could be thought of as informal. Using this rigged definition, the examples of informal feedback in the Extricate case would be primarily seen between Brian and Dennis (who were working on projects individually), and also Edgar and Lois.

The visualisations below reveal the most centralised actors, groups of actors and those who are most isolated within the network at Extricate. It does not show, however, that the data captured occurred over many days. During those days there were patterns of interaction, with some days being busier than others. The visualisations are results of the accumulated data, an average of all that occurred during the main part of the study.

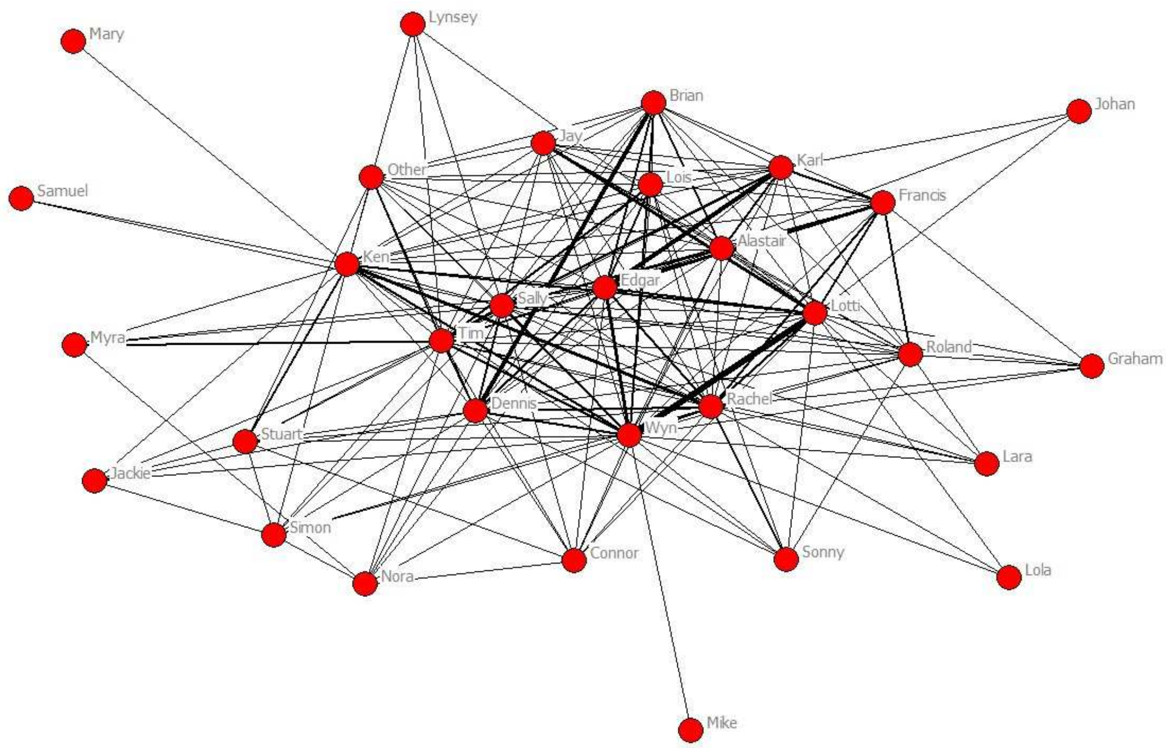


Figure 53: Network diagram of all communication in Extricate

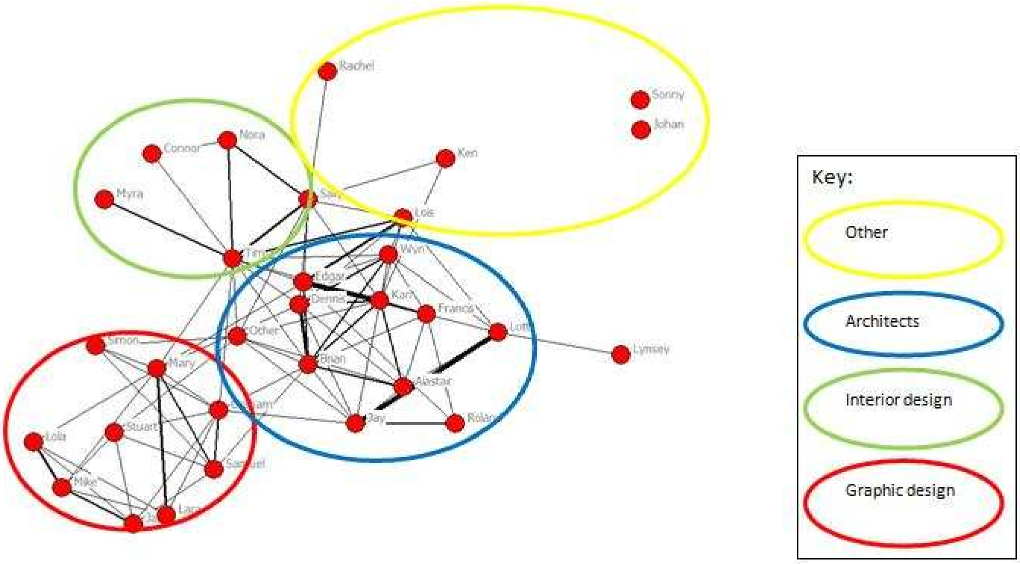


Figure 54: Network diagram of just feedback (both formal and informal)

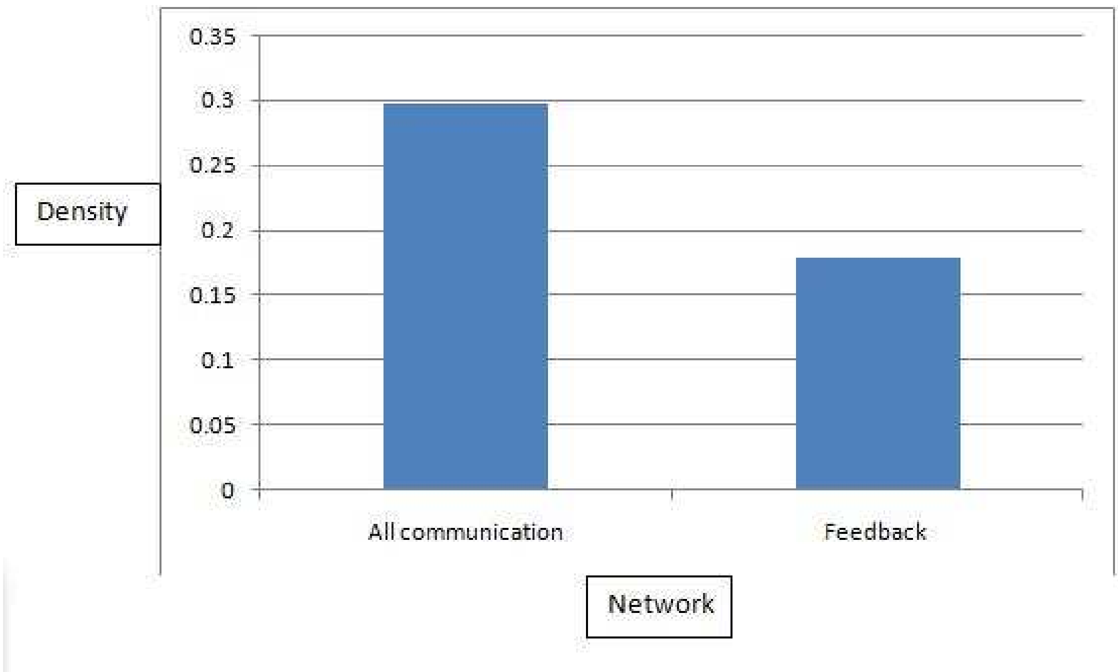


Figure 55: Network densities of all communication compared to feedback in Extricate

It can be seen from figure 53, that people did not share feedback as much as general communication. The network density figures in figure 55 also confirm this. It should be noted that the network density figures are based on transformed binary data whereas the visualisations in figure 53 and 54 are valued data. Transforming the data into binary (either they did or they didn't communicate or share feedback), makes the density figures more easily understood. In binary data, the density figure is a ratio of actual adjacent nodes divided by possible number of pairs - what proportion of all possible connections are actually present (Hanneman 2008). With valued data, density is defined as the average strength of ties across all possible (not all actual) ties and the tie values in the Extricate were often very large. The density based on binary values gives enough information to convey the idea of the communication network being denser than the feedback network. It also enables comparison with the student studio, as that used binary data.

The network of feedback association within Extricate (figure 54) reveals far more distinct groupings than the network of general communication associations (figure 53). Those distinct clusters that form each of the different creative disciplines in the company can easily be seen from the network visualisation in figure 54. The red circle represents the graphic designers, the blue circle the architects, the green circle the interior designers, and the yellow circle the accounts people. These demarcated areas rarely overlapped, with different sections of the company not exchanging reflective conversations. Although this company may appear inter-disciplinary, in practice, people kept to their discipline alignments. Possible exceptions to this are Tim and Sally, who, although interior designers, have a strong alignment to the architects (shown in figure 54), they also sat in the same floor as the architects. Another exception is Lois (Lois), who uses 3D studio Max and CAD packages. During the time of the field research, her work was applied to an interior design project but was also applicable to the work of the architects.

Figure 54 also reveals strong pairs of connections (the greater the width of the connecting line the greater the connection between the actors). Jay and Lotti, Karl and Edgar, Dennis and Brian, and Karl and Francis are all examples of strong pairings. With the exception of Dennis and Brian (both fully qualified architects); the other pairings form an expert and apprenticeship pattern which is very typical within architecture practices (Lee, Eastman and Zimring 2003). This formed a formal feedback process based on formal team alignments. Dennis and Brian's reflective conversations were more informal even though they were not working on the same project. Dennis would often oversee Wyn's work (although this is not shown in the network diagram), but also often worked independently. Brian also worked on projects on his own (during the study), and they sat close to each other as well. Sitting the other side to Dennis was Edgar (a much more junior architect). Although Jay sat next to Brian, there was a partition between the two and there was no direct line of sight.

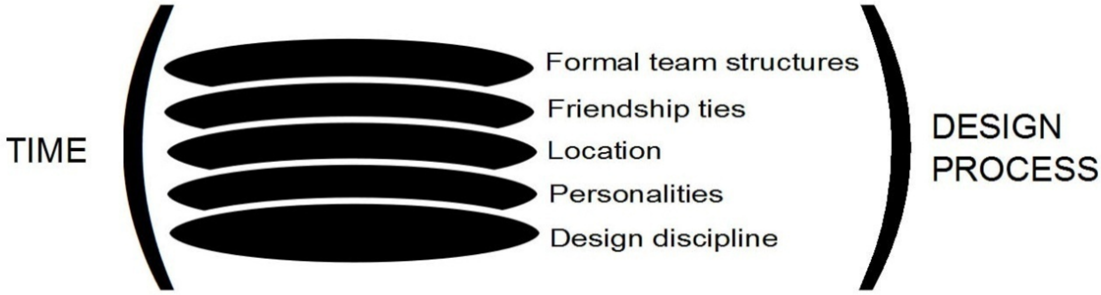
The feedback conversations tended to remain within each design discipline and with the strongest connections between formal team pairs. Location does not seem to have much of a bearing on the feedback network (apart from Brian and Dennis perhaps), but the role of location can magnify or decrease the relationship between two people. If a designer needs to cross the floor to discuss work, then the association is all the more important. Karl and Edgar did not sit close to one another so their close working relationship (shown in figure 53), is all the more connected. Friendship ties are not seen in figures 53 and 54. This was surprising as it was expected that friendship groups would be referred to during the project. Perhaps it was the case that the actors kept these kinds of conversations out of work hours. The communication of feedback and reflection that was observed between friendship groups was always during lunch breaks, which were not recorded in the network analysis framework. The personality, motives and interests of the individual form the final category that could impact on who gives feedback to whom. Edgar and Lois for example are revealed in figure 54 as having a close connection. However, they were not on the same project and they were not friends (Lois had just joined the company), they were not of the same discipline, but they did sit next to one another (so did Dennis and Edgar but they did not have a strong connection). It is possible that their relationship was based on likeable personalities or common interests. Edgar had an interest in Lois's work (figure 60, 61 and 62); a connection which may have been intensified because they sat next to each other.

To summarise this section, it has:

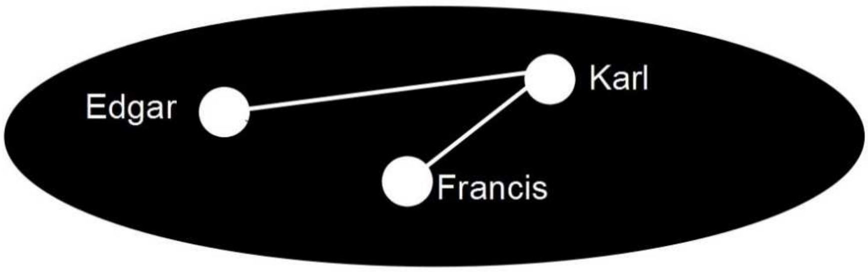
- Discussed the difficulty of distinguishing between informal and formal reflective conversations in the studio
- Shown that the groupings within the feedback network were based on discipline area and this suggested the company was more multi-disciplinary than inter-disciplinary
- shown there were strong patterns of dyad feedback relationships in the studio
- shown the issue and impact of studio seating arrangements

8.2 Build a network model

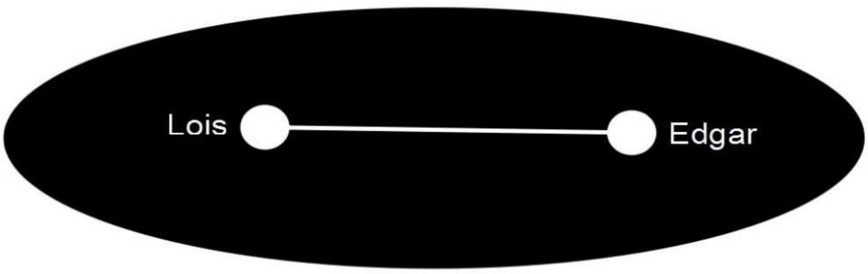
The network analysis so far has concentrated on describing the overall network and trends, but the connections and attributes between people also need to be described. These manifest themselves as a series of influences upon the sharing of feedback. The network analysis showed a series of social influences inherent in the design studio that effect the sharing of feedback. Each designer resides in a network of influences (or layers) that accumulates together to form a complex set of interactions and pressures. A list of five identified layers are shown in figure 48. Although these layers are distinct they are not independent of each other. An obvious example is the link between the friendship layer and the personalities (interest) layer. Each layer in turn can be cross-referenced with the feedback network to identify any similarities. It could be argued that if a layer does match the feedback network, then this is the primary influence for feedback being shared (feedback network and formal team structure for instance). Of course it is probably the case that there is a myriad of influences and so the layers are referred to as such rather than as networks in their own right. Each layer in turn will dynamically alter as time passes, depending on the stage a project is at within the design process. Figure 56 models the differing layers, with each layers shown in more detail. The examples given relate to the actor Edgar.



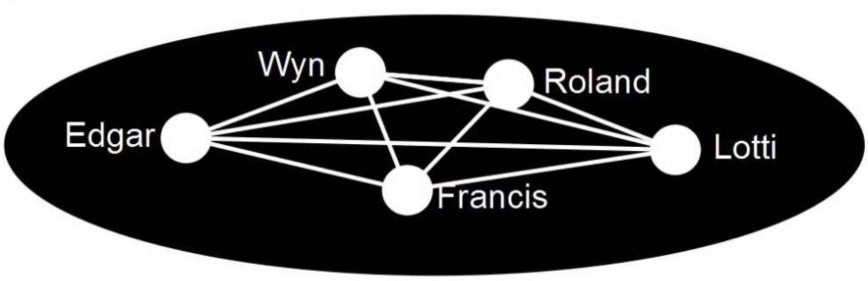
Formal team structures



Personalities



Friendship ties



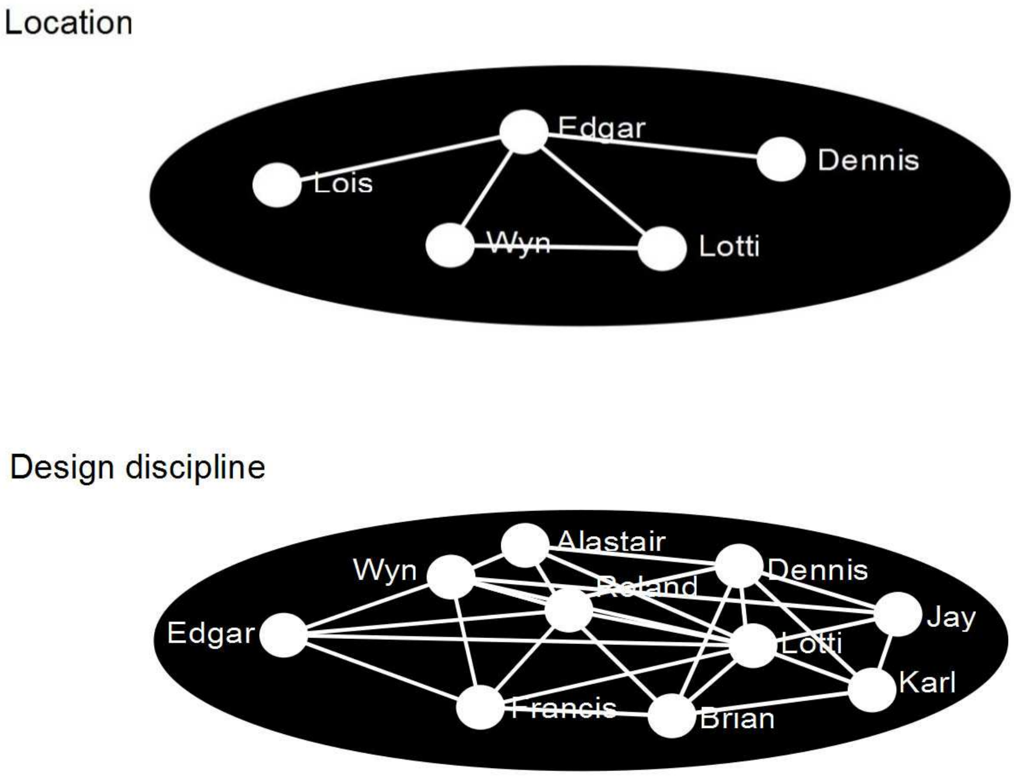


Figure 56: Influences to the feedback network within professional studio

This section has shown the differing networks that exist for each individual and the potential influence this has on the sharing of feedback. It has also discussed how the network visualisations is a flat snap shot that doesn’t reflect the various network layers or the changing network over time

8.3 Identify inhibitors and promoters

Inhibitors and promoters of the inter-disciplinary nature of the network at Extricate can be identified as those people who had high go-between (betweenness centrality) values or were highly connected (degree centrality). These two measures were used in the student analysis (and explanation of the difference between the two types of centrality can be found in chapter 6). Inhibitors and promoters can also be seen as cutpoints that divide the network into sub-groups (cliques). Inhibitors can also be isolated designers as an introduction of idea or software to these individuals would not spread through the network.

8.3.1 Connectivity (go between and centrality)

When betweeness analysis was carried out on the data, the following list of people scored the highest go-between rating:

Go-betweens (betweeness centrality)

- **Tim**
- **Monika**
- **Sally**
- **Greg**

Tim and Sally from the interior design team were go-betweens or promoters between the interior designers to the architects, and graphic designers. Their long-standing employment with Simon and Stuart and the associated graphic design team (noting that Tim and Simon had also grown up together) were all prior to the architectural side of the company joining Extricate. The interior design team's new location, on the same floor as the architects meant they had a pivotal position and could move between the two floors.

The strong connection bonds influenced the centrality of individuals within the company. People with many strong bonds ultimately appeared to have high centrality scores (when a degree centrality algorithm was applied). Karl, for example, had an expert role on two projects that related to Edgar and Francis and as a consequence he is the most centralised person:

Most centralised people (degree centrality):

- **Karl**
- **Edgar**
- **Brian**
- **Tim**
- **Jay**
- **Dennis**

- **Lotti**

The physical layout of the office inhibited the inter-change of ideas, because walking (or getting the lift) to another floor to speak to a colleague about a piece of work is a very intentional and specific act. The strong connections which exist within the company that require a person to move away from their desk are therefore all the more significant. For instance, Karl and Edgar did not sit close enough to converse about the project they were working on without one of them physically moving to be closer to the other. The same is true of Jay and Lotti. These strong connections are therefore even stronger, whilst the connection between Dennis and Brian (who did sit close to each other) is less significant. Thus the physical layout of the Extricate office can be an inhibitor or promoter to communication process, and can magnify or decrease existing ties. In hindsight it would have been useful to chart the interactions between people in the old office and compare that to the new office. It is envisaged that the old office network analysis would reveal higher levels of interaction.

Figure 57: Extricate at their previous office – taken from the entrance doorway

Figure 58: Extricate at their previous office – the communal area

8.3.2 Reciprocal ties, cliques and sub-groups

The next network role to be looked at is the clique member. To gauge whether a group will have many cliques, the visual analysis (figure 54) can be examined. This shows that cliques seem to form around design discipline. To confirm the observations from the network visualisations, a series of network statistical measures can be applied. The first of these is reciprocity. If there a high degree of reciprocity it can be assumed that groups are formed within the network (unless of course everyone in the network is inter-connected, but the density figures in figure 55 disproves this). Figure 58 shows that within the feedback sharing network, there is an incredibly high level of reciprocal ties (93%). This forms good grounds for suggesting that the professional studio will form into cliques.

When n-clique analysis was carried out, the communication within the company revealed there to be one big clique (the whole company). In the feedback network, 5 cliques were identified, despite the visual diagram only revealing four groups. In the n-clique analysis, overlaps are counted. So one person could appear in two or more n-cliques, thus allowing for there to be cliques within cliques (this is only seen when n-clique rather than clique analysis is run because clique analysis defines cliques as everyone being linked to everyone else). One possible reason for five n-cliques being identified is the impact of Lois's work. Lois was carrying out a project that concerned interior design but was also of interest to the architects. This meant that she spanned two cliques. When block analysis was carried out (which distinguishes a group, if the removal of a cut point will make them an autonomous component), there were indeed 4 block groups identified. This confirms the visualisation and analysis that Extricate was split divisionally when they shared feedback.

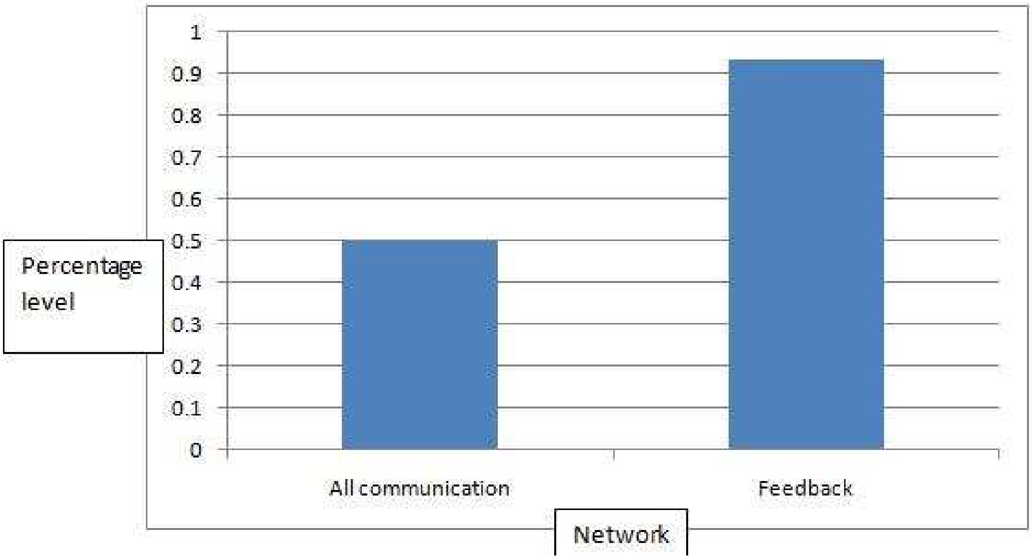


Figure 59: Level of reciprocated ties for each network

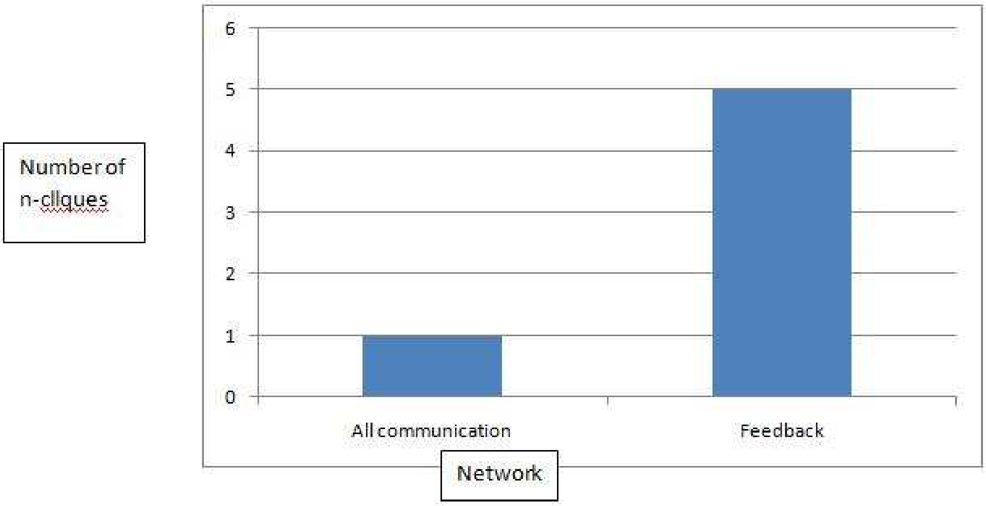


Figure 60: Number of n-cliques within the professional studio

8.3.3 Isolates

Two isolates can be identified from the feedback network (figure 54), namely Sonny and Johan. Johan left the company at the beginning of the research so his isolation is not really of note. Sonny on the other hand, was involved in the managerial side of the business and this, at first, would seem an obvious reason why he was isolated from conversations about feedback. However, Ken and Rachel were also involved in accounts and management but they did participate in some reflective conversations. Admittedly these were quite few in number but the reflective conversations that occurred centred on how a project would be seen by the client (with both Rachel and Ken having a lot of client exposure). Furthermore, Sonny was out-going and friendly. Perhaps he was not as client facing as Rachel and Ken (as he was primarily carrying out strategy within the company for his KTP); he also sat very close to two of the directors. It is possibly the case that this limited how often people would ask him for feedback (especially when he's not dealing with their client in particular), as the directors might question why Sonny was involved in the conversation. Furthermore, if a designer was making the effort to approach Sonny (who sat some distance away from most designers), then the two directors could easily be approached as they had more of a creative background than Sonny did.

In this section go-between designers were identified, and those people who worked with more than one discipline were highlighted as more highly connected. Clique identification re-affirmed the company as multi-disciplinary rather than inter-disciplinary. That there are many issues surrounding those people identified as isolated.

8.4 Actions

The patterns of associations that exist within an organisation are often unknown. In a best case scenario, people within an organisation will have pre-conceived ideas about the relationships within their organisation. For instance, it would be perceived that those architects who had travelled round Europe together and had gone to the same university would have strong associations when discussing their work. However in practice, formal team alignments superseded friendship bonds. In other scenarios, people freshly coming into an organisation would have no idea about the team interactions that occur. Visualising a network can therefore reveal the associations and dynamics of an organisation. This can help those within the network to reflect on their role and people outside the network to understand the formation of staff, informal associations and formal project teams.

Critical among this, is the identification of roles and how the actors play these roles. Certain roles are hugely influential to the network at large. An actor can have many connections to them, such as Karl. He may work on numerous teams (Karl was actually working on two projects and previously worked on a project that Alastair had taken over), or a team with lots of people working in it, or they may simply be a source for information and advice. Go-between people can act as mediators between different disciplines within an organisation. Tim, for example, could bring the multi-disciplinary nature of Extricate to form an inter-disciplinary company. Identifying these people is therefore highly important. Equally, identifying isolates that do not connect with other people within an organisation may suggest they are not fitting into the right team or psychologically they feel isolated and potentially may leave an organisation. Group formation may reveal where teams exists and also gaps in those teams. The feedback network (figure 54) clearly showed the disciplines as segmented.

The fluidity of any network of people is evident in the Extricate case study. Organisations change, people move on and new people are employed. The projects, teams and the work that is being completed will all have changes in personnel but also the work will change as it moves through the design process. The networks visualised in figures 53 and 54 are a snapshot; in the next month, year or ten years there will be a completely different configuration of people. Any visualisation should therefore reflect this change over time in some way, both in terms of social changes but also changes in the designs, and how this inter-relates to the personnel working on a design from conception to producing the finished article for the client.

The identification of objects and work was difficult within Extricate as people ‘hid’ behind their computer screens. Work that was shared and sent to other people was not known (unless it was openly referred to) and this, virtual feedback network, was less overt than explicit communication between individuals. That being said most reflections referred to work (both digitally and otherwise), for example Lois’s work (figures 60, 61 and 62) and some work featured on the walls of the office (this was walked through by Francis). The interactions between Edgar and Lois all related to the [removed for IPR] project she was working on in Studio Max (see figures 61, 62 and 63 below). This connection was partly fuelled because they sat next to each other, but also because Edgar had a certain level of expertise in CAD and a keen interest in graphical representations. Of course all the work related communications and reflexive communications related to objects of work in some degree or another (and whether or not that work was manifested in some way). All the networks of interaction between individuals that are shown in figure 46 could easily be links between work objects, with the persons involved replaced by the work objects concerned. In essence images of work are snap shot representations of the actors who have created them. Consequently, the work objects associated with an individual are important in understanding what the work related communication is about, and why the people involved are reflecting upon it.

Figure 61: Lois’s 3D StudioMax project for [name removed for IPR] 1

Figure 62: Lois's 3D StudioMax project for [name removed for IPR] 2

Figure 63: Lois's 3D StudioMax project for [name removed for IPR] 3

To summarise, it has been shown implication of role identification. The importance of the changing network during the design process was re-iterated and the intricacies of revealing this. It was also shown the importance of objects (graphical work objects) and how they should be referenced and included in the network.

Conclusion

This case study has looked for the social influences within the studio and in particular how professional designers share feedback. It's sought to reveal patterns of interactions and the social networks that exist within a studio setting. The discussions so far (in both case studies) have sought to describe what occurred in an educational and professional inter-disciplinary design studio. It has sought, in general, to describe rather than explain in order to adhere to Actor Network Theory and Ethnomethodolgocal principles. Neither has it sought to produce a new theoretical stance, rather describing what has been seen from a social constructivist stance. The following chapter takes these descriptions and gleams from them the requirements for a visualisation software tool. The next chapter discusses the findings from the case studies and how they inform models of design. It will also discuss how requirements can be specified from the research in order to develop prototype software that aids designers reflect on how they are socially influenced.

9. From case study research to prototype development

Introduction

The write up of the research case studies has been structured chronologically as well as categorically into the qualitative and quantitative findings, this section however looks at the concept of social influence in both studios in their totality, using examples from both types of research to make the argument for what should be prototyped.

This chapter links the findings from the two case studies, within a framework of requirements, into the next stage in developing a prototype network visualisation tool. In developing a socially translucent software prototype, the two case studies have addressed ‘what is to be built’ the definition of requirements gathering. They have done so by understanding the intricacies and particularities of social influence and networks within an interdisciplinary design studio in order to technologically reveal the social dynamics at play. The case studies have shown what is to be built and what the network visualisation should expose in a design studio.

So far, the research from the two case studies has described the social networks within a design studio. The next phase is to begin planning and developing software that helps to understand and articulate those networks. In software design processes, there has often been a distinct stage in which technology is produced. The requirements stage is, to some extent, separate from the specification stage, which is again separate from programming the technology (although it is noted that some programs are written during and before the writing of the specification). The systems design process looks at what is to be built and then moves to the building of the software itself. A ‘half way house’ to this, is the production of a prototype, that aids users, requirements engineer and developers to crystallise and manifest theories that have previously been put forward. The prototypes can be lo-fi (non-technical often paper prototypes) or hi-fi (produced in software), but both aim to provide “tools for traversing a design space where all possible design alternatives and their rationales can be explored.... Designers communicate the rationales of their design decisions through prototypes. Prototypes stimulate reflections, and designers use them to frame, refine and discover possibilities in a design space" (Lim et al 2008 p7).

Prototyping software can be achieved in many differing ways. The most common examples are paper based prototypes, in which paper is used to simulate what the software should achieve, and software based prototypes which allow for relatively simple programmed concepts to be put forward. There are many pro and cons for choosing one over the other. Paper based prototypes can, for example, explore more options as there is an ease at which paper simulations can recreate the software more fully (incorporating broad ideas such as content, form and structure etc) (Benyon 2010). However they require the tester to sit with the paper prototype, interacting with a tangible medium that does not represent the technology which would be used (in a sense it can be seen as more artificial). Software based prototypes, on the other hand, tend to be smaller in scope because of the length of time it can take to programme the prototype, although they can provide a more detailed evaluation about content, visuals, interactivity, functionality etc (Benyon 2010). They can also however be programmed in the manner in which they are eventually meant to be used (the choice of technology), although this can also lead to users perceiving the software as a finished product. Testing can also be achieved at distance, without the presence of the researcher. Many aspects of the feasibility of the software can also be learnt from actually beginning to programme it, such as facets to the proposed software that are difficult to achieve (and that may require a questioning of their inclusion if the cost is too great). If this happens earlier rather than later, when requirements engineers are actively involved in the project and uses can 'sign off' the conceptual design, it can avoid costly disputes.

In testing of a prototype with real users, the claims made from the requirements and the specification, to some extent, are questioned and evaluated. If the tests reveal that a prototype does not fulfil the task it was set out to do, questions can be asked about the accuracy of the specification, if the requirements from the field are justified and in particular if the methodological approach taken to understand a field sight was an appropriate one. It can strengthen or weaken any argument put forward in the specification and from research findings.

In light of these issues, the following section outlines the development of a programmed prototype based upon the findings and concepts emanating from the two case studies. The following sections are broken down into themes that emerged from both network analysis and contextual observations. These themes are also used during the testing of the prototype. These themes form part of the assessment of the methodological approach and facilitate a common strand through which evaluation can be made beyond personal opinion about the appropriateness of the requirements gathering techniques (as this is based on the opinion of real users rather than the researcher alone). The findings from the prototype software also inform the general understanding of feedback sharing in an inter-disciplinary design studio. In particular, the role of visual technology to aid peer evaluation between designers. With these two elements in mind (evaluating the findings from the case studies and how they inform the software, and the use of software to visualise the network of feedback sharing), the following section looks at the five core themes (roles, visuals/objects, time, location and levels), and their grounding and justification from the case studies.

The software outlined in this chapter aims to support designers reflect on their role and work within a group (network) context. It has previously been discussed both in terms of the prevailing literature, and also the field research carried out, how design is part of a social model. Designs, and designers, are judged on their work in light of those around them, the field at large and the general design domain. Designers, by the time they reach their final year of undergraduate studies, have an innate awareness of this, and as such reflect on the work of their peers, as well as ask their peers to reflect on their work. This forms part of a feedback cycle that continually challenges the designs being produced until the final work is completed, published and disseminated. The software outlined in this chapter aims to visualize this process:

- who a designer is connected to
- their work and the work of those they have a close relationship with
- the identification of key network roles (and potentially whose work a designer does not review at all)
- how group dynamics and design work change over time.

This enables the reflective process of the designer particularly concerning their role within a group, and group work in general.

Technology is used to support each stage of the design process, enhancing or even replacing what is supposed to occur. Some technologies even span a number of stages during the design process, whilst others are a certain aspect of a particular stage. In order to reflect upon initial product concepts, the prototype software is used to reveal the patterns of collaboration during this concept development stage (figure 58). Although it can be used to show the changes of patterns during the design process as a whole, the focus is still within the concept development stage as this offers the best opportunity for the feedback of peers to have the greatest impact. The software forms part of the cyclical process in generating and selecting concepts based on advice or influence from others (figure 56). Similarly it also aids the cyclical process proposed in the DIFI model (figure 4), where the artefact is evaluated and feedback given between designers and their peers. The artefact is then modified in light of recommendations and presented again. Visualising this interaction allows the designer to understand who is influencing their work within a social model of design. Potentially, facilitating a widening of peoples who respond to the artefact.

9.1 Themes and concepts emanating from the case studies

9.1.1 Roles

The issue of roles came to the fore prior to both case studies, during a review of the literature surrounding SNA. Role identification is prevalent within SNA research and indeed it is featured in Ashton’s (2001) work also. Three types of roles were identified in the educational studio: the isolate/vulnerable, the clique member and the go-between. It was proposed that if being a certain network role was shown to have an impact on student grade, it would seem important to reveal those roles in order to aid both educator and student. The assessment of grade to role had a mixed response. Being a go-between student seemed connected to higher grades in the first cohort but in the second and third degree courses, there was no significant connection with grade. In the visual network however, there was a distinct correlation between higher grades and being a go-between in the network. It is probable that the students viewed the work of their peers with the highest grades, when it was done so anonymously. They would look at the work of the best student, which they may not do in a real studio as they may not necessarily be friends. The analysis of grade to clique membership, did seem to show a connection, but without checking the grades of students prior to and after membership in a clique is it difficult to tell if being in the clique keeps students within average grade boundaries. There also seemed a connection between isolated and vulnerable students in the network and lower grade results.

A comparison between grade and role within the professional studio was not carried out as capturing a grading mechanism in a professional studio is far more complex, especially when assessing projects when they are only part way through. Some role identification was carried out though and go-between designers were revealed in the professional studio, as were isolates and clique members. It was shown that go-between designers were in positions where they worked with two differing design disciplines. People with high centrality scores were most frequently asked to reflect on the work of others and sat in a pivotal position in the network. Clique membership centred around design discipline whilst the isolates were both accounts people.

The identification of roles was therefore a feature to be included in the visualisation tool. Although not all the results indicated a link to grade, identification of roles concerns more than just grade values. Certain roles can be pivotal and influence and it worth identifying them to aid educators and managers reflect on the studio dynamics at work. Similarly isolated designers, for a whole host of reasons, may need encouragement and re-allocation to a new team.

9.1.2 Views and levels

Both sets of contextual observations revealed how designers have multiple levels of social network in which they operate. This transcended not just general friendship links but also formal team associations, and previous collaborations. The educational studio revealed how the two design students were influential to each other, how they were influenced by the team, by the studio and by external social factors. In the professional studio, designers were influenced by their projects team with and the design discipline they operated in. Any prototype software would need therefore, to represent the multiple levels at which the designer operates.

9.1.3 Objects

Visual objects were key features within both studios. In both cases, reflective feedback about work nearly always centred around a project graphic or model. The role of graphical objects was compounded when the student's work was uploaded to Virtual Learning Environment (VLE). When students were able to view anyone's work anonymously, regardless of whether there was a friendship link or not, students tended to view a greater range of peers. The resulting network from the VLE viewing statistics were a much more evenly spread, producing a denser network. Indeed when tracking data was taken from visual displays of work, there were no isolated student, the work of every student was looked at. Some students stating that they liked to see the work of others, particularly those they didn't know. One student was based in Australia for her final project and said she found it "fascinating" to see the work going on back home in the studio. Although a static graphic is only a representation of a person's work, if enough work is visually available that snapshot becomes more and more thorough. Graphical objects should therefore be included into any prototype network visualisation tool.

9.1.4 Time

Time was acknowledged by both case studies as being an underlying feature to the social networks in the studio. Networks of people changed as requirements for the project did, and with differing people coming into and leaving the project. Designers became more reflective at some points in the design process than at others. The role of time, and how networks of influence changed over time were however, quite different in the educational studio and the professional studio. In the educational studio, all the students from one course progressed at a set pace in order to complete their work at the same time. All students go through the design process at the same given points. In contrast the professional studio had multiple projects running at differing times in the design process. The software would need to reveal how networks changed over time and also encompass the differing type of time dimension needed.

9.1.5 Location

The location of the studio and more precisely where people sit in relation to each other had a bearing on the social networks of peer evaluation. In the educational studio, students left the studio to go to the computer lab and this essentially stopped the reflective process from occurring. Similarly the change of location in the professional studio meant that the “creatives” were split into two floors and as such their reflective conversations were demarcated into their design discipline. Location can also limit or exaggerate the sharing of feedback. If a person reflects on work with someone who sits far away from them, that sharing process is all the more important. Whereas this is the reverse if two people sit close by each other. The location of designers in the studio should there before included in the prototype software.

9.1.6 Summary, implications and discussion about the prototype

The ad-hoc feedback shown in the educational studio was not as apparent in the professional studio and this may have an impact on how the prototype is used. In the professional studio, as well as being a reflective tool, the prototype could potentially be used as a repository or a way to allocate projects or identify isolated designers. Professional designers tended to keep to their project teams and reflective conversations were generally between senior designers and more junior ones addressing the project at hand. The professional designers had their own desktop computers and did the majority of their work using software. The overall consequence of this is that feedback is all the more formalised and visualising the network maps of informal collaboration, all the more difficult.

The non-professional designers, although used software to produce their designs, did this outside of the studio. Within the educational studio only 1 computer was available so students tended to use this for searching internet sources and as a reference. More complicated software requirements were carried out at the

University's computer lab, which required the students to leave the studio. The resulting feedback shown in the studio therefore, referred to physical design work and graphics that the students could see that were often the end product produced through a software package. This allowed students, often without being asked, to offer comments and suggestions about the work of their contemporaries. It also allowed students to view the work of their peers without invitation.

The student designer were influenced by those students who sit closest as they are able to casually comment on the work they see, rather than physically moving to the other side of the studio to explicitly ask a question about the artefact. With changing studio patterns and a greater emphasis on using software, the ability to simply view the work of the others, becomes much harder. If students are leaving the studio to work in a computer lab with complete strangers sitting beside them, they are not in a position to be offered advice from their friends in the studio. Moreover the designs being worked on are screen based and allowing another person to view software based designs, needs that person to be very close and face onto the screen. A result of the designer making a request from another designer. Viewing software from distance or from an acute angle is difficult as the work on the screen will often be smaller than it appears in reality, and any angle makes the screen darker and difficult to view .

The prototype tool can be used by educators to identify certain vulnerable designers, however its envisaged use it to aid the reflective process of student designers. The prototype software reveals the designer's work and allows a designer to look at the work of others from within the studio. If that designer had not been able to attend studio time (for whatever reason), they are still able to view the work that is going on. They are able to do this without limitation, they are also not restricted to the physical location of where they sit in the studio. A designer is able to view the work of any of their peers, regardless of how well they know them, with students able to look at the work of a broader range of contemporaries (from the highest to the lowest graded). The students are able to see if they are isolated or view the work of an isolated student, they can look at the work of clique members that they are not a member of, or look at the work of people with lots of connections to many others. These roles have been identified in the research and shown to have some bearing on design outcomes, anecdotal evidence also discussed the impact these roles have and why it is important to identify them. The prototype also allows students to view their fellow students work but, if desired, see their physical location for reference (if they sit in another studio lab for instance).

9.2 Elicited requirements and specifications

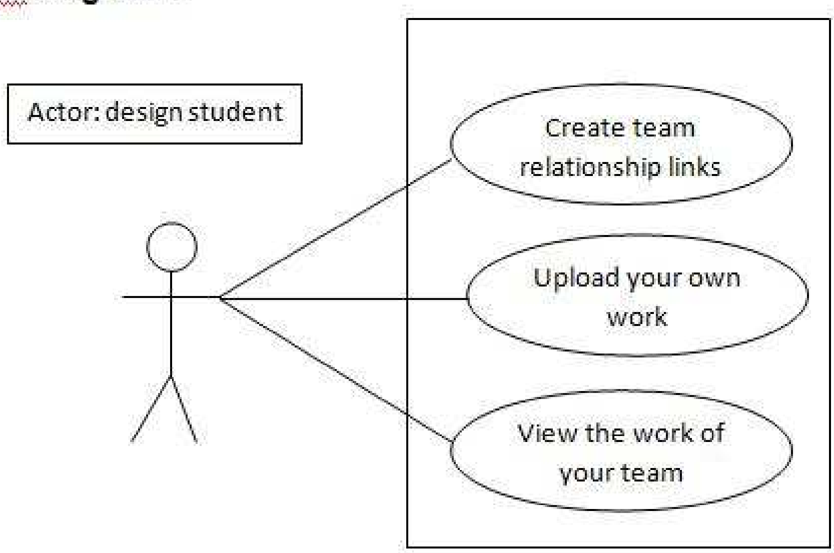
In order to develop a prototype system that aids designers reflect on their role in the social studio, various requirements engineering techniques are available to specify the system, such as structural analysis, Joint Application Development (JAD), interviews, cultural probes (Gaver et al 1999) and focus groups (Wood and Silver 1995). This thesis uses a Unified Modelling Language (UML) to document requirements for the software as it very diagrammatical. It is a popular requirements engineering approach that uses Use Cases and scenarios to document and convey requirements that can be easily understood by stakeholder and developers alike. UML is a diagrammatical language developed by Rational [http://www.rational.com/uml/], who have since been taken over by IBM. UML allows for interactions between stakeholders and the system to be shown in a visual way and allows for various viewpoints to be shown as having input into the system: the user, the hardware, the architects, the source code etc. There are many types of diagrams that are within the UML arsenal, each to be used for a specific purpose. A UML activity diagram for example should be used to plan procedures and sequence diagrams for working out object orientated design. In this section, UseCase diagrams and scenarios will be used to share the ideas and findings from the research in order to develop the prototype software. A UseCase diagram describes an actor and something they want to do (a UseCase). An actor can be a human, device or software but is not the program that is to be developed. The UseCase describes a series of steps the actor needs to take to achieve a certain goal. A scenario describes in more detail the UseCase. The scenario gives step by step details of how the user achieves their goal from the system. It describes what the actor does and how the system responds. Scenarios are used in the prototype design as they help to justify the claims put forward (Rossen and Carroll 2002). The following section lists a series of UseCases and scenarios which can help to understand what the prototype should aim to achieve.

9.2.1 Prototype specification and UML

9.2.1.1 Example 1

The following specification is based on contextual observations made during inter-disciplinary design project from case study 1. The research carried out in that phase revealed how, in general, work was carried out separately and then brought together at specific time. Sometimes not all team members were present and it was difficult to know what the missing person had done and how they had progressed things. Also, a lot of work was completed at home when there was no one around as a sounding board, with work being completed asynchronously. The influences that were also involved were always separate to the team, the designer took the work to a friend or family in order to provide input into the project.

UseCase Diagram 1



9.2.1.1.1 Scenario1

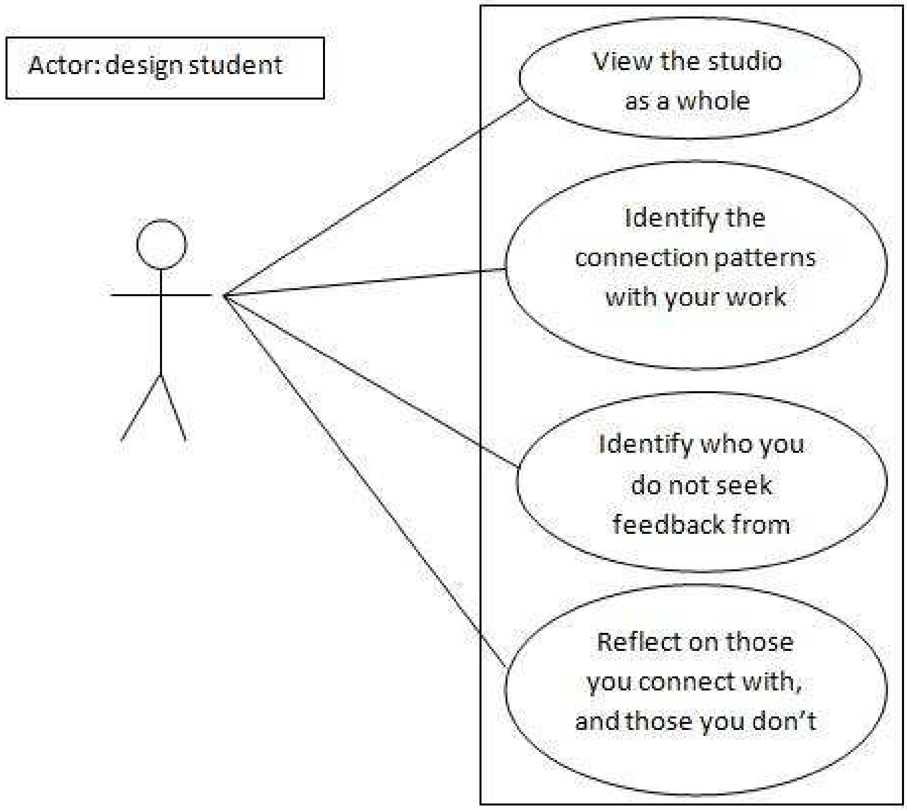
A design student is placed into a team with students outside their own discipline (in this instance computing). They are asked to produce a multi-media application which utilises the skills of the design and computing students.

1. The design student initially meets with the other members of the team to get to know each other and to propose ideas for the project
2. The design student has timetabled studio time to work on the project but meets with the other team members in free-time on an ad-hoc basis.
3. Although the majority of the team meet regularly, often not all members of the team are able to make meetings (due to work or personal commitments).
4. The meetings usually involve sharing the work that each of the students have been working on. Some of the meeting is spent re-capping on developments with team members who are not up to speed or have missed the last meeting.
5. The design student uploads their work to the software, the other team members can view that work and see how the work is progressing.
6. Other team members can upload their work and the design student can view this, write comments and adjust the designs they are working on.
7. All team members can access the software at any time, allowing all team members to be kept up to date on the progress of the project.
8. Work can progress quickly as each team member is not waiting on a designated face to face meeting time before receiving feedback from the other team members in order to progress the work.
9. Once the project is completed, the designer reflects on interactions that have occurred during the project, who contributed what, who gave feedback and how connections between actors altered. All of which helps the designer to consider how they approach designing in a group context.

9.2.1.2 Example 2

The following specification is based on the network analysis carried out with student group 2 and 3. One of the students, Juliet, was completing her final project from Australia and wanted to view and see the work of her peers. Additionally she could view the people connected to her, and those who were very much separated from her friendship group. Noting that Juliet had only known one of the two groups that formed the final year project teams. Usecase 3 relates to the same idea of viewing students work and identifying certain network roles but is seen from the educators' perspective.

Use case 2



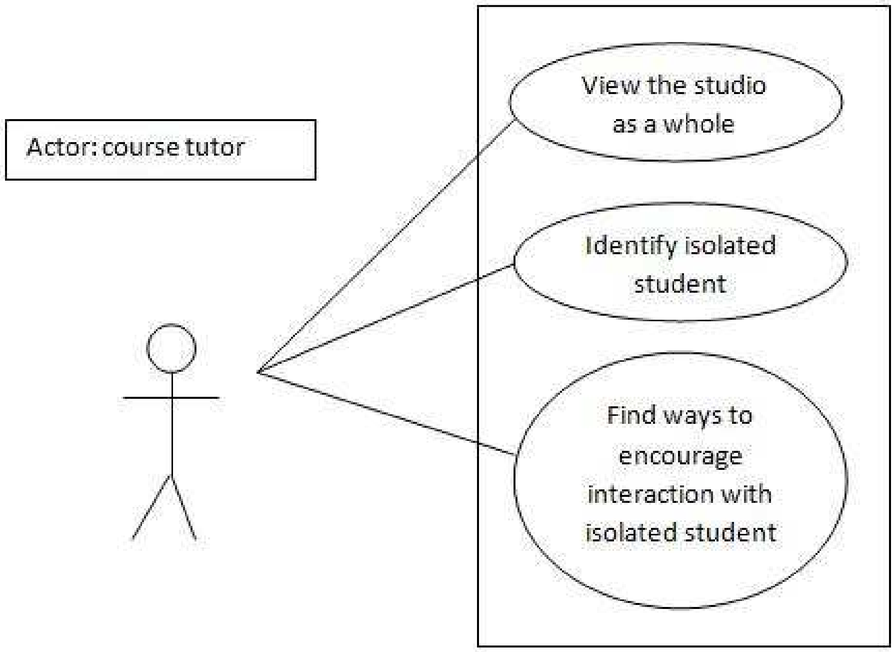
9.2.1.2.1 Scenario 2

1. A design student wishes to reflect on their work in regard to others on their course
2. They look at the full network facility of the software
3. They click on their own actor node
4. They see their own work
5. They see who they are most connected to
6. They notice who they do not have any connections with
7. They click on actors who have no connections to them to see their work

9.2.1.3 Example 3

In a similar manner to example 2, example 3 uses the software to reflect on the network within the studio. It is though taken from the perspective of an educator, whose purpose when reflecting on the network is different to that of the student. The educator is may wish to look for certain patterns, for instance where there are groups, the people who provide the most feedback from within the studio, or in the case of the example below, isolated students.

Use case diagram 3



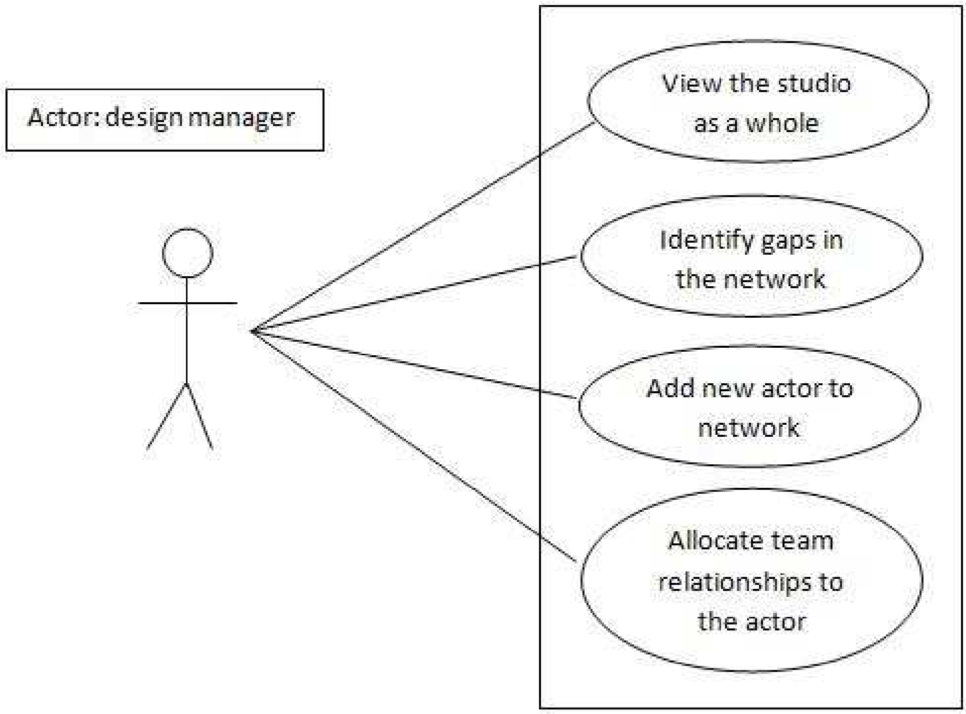
9.2.1.3.1 Scenario 3

1. A tutor from a design course want to see the group influence and dynamics within the design studio
2. The tutor views the full network (field) view facility
3. They notice the groups and cliques of students
4. The identification of isolated and go-between students are shown
5. The tutor makes a note of the isolated student

9.2.1.4 Example 4

Use case 4 relates to the professional studio case study. In particular the role of the design manager (director) and changing staff as during the field research two interior designers left leaving a gap in the company and the projects that they were working on (and allocated to in the future). A new member of staff also joined, and this person placed into a project that would aid the interior designers.

Use case diagram 4



9.2.1.4.1 Scenario 4

1. A new designer has joined a inter-disciplinary design team. The design manager wants to allocate this designer to a project that is currently on-going.
2. The manager looks at the full network facility of the software to see if there are any gaps in the network of designers within the company.
3. The manager discards groups of designers who are in a strong cluster and instead chooses a few people who only have a couple of connections to them. Thus allowing the new designer to be grouped with persons who are not in numerous other teams.
4. The manager selects a couple of people who are part of a potential team for the new designer.

5. The manager checks those individuals in the ego-view to see what work they are currently doing, how far through the project they are and who is also on the team.
6. The manager notices that one individual is in a project which only has a few team members, the project is also in its initial stages and the work they are currently doing would suit the new designer.
7. The manager places the new designer in the team.

The field research has highlighted the importance of social evaluation during the design process, and how these interactions can be hidden, unexpected and a valuable resource. To address this, a social network visualisation tool is proposed that reveals the complex patterns of social interaction within the studio, allowing for designers to reflect on how they are socially influence. The findings have shown that this visualisation tool should:

- Contain network maps that reveal who is connected to whom
- Levels of complexity within those maps (revealing simple connections to one designer, more wider social interactions seen in the studio, and broader domain connections between the designer and external bodies)
- Identification of key network roles
- Exposing the evolving network through time and through the design process
- Allowing for location and studio settings to be referenced or seen
- Allowing for graphical objects to be associated with the actors involved

9.2.2 Personas

Personas refer to a short narrative from the user's perspective. They are not real people but they are archetypal users of the system. They are aimed at helping the developer understand who the software is aimed at, the user's goals and the purpose of the system in a given context. The more detailed and life-like the personas are, and how clearly the goals are written, the better they are understood by the development team.

The design manager.

He is a senior manager who oversees the running of a design department within a larger company. He is in his late forties and has nearly twenty years experience of design. His time is spent obtaining new clients and work, overseeing the allocation of personal to projects, liaising with other managers from the larger company and meeting with and presenting work to clients. He occasionally carries out design work but only if the project demands it (possibly if additional help is needed to get the project finished on time), or if a project he has a close connection with. He is interested in knowing what his design teams are doing, who is involved and what stage the project is at.

The design educator

She is the programme lead on a design course within a design department of a university. She is in her mid-fifties and although has professional experience has spend the last ten years in a teaching position within the university. She oversees a course of 50 students with 3 lecturing staff. She aims at providing a course that is rich in reflective discourse.

The professional designer

She is a graphic designer with 7 years experience, the last two of which in the digital domain. She is in her late 20s and has moved to a new company relatively recently. She has worked in numerous companies and projects since finishing her design degree and has often worked freelance. She is interested in the work of her digital design colleagues in order to learn from their experiences.

The student designer

He is in his final year of an undergraduate design course. He is in his early twenties and has worked on a placement within a design firm during the previous summer holiday. He is on target to receive a 2:1 degree course grade. When he finishes his degree he hopes to travel to New York (hopefully getting a design related placement position while out there). He wants to understand how his fellow students have understood the design brief for a project they have all been assigned. To see how his work relates to his student peers.

9.3 Description of the software

The software described in the four scenarios relates to a prototype (appendix CD 3) that tested key features rather than usability or accessibility (to be added at a later date). The prototype is also featured on the following website: http://members.multimania.co.uk/sianjoel/NewWholeProject.swf [link valid in February 2011]

The scenarios refer to certain terms and concepts featured in the prototype. The prototype relates to ideas of nodes (actor or individual designers), edges (connections between the actors) and the network (the interconnections of all nodes). Definitions of these key elements are listed in the glossary.

The prototype software reveals both the full network with actors and their connections but predominantly concentrates on the ego-net of each designer. The intention of this was to simplify the network visualisation. The full network although able to reveal how actors sit within the network and the role they perform, it can become quite complex. Particularly if you are interested in only one designer, their work and the relationships they have. On the other hand, the ego view will, by definition, relate solely to one individual and the defined number of alters connected to them (2 degrees of separation in the case of the prototype).

9.3.1 The nitty gritty of the prototype

Haber and McNabb (1990) maintain that visualisation is seen as a pipeline in which a source of data is fed in, filtered, mapped and rendered to create the final image (see figure 64). In this process a body of data is available, and by visualising it, humans can gain an insight which may otherwise be lost (Spence 2001). It is this process that is also used to describe the software in more detail.

Figure 64: Visualisation pipeline

9.3.1.1 Data

The raw data used in the prototype, takes the network survey data from the 2nd and 3rd student groups (an online survey that was given to the students during their 4th undergraduate year and while they were completing their final project). The images from this course are also used as reference. The raw data for the time based aspect of the prototype is based on the network of interactions from the professional studio.

The prototype uses raw data based on the excel format output files from the online questionnaire, but also from the manual collection of data (through observed interactions and the taking of photographs). It is envisaged that the prototype should visualise data that is automatically provided. In the educational studio, one possible way of providing this is through accessing the data through a VLE. Images of student work would be uploaded (by students or tutors), and the logging of tracking statistics utilised through existing VLE functionality. In which case, the software would be a plug-in to existing VLE software. An issue with this approach is the reliance on design students using the VLE, both to view and in uploading work. Indeed the use of VLE's within the educational studio case study previously referred to, was scant to say the least.

Another option is for the visualisation software to plug into pre-existing social networking websites (e.g Facebook). This option could also be considered for both professional and students designers alike. At present there is network visualisation software available for social networking sites. Touchgraph (http://www.touchgraph.com/TGFacebookBrowser.html), for example, provides a Facebook application that reveals how Facebook friends are connected. It uses the uploaded Facebook photos and the tags within photos to join people. There are multiple issues surrounding the use of a social networking site like Facebook to provide the raw network data for the prototype software. Firstly, the designer would need to be signed up to the social networking site. Secondly, the site would probably include persons outside the design studio which would complicate the capturing of raw data. Thirdly the site may not include all persons from the studio. For instance, a designer may be reluctant to add their boss as a Facebook friend. There is also the issue of work related design images being available through Facebook (most companies may not wish this to be the case). An alternative would be to set a social networking group from scratch through Ning (http://www.ning.com/), for example. This social network could then relate to a specific studio and the raw data for the network visualisation taken from that.

Another option is for the software to plug into the project management software used in a professional practice. The data from Sharepoint (http://sharepoint.microsoft.com/en-au/Pages/default.aspx) for example could be used, and visualised. There is currently network visualisation software available within Sharepoint. This provides a view of relationships within and beyond (clients) an organisation. This visualisation software relates to contact information and relies on a company already buying into the management software. In the second case study, Extricate, at the time of the study, did not use this software. Instead they used Microsoft office software and saved graphical work (from AutoCAD, 3D Studio Max, Illustrator and Photoshop) to a central server.

The software could be used within the Extricate case study, by using the data from the central server. Unix scripts such as cron jobs could be run which looked for updated images from the server. The network data could be provided from the visualisation software itself. When a designer viewed the work of another, this would be logged as a connection. Administrators could also pre-determine and allocate teams.

Alternatively the network data could be self-generated from the software itself. Through logging onto the prototype and viewing work, is essentially creating a relationship between one designer and another and providing the network data needed. This solution would work effectively once the software was up and running and used. When the software is introduced to a group, however, it would require a seed of information to start the network visualisations.

9.3.1.2 Filter

All network data used for the prototype was originally from excel format and was manually converted into an XML file. This conversion should take place automatically through a programmed script of some kind. Ideally the data would be fed into the process from a digital source as this would aid the conversion of data into the correct XML format. As it stands, a snippet of data taken from the excel file is shown in table 10. Table 11 then shows an example of the converted XML format:

	Colin	Toby	Inga
Colin	0	1	1
Toby	1	0	0
Inga	1	0	0

Table 10: Example snippet from excel file, used for the code

```
<node id="2">
        <data key="name">Colin</data>
        <data key="gender">M</data>
        <data key="DOB">010885</data>
</node>
<node id="5">
        <data key="name">Toby</data>
        <data key="gender">M</data>
        <data key="DOB">020786</data>
</node>
<node id="6">
        <data key="name">Inga</data>
        <data key="gender">F</data>
        <data key="DOB">040686</data>
</node>
```

```
edge source="2" target="5" />
  <e edge source=" target="6" /> 2"
```

Table 11: Example snippet from XML file, used for the code

9.3.1.3 Map

The XML data of nodes and edges is then used by the AS3 code (the prototype was developed using Adobe Flex). The AS3 code firstly loads the XML data (table 12):

```
var gmr:GraphMLReader = new GraphMLReader(onLoaded);
        gmr.read("SecondGrpSeekFeedback.xml");
```

Table 12: Example snippet from AS3 code to load XML data

The AS3 codes read in the nodes and displays a circle and node name per node (table 13):

```
vis.data.nodes.visit(function(ns:NodeSprite):void {
            ns.shape = Shapes.CIRCLE;
            var ts:TextSprite = new TextSprite(ns.data.name,textFormat);
                        ts.x = 0;
                        ts.y = 0;

            ns.addChild(ts);
});
```

Table 13: Example snippet from AS3 code to attach a circle per node

The edges between the nodes are then also read and displayed (table 14):

```
vis.data.edges.visit(function(es:EdgeSprite):void {
                                        es.lineWidth = 0.5;
                                        es.lineColor = 0xff000000;
});
```

Table 14: Example snippet from AS3 code to attach a line per connection

A radial tree layout is then used to display the nodes and edges (table 15):

```
var lay:RadialTreeLayout =  new RadialTreeLayout();
```

Table 15: Example snippet from AS3 code to display radial tree layout

More in-depth details about the code also appear in appendix CD3.

9.3.1.4 Render

The radial tree layout is part of the Flare visualisation package (http://flare.prefuse.org/) and requires a series of flare libraries to be imported such as “flare.vis.operator.layout.RadialTreeLayout”. Additional button features have been applied which:

- allow for jpgs to be loaded when a node is clicked
- the clicked node becomes the root and the ego in question (removing all the alter egos that do not relate to the new ego and attaching those that do)
- the XML attribute data to be shown when the nodes are hovered over.

9.3.1.5 Image

The final prototype that was tested by designers, appears in image 58. This image relates to the opening page and the “designer” view. In addition to this is the “field” which shows the entire studio, and the “domain” view which shows the connections outside the studio. Additionally there is the option to view the networks over time. In the educational studio this relates to network sociograms at different points in the design process. In the professional studio, an animation is played that shows the designer interactions and their studio location. The next section describes these features of the prototype in more detail. There are many features which the prototype could (maybe should) have included. For instance in its present form, there is no opportunity to add written comments and feedback about any of the work, but this would be included in a final software product. The intention of the prototype was to articulate the feedback processes involved in two differing design studios and test key features for inclusion.

9.3.2 General overview description of the prototype

Gitta Domik (1993) suggests five observations as to what a person should look for as a good medium to visualise data. These five characteristics are used to describe the software in more detail. The characteristics are:

- Data characteristics
- Interpretation aims
- Abilities and desires of user
- Available software and hardware
- Meaningful Pictures

9.3.2.1 Data characteristics

Currently there are numerous ways to display the characteristics of data. Whereas previously, data could only be displayed as a static image such as a 2D pie charts etc, with the advancement of visualisation technology, data can now be expressed in 3D and interactively. The software enables the user to select the designer they wish, centring the visualisation on the chosen person. Figure 65 shows the ego-net centred on Colin and the other students who are connected directly to him (one degree of separation) and also those people who are two steps removed. Figure 65 shows the group of individuals associated with Colin. In the full network visualisation (see figure 66), clusters of designers are identified, revealing groupings of students who rate each other highly and are influential to them.

9.3.2.2 Interpretation aims

In terms of interpretation aims the tool can provide insight for the designer to understand how he or she sits within the network. They can see what kind of role they play, who are their close colleagues and how these people may influence them. The tool can also highlight who the designer does not liaise with. The designer can then reflect on their network position, whether it effects their design work and if they wish to change their network role. Designers can also reflect on the work of people within the network. Understanding the influence of others, and their work, through the incorporation of a graphical representation of work. The visual prototype combines graphics and text to highlighted and link to subsidiary data. Figure 69 shows the associated final year work when a student designer is selected.

The user has input into what visualisation can appear or what area they would like to look at. If the network visualisation was purely static, it would be less intuitive and less useful to the designer. Choices that the user makes about how to view the information will directly affect their judgement; potentially biasing their results. A set of results mapped and rendered by one person may be completely altered by another person. What may seem intuitive to one designer is not to another.

The visual nature of design work means that visual representations of each of the designers work is paramount in understanding design networks. Indeed, each of the circle nodes could be visual representations of their work. However this would limit what images were shown as there could realistically be only one image that would represent the designer and that image would need to be quite small to allow for all other nodes to be seen on the screen. A consequence of this is that the actor (in the form of a black circle) needs to be selected and this then opens up a jpg of their work. Although the prototype only features one example page that is opened per mouse click, it is intended that multiple pages could be shown. This is particularly the case in assessing progress of the work over time.

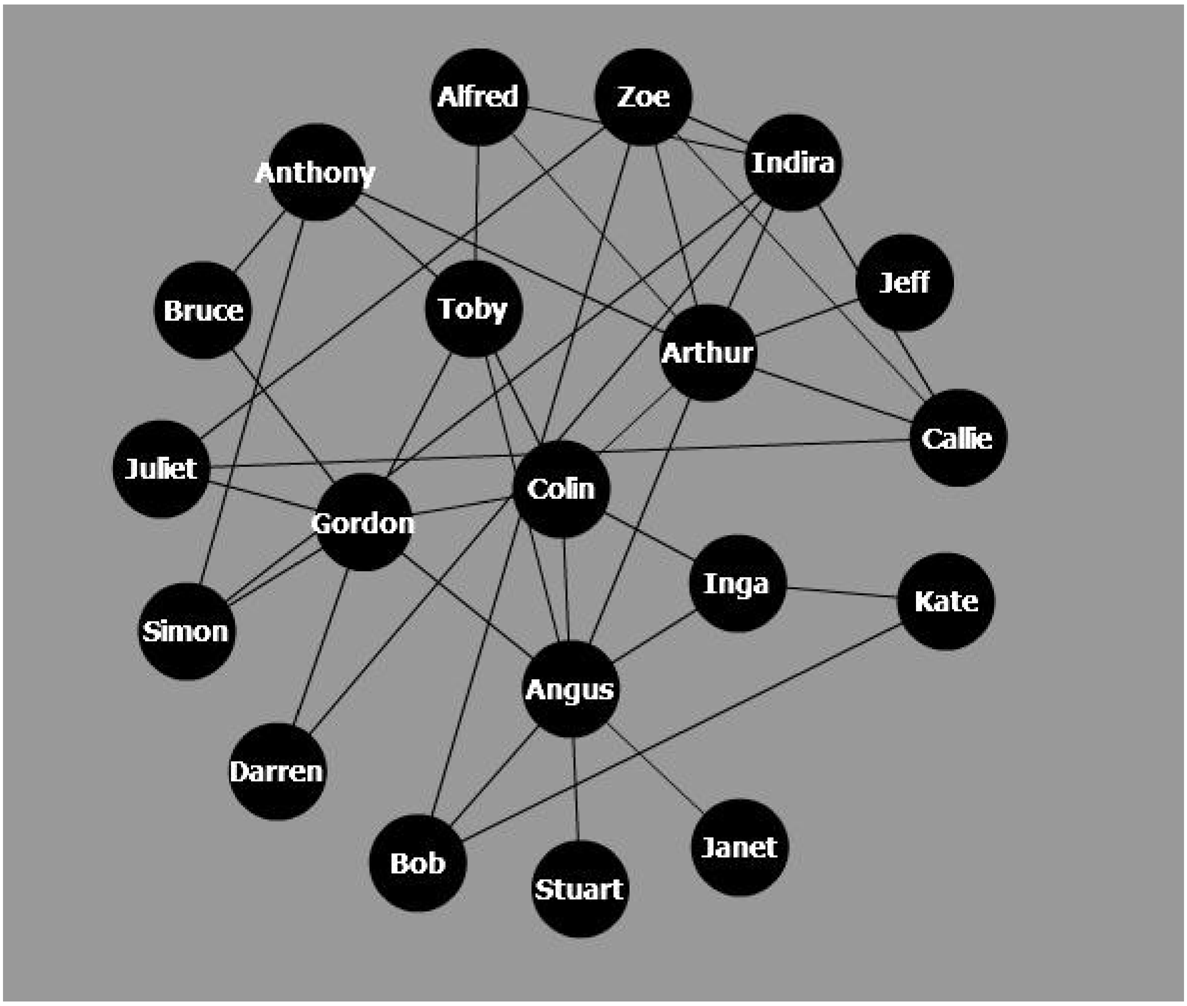


Figure 65: The ego-net of Colin

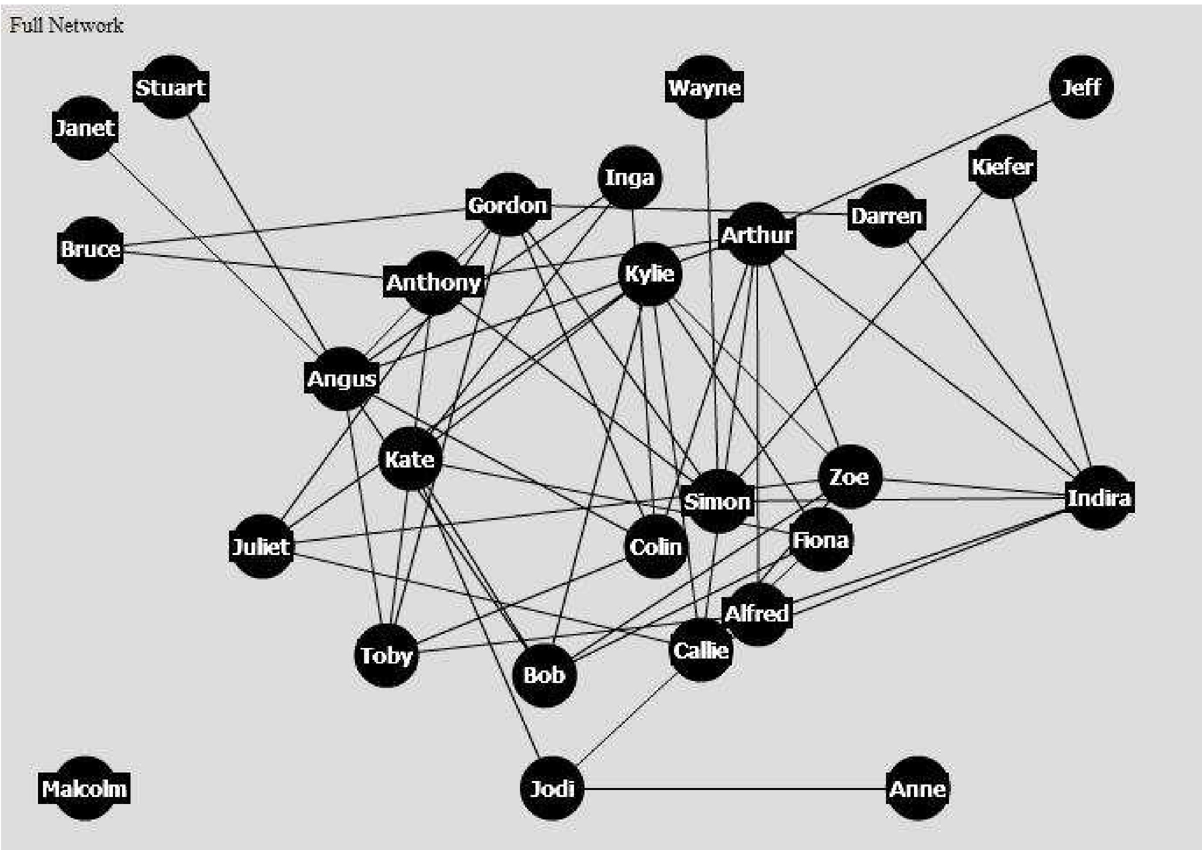


Figure 66: The full network

9.3.2.3 Ability and desires of users

The ability and desires of users can be met through representing data in a way that utilises the power of the human visualisation system. The human visual perception and cognitive abilities are very effective at processing rapidly and can identify trends when presented in a visual environment. Preece et al (1994) give five principles which give insight into how the human visual system works in assessing visual stimuli: proximity, similarity, closure, continuity and symmetry. Some of these features are present in the flare library. Proximity of nodes to each other, for example, are based on their level of network connectivity.

It may be the case that the social network of the designer may change over time. The designer may rely on certain individuals at the beginning of the design process, and then alternative people at the end. The selection of people a designer turns to may reflect the skills of those differing people. For example, a designer may consult with a trusted friend to run ideas about their work at the beginning of the design process, whereas they may discuss how to market their work at the end of the design process with an individual who has marketing experience. The change of the social network over time is shown in figure 68 and 69 (although the data for figure 69 is fictitious and only shown to illustrate the point). A timeline feature at the bottom of the prototype screen would enable the designer to move between the stages of the design process, revealing the differing social networks associated with each stage.

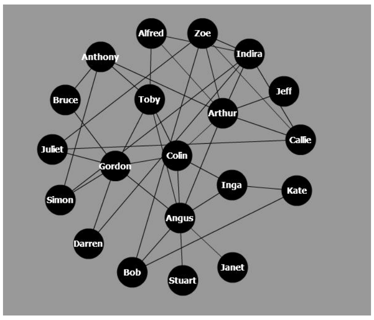


Figure 67: The ego-net of Colin at one stage of the design process

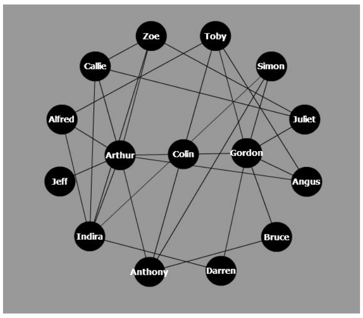


Figure 68: The ego-net of Colin at another stage

9.3.2.4 Availability of software and hardware

Progress in visualisation is driven by physical progress with computers, as technology advances, visualisations become closer to representing reality and are consequently a more efficient source of displaying information data. Computing technology is constantly changing, particularly in areas that involve graphical representation. The interactivity of the software, for example, means that data can be stored as to which designer views the work of other designers. It is essentially self generating.

The software tool can also be considered as one way of storing data (both images and connections) which is searchable through the social network and which drives the understanding of a designer’s work in a group context. Although there are many alternative ways of keeping a repository of design works, the search facility allows for designers to investigate a person. In more complex versions of the software, key terms would reveal which designers are working on certain themes, the ego-net of those designers as well as the images associated with them.

The final software should contain the facility for the actor to upload their own photos of their work. Additionally team members, close connected persons to the actor, and possibly anyone in the network could annotate the notepad on the right of the screen. This would aid in the feedback cycle and allow for virtual peer reflection in the design process.

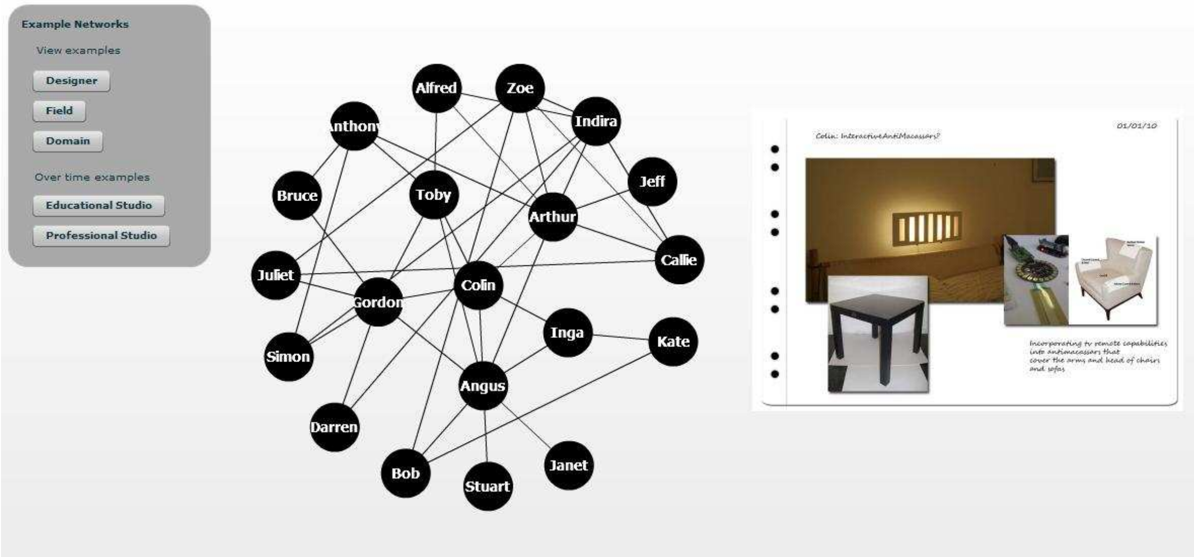


Figure 69: An example page from a repository of images associated with each actor

9.3.2.5 Meaningful pictures

Finally, the criteria of meaningful pictures are considered. Visualisation cues will be of significance or more readily understood if they are in tune with images and scenarios that the user is already familiar with and can make associations from. For instance, to aid the designer reflect on their role in the network, certain roles are clearly identified in the full network visualisation. Figure 70 shows the isolate role in red (no connections) and three go-between actors in green (high go-between centrality score). If a designer is one of these roles, particularly if the designer is an isolate or vulnerable to being isolated (only 1 connection), the designer can assess how they feel about being in this position. Other designers can identify who has many connections to them (the go-betweens) and how pivotal and potentially influential they are.

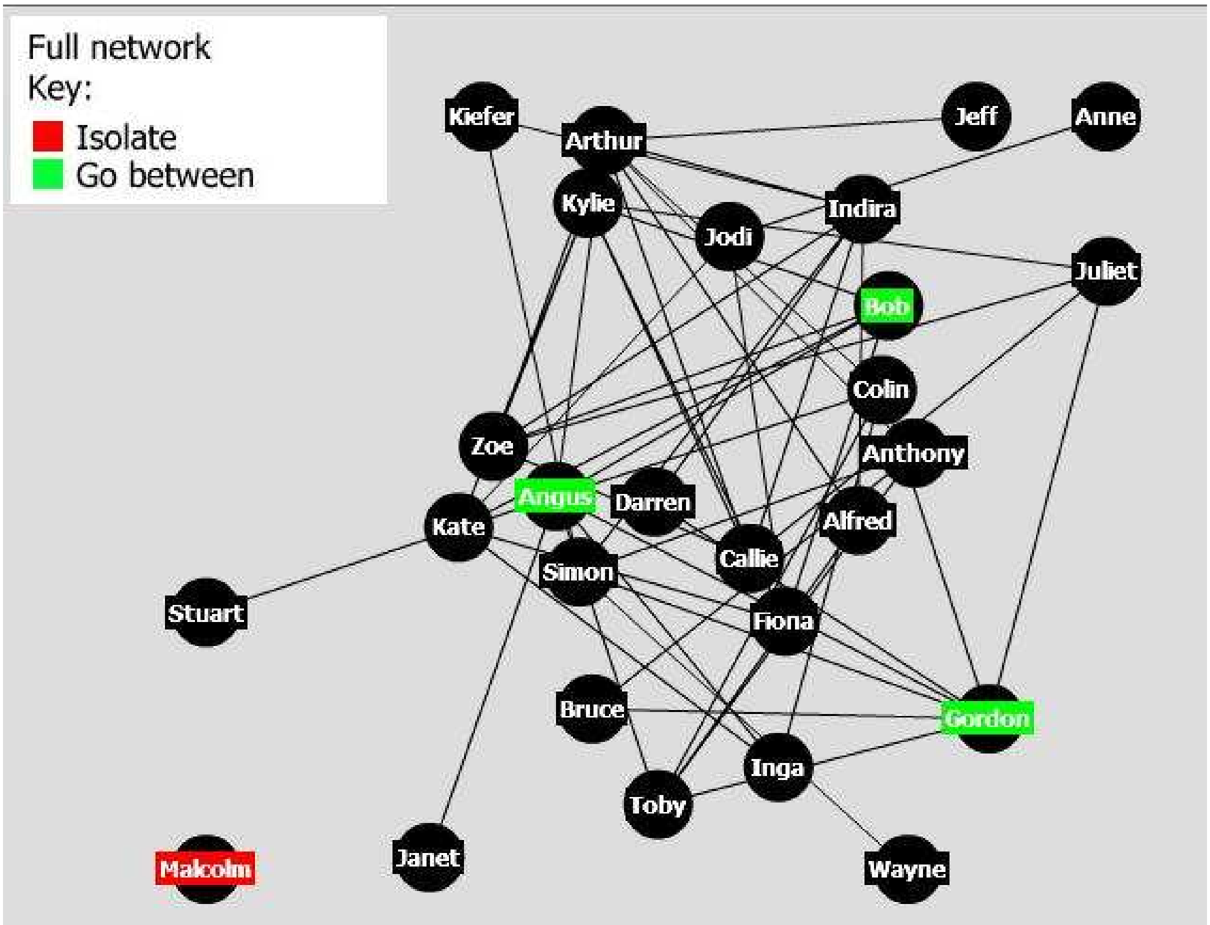


Figure 70: Identification of isolate and go between role in network

Some themes identified for the purpose of the software are: 1. revealing and reflecting on group connections between designers, 2. an interactive repository of images, comments and feedback, and 3. the identification of roles within the social network. In addition to this, the software could aid designers who are working within a team that is geographically separated. The designer can do this by reflecting on the work of their colleagues who are physically separated but uploaded to the software. The visualisation could also include a background image that reflects the regions involved. Actors working in certain countries, locations or even rooms could be placed into a boxed region on the screen which relates to an image of the locations involved. A background image of the studio setting, for example, with each actor placed into the location in which they sat in. This would reveal if there were any patterns between location and connections.

The research from both case studies has highlighted the importance of others during the design process in order to evaluate designs and decisions. It also showed the serendipitous nature of feedback within the design process and how there is a constant cycle of evaluation, feedback and modification. The prototype therefore aims to reveal the influence of others in order to facilitate how designers reflect on their work in context. The prototype also reveals network patterns on various levels within a social model. The differing levels, allow the designer to reflect on who in their immediate circle influence them, who from the studio at large does and the influence of the broader design domain. The prototype also shows the fluid, cyclical nature of the feedback and reveals how differing people impact on the designer at different stages in the design process.

The prototype is one mechanism to articulate the sharing of feedback and the social reflective process. It articulates that which has been researched and revealed during the two case studies. The following section discusses the findings from both from the field research and the feedback cycle shown through the software. The following section also discusses the findings from the case studies as autonomous units of research in their own right. It summarises the findings from the case study (and the appropriateness of the techniques used) and the ways in which this has informed the development of software. The next section discusses the software itself, the response it received from users testing it and how it can be developed further.

10. Findings

Introduction

This chapter summarises the findings from the two case studies in terms of

- how it informs social model of design and design research
- the methodological approach taken
- how the research has informed the development of software.

10.1 Findings that inform design research

10.1.1 Findings from the educational studio

The observations from the inter-disciplinary design team highlighted how the design students participated in ad-hoc feedback with their peers during studio sessions, in semi formal meetings and in informal locations. This was also confirmed when open-ended questions were asked to students about who they referred to when reviewing their work. The questionnaires revealed the importance of friends in influencing students, and in particular in providing appraisal to their course peers. This result added weight to the argument that the feedback network in a design studio is an important facet within design education.

The high levels of face to face interaction that occurs in the studio setting facilitates the sharing of feedback and effects the design work produced. When looking at the feedback network in more detail, it was shown that the feedback network had fewer connections between people than the communication or information sharing network. It is proposed that feedback sharing requires a closer friendship bond than general communicate with others does. The feedback network has a relative delicacy to it that needs to be supported.

The fragile nature of the feedback network (face to face) led to questions of how to support it through technology. To begin answering this question, a visual tool (the portfolio feature of a VLE) was used to show students work. This enabled tracking data to be gained that revealed which students looked at the design work of others. The resulting network was then analysed and showed the network to be far denser than the face to face feedback network. Students were happier to “anonymously” to view the work of their peers through a visual tool, than in a face to face scenario. The visual tool, enabled all students to have access to everyone and effectively removed friendship and environmental boundaries. The portfolio of student work was used by nearly all the students in the course, and all graphical representative work for each student was viewed. This revealed the importance of incorporating graphic images (static representations of design work), when socially reflecting upon the work of others.

To understand the network analysis in more detail, certain network roles were identified to understand whether being a certain role has a relationship with final year grade. It also allows for cross-referencing of the network with a rating mechanism. Three roles were analysed: the go-between student, the clique member and the isolated student.

The go-between student referred to those students who repeatedly connected two other students. The results showed no conclusive result as to whether there was a link between being a go-between student and higher grade values. Even though there is no conclusive link between grade and go-betweeness, these students are in a very influential position. They may not have the highest grades but they are in a powerful position to impart their opinion to many different people and span differing groups with their own perceptions. In the visual network, however, there was a link with grade and go-betweeness.

Clique member students, where each person within the clique is connected to everyone else, did show, to some extent, that students sat within an average grade boundary of the clique. It is envisaged that clique members, by only referring to other students with similar average grades are not receiving feedback from students with higher grade levels who may be able to critique the clique member’s work more constructively. However understanding the impact of being in a clique, requires revealing network patterns over time. In particular, a student entering into, being within and leaving a clique. Also, the clique could be within a set boundary of higher grades, or lower grades. If all clique members are high achievers, it is advantageous that they are bouncing ideas between each other, at the detriment, perhaps, to the rest of the course. On the hand, if all students within the clique are lower achievers, this will potentially continue this grade pattern in the future. The issue of clique membership within a design studio is a complex one.

The final role that was analysed was the isolated student. These students did seem to produce poorer design work and gained lower grade values. These students did not receive feedback from other students and potentially as a consequence did not refine and improve their work. There are many issues surrounding the isolated student role, one of which is attendance in the studio, as students who do not attend studio are not physically present to offer feedback. In the visual network, there were no isolated students and this result strengthens the argument that levels of attendance in the studio are linked to face to face feedback levels. Further investigation into who students would like to ask or receive feedback from may offer some additional insight into this issue.

10.1.2 Findings from the professional studio

The findings from the professional studio, revealed patterns of interaction that were quite un-expected. Prior to the analysis certain friendship bonds would have been thought to become apparent in the network analysis, however project ties were shown as far stronger. Furthermore persons who had more projects on-going were shown to have a higher degree centrality value (this was the case for the actor Karl).

The network analysis also showed that discipline teams were quite separated and that there was little sign that this company was inter-disciplinary. This may have been a consequence of the seating arrangements, with the graphic design (advertising and software developers from the new company) residing on one floor, whilst architecture and interior design resided on another. Where links between disciplines were apparent, the connections between those groups were made with pre-existing friendships. Tim's childhood friendship with Simon, for example, meant that they often worked and spoke together.

During interviews with the Extricate staff, it became apparent that the networks in question were very fluid. The interactions between people were highly dependent on the project they were working on, who was on the project and at what point they were at in the design process. Early stage concept development required certain individuals and a certain level of interaction, whilst at other stages, different personnel would be needed. Also, depending on both organisational and personal circumstances, preferences and choices, a project would adapt. Alastair commented that:

Alastair: no, no this is individual because of the nature of the project. This is an old church. It's called [removed to protect IPR] They're turning it into 18 flats. It started off with Karl and I as a team but then [removed to protect IPR] became a priority so Karl came off and I took over. Then Lotti was brought in to help me as pressures became critical. Then Lotti will move on to help Jay and Karl will be on [removed to protect IPR]. So I'm left to do this specifically. What happens is that once the pressure is off, then the team comes back. Karl was away for a month at Christmas and there was no one to do [removed to protect IPR] and I took over responsibility and kept [removed to protect IPR] flowing so there was no drop. The client didn't see anything. That's what happens on all the jobs. Somebody can step in and take over.

10.1.3 Comparison of findings between professional and educational studio

The professional studio and the education studio were approached somewhat differently with methodologies that were not identical. The practicalities of the two cases meant that the two studies could not be dealt with in the same way. The student case study had the benefit of grades being attached to each student, which meant that links between being a certain role and grade could be judged. This is far more difficult to do in the professional studio. Without projects being explicitly graded, the assessment of "better" designs is a complicated matter. The designers in question could have been asked their assessment of the design they were working on, although there are very obvious biases with this. The managers and directors of the organisation could also be questioned, but there are many factors that come into play when judging whether a design is successful, such as client opinion, financial gain of the project, if the project could be repeated etc. It is also possible that a design is a good one but not commercially successful. All of these criteria for success are discussion areas in their own right, and all of which assume that a project in question is completed. In the Extricate case, all of the designs being worked on did not complete during the field study. It would be very difficult indeed to judge a partly completed project.

In addition to this, the professional case study had more intellectual property issues where projects weren't to be referenced or filmed. Personnel were also less receptive to being videoed (with the graphic designers being quite hostile to the whole research project). Time was also more of an issue, with staff members unwilling to complete time consuming surveys, although were willing to simply be observed (as long as that did not interfere with the on-going projects).

Other issues are more theoretical, the surveys that were given relate to how students perceive they interact with others. Of course this may be completely different to how they actually do interact with each other. In the professional case study the network of interactions were observed and were discussed in terms of the researcher's perception reality; what they [designers] do, rather than what they say they [designers] do. It is acknowledged that the professional studio may have behaved differently due to the presence of the researcher, and that the researcher only had one field of view and this had certain limitations to it (who sat closest to the researcher would probably be more dominant, overlaps in conversations, people having conversations out of ear shot etc).

Although the methodology used for both case studies have differences, there are some themes in the results that are common across both studios. Firstly certain key network roles were identified, which, in the educational studio were cross referenced with grade. The go-between student, although not conclusively linked to better design outcomes, is still in an important position within both the educational and professional studio, and as such should be acknowledged. In the educational studio, cliques were identified and shown to reside in a certain grade boundary. In the professional studio there were some groupings, but these normally centred around the design domain rather than being within a friendship clique specifically. Within the educational studio there more student designers who were isolated or vulnerable (only a few connections to other people), whereas in the professional practice this was not the case. Perhaps a consequence of project having allocated team members and a professional environment where it is uncommon for people to not turn up for work for no reason.

Both qualitative accounts from each studio gave insights into the fluidity of the design networks. In the professional practice, interviewees gave reference to how teams changed during their lifecycle, depending on many factors such as who was employed at the time, allocation of funds to a project etc. These changing teams and project dynamics had an impact on how a network should be represented, and how traditional network visualisations generally reveal interactions at any given moment in a design project (the examples in chapter 5 and 7 using Netdraw do just that). Although in the educational studio the ad-hoc interviews that were carried out did not refer to the changing nature of a social network, the observations of how designers interacted did reveal this moving pattern of behaviour. Figures 18 and 19, for instance showed the changes of conversational pattern over time.

The network analysis revealed certain patterns of interactions, but some of these were quite unexpected. The social networks within the first group of students, revealed patterns that were expected (based on the observational stage). However in the 2nd and 3rd group, the network patterns highlighted how there was a lot of cross over between the two groups (who had been merged at the beginning of their final year). It was envisaged that these two groups would predominantly refer to people who were from their original course, however the network results did not reveal this. Similarly the professional studio exposed network patterns that were also unexpected. It was presumed that friendship ties based on university connections would be shown in the network visualisation but what occurred were pairings of designers that were work related and project based.

Both studies showed a number of social influences that were complex and often intertwined. These influences resulted in a series of pressures which effected how designers interact with one another. It was noticeable from the observations from both case studies how informal reflection within the educational studio was based around trust and friendship, whilst within the professional studio informal evaluation was based around formal team alignments. It is possible that within the professional studio, the presence of formal hierarchical orders had an impact on who people sort for feedback. The presence of someone's boss within the studio may have limited the movement of designers around the studio and who they spoke to informally. It may have been thought that if a designer moves across the studio to talk to a friend, they were involved in non work related conversations. In the educational studio on the other hand, it did not have this regular hierarchical influence in the studio (although the lecturers did frequently attend studio sessions). Another factor that might explain this difference in the informal feedback is the seating arrangements. In the professional studio, once the seating and desk places had be positioned, new designers joining the company simply filled the first available desk (this was the case when Lois joined the company). This meant that friends may sit at the other end of the studio or even on another floor, making it much harder to speak to them off the cuff. In the educational studio, students sat with the friends they had made during the course (it would be interesting to view the seating changes during the course and how this would alter from the first year when students did not know each other). The influence of seating arrangement can magnify informal feedback between close pre-existing friends. Moving to seek feedback from someone from the other side of the studio is an interaction of even more significance.

The network patterns in both case studies showed various complexities and issues with the analysis. For example, staff hierarchy or friendship ties were not identified as a factor in the professional studio. These differing layers and influences have not been visualised in the NetDraw diagrams. The professional studio visualisation also did not show if there were any cross-overs, for instance if a person was working on two projects with differing collaborations on both. The educational studio only showed the others students and didn't reveal the role of tutors, lecturers and external persons had upon the student design and feedback network. The educational case study related to students and their peers, with a very flat feedback structure. In the professional setting, staff hierarchies were involved, length of time people had worked for a company, how senior they were, if they were a director or related to a director. These differing levels of feedback sharing were un-reflected in the network analysis carried out or indeed visualised so far.

The works carried out within the educational and professional studio were quite different in their disciplines and this may also have a bearing. The professional studio had a greater number differing design disciplines within it than the educational studio. Both studios also worked differently, with staff within the professional studio mainly working behind a computer, whilst in the educational studio the students were much more hands on, building models and drawing up boards. The educational studio only had one computer within it, so students who needed to use a computer to produce graphics tended to leave the studio and go to the university's computer lab. In both cases, it was difficult to analyse how designers reflected on the work of other designers through a technological medium. In the professional studio, the designers did not make reference to reflecting on work digitally sent to them. The observed feedback process involved designers physically looking at the same screen or print out, or occasionally describing the particular project they were working on. Digital feedback, if it occurred, existed in a differing social sphere than was observed. In the educational studio, students would physically leave the studio in order to work with a software package.

10.1.4 Findings from the visualisation software and how this informs design research

There are two aspects to how the visualisation software informs the sharing of feedback between designers, revealing of social influence, and being aware of the work of other designers. The first of which stems from the VLE portfolio tool and the tracking data from student viewing patterns. The resulting network formed from the viewing statistics, showed there was a denser more even spread to how students viewed each other's work. Although not everyone used the facility (the majority did though), everyone's work was viewed and there were no isolated student. The ability to view anyone's work, without inhibition seems to positively affect the viewing patterns of the studio. The results from the VLE network, informed the development of the prototype tool (would could easily be a plug in to VLE software), in particular the need to graphically reveal work as well as show social connections.

The second aspect that informs design research, are the findings from the prototype testing itself. The ability to show how designers connected to others, was seen by most of those who tested it as a positive feature. Comments suggested that it gave the designer a sense of community and the group a sense of ownership of the design work produced. Perhaps feedback sharing itself, bonds people together, spreads the risk of a design and allows other people an element of buying into a design.

10.1.5 How the findings inform a social model of design

The findings so far have summarised the key issues from both case studies and the visual tools used. The following section uses those findings to enhance previous research surrounding the idea of a social model of design.

It is proposed that design as a reflective process can also be been seen a socially reflective process. Whereby the conversation with materials exists with others (peers, lecturers, clients etc). Similarly within the DIFI map of creativity (figure 4), feedback is obtained in reference to the designer, field and domain (Sosa and Gero 2008). In the educational studio, the designer, field and domain distinctions are mirrored in a more micro level. The studio itself and the students within it provide the backdrop to a field setting with the wider domain contained within the university in question. When feedback is obtained, rather than the artefact be available to society, the artefact in question is available to the studio (at least in the first instance). During the studies of student designers, feedback was continually sought from course peers through the duration of a project's development. Indeed there is some evidence that the greater amount of feedback given in a cyclical loop during a design project, the better grade a student received (particularly shown in the visual network). The impact that this would have on the DIFI map of creativity is the blurring distinction between the designer field and adopter field. It can be see that peer recognition can be highly influential to the quality of the design artefact produced. Within the student design studio, it is a student's peers and lecturers who are the adopters. This transcends a student's friendship groups, as students should seek feedback and adoption from those with higher grades, particularly when feedback is anonymous.

The concept of isolation for the research is restricted to those within the course, or not seeking feedback from their course peers. For low-graded students this isolation extended beyond the course as their questionnaire answers revealed that they did not seek feedback from a wide variety of persons in general. High graded students on the other hand, sought many sources (particularly from the wider design world) to provide insight and input into their work. It seems that the student designers who *only* base their feedback on the judgement of their course peers do not fit the wider DIFI model. Those who seek feedback from others outside their course though, begin to approach the DIFI model. They, as designers, are closer to the real world design world (and DIFI model) and perhaps this is why they gain better grades. These students have a wider social context as they have their work reviewed by adopters who are more influential and knowledgeable on the subject.

It is proposed that the DIFI map of creativity is slightly different within the context of design education. Within a studio setting the social preferences and perceptions of adopters are based on the opinions of peers. Arguably it could also be the case that the environment field can be equated to that of the course tutors, external examiners and possibly competition judges. In the professional practice of Extricate the abstractions of designer, field and domain remain as they were defined in the model. Indeed the field view within Extricate incorporated a wider sphere than just the studio, as the company employed many free-lance contractors on an ad-hoc basis. The interviews from Extricate also revealed the shifting patterns of designers and roles over time. Some designers would come into the project and remain on board for its duration, others would come and go, and some designers would be freelance, whereas some designers would only feature during a set stage. This may be a consequence of time restrictions or financial allocations of personnel. For instance, there was budget for a certain number of architects on a project and when one person went on holiday another person would take over (as was the case at Extricate). Or the allocation of people may be based on expertise, with certain individuals coming into a project at a certain point because they are particularly good at a specific feature. In the case of Extricate, high level design decisions and client interactions were dealt with by senior members of staff. Once design decisions were made, more junior staff would be called upon to complete the project. All conversations about high level designs tended to be between senior staff members and clients and the final presentation also only involved senior architects, interior design managers or directors (unless there was a personal knowledge and association with a more junior designer: as in the case of Wyn and the [removed to protect IPR] case).

10.2 Evaluating the application of the methodology

In applying contextual observations in conjunction with SNA, there a number of benefits that arises from each type of methodology when applied in isolation (which were discussed in more detail in the methodology chapter). This section looks at the combined approach, and discusses how the technique fared in regard to the two case studies.

10.2.1 Understanding design

The combined use of contextual observations and SNA facilitates each technique informing the other. For instance SNA can also be used to narrow down the ethnographical research, which can be wide and all consuming, or the contextual observation inform the development of a SNA questionnaire. In the educational case study, the survey questions were in direct response to the observational stage of the research. A consequence of which was that the SNA questions had a certain background, context and research question that was already understood from the ethnographical studies.

Network analysis can be gained from the researcher’s perspective, rather than solely from the interpretation of the person completing the survey. There are pros and cons to both interpreting actions by the researcher or from the person under scrutiny. When the issue at hand is a complex one, such as feedback sharing, with many idiosyncrasies to it, there can be many reasons why designers may not complete the questionnaire thoroughly. The use of SNA through observation, as in the second case study, works around this problem and as such provides a differing perspective on the idea of feedback with the studio.

Contextual observations like ethnography can often produce a large quantity of information, often involving rich descriptions. These accounts can be difficult to convert into numeric data that can be statistically analysed. Using an SNA framework for the observations, as in the Extricate case, analysis can be carried out to test out observed phenomenon. For instance, in the second case study, the company was not observed as being “inter-disciplinary”, this was then confirmed using SNA techniques.

10.2.2 Informing software development and interactive design

There are a whole host of reasons why contextual observations should provide a foundation of information from which to build software. Many of those reasons are based on the decision to choose an ethnographical type methodology over any other methodological technique. Contextual observations can provide rich pictures of the social and organisational setting into which the software is to be introduced. Sommerville (2001 p135) noted that “satisfying these social and organisational requirements is often critical for the success of the system”. In the case studies of educational and profession studio, the contextual observations revealed the prevalence and importance of feedback sharing, particularly in the educational setting. It also enabled Use cases and scenarios to be based on real world examples.

Software design requires various data, to inform Use case and scenarios, real world examples for the requirement specification documents, and raw data in which the software can be built upon. Both ethnographically informed data and SNA data provide an array of information that can be used to build up a concept of what should be built. The prototype software for example, revealed network patterns of interaction of designers who actually existed. Using multiple sources of information to inform software development strengthens any arguments put forward. This is especially true when the research techniques in question provide insight from very different viewpoints (the designer and the researcher).

Contextual observations can elicit what actually occurs in a given setting, not what the users think occurs. It reveals how people actually work, rather than the prescribed processes (often laid down in their job specification). Ethnography is however, a costly, time consuming process and the research can prove difficult to translate into software specification documents that developers need. In the second case study for example, the use of a SNA framework, greatly aided the field research. It enabled the data to be more targeted, less unwieldy and arguable aided the speed and quality of the research.

SNA was used to discover who the go-between, highly centralised people were in a design studio. These people had lots of connections (in desirable network positions), to receive information from the studio and also pass information on. By identifying these people through SNA, these people could be used to test the software as they represent the widest number of their colleagues (as they have more connections to them). They also can pass information onto their peers, for example to accept or reject the software. These people would be also useful if the software was to be designed through user participation. In the second case study, designers like Karl could be used to test the software, or they could be shadowed in further contextual observation exercises.

Testing the impact of software can have upon a group, can be difficult. The impact could be observed through contextual observations, but if the use of the software is somehow removed from the ethnographical field site, the observations do not provide enough insight alone. In the case of the educational studio, the introduction of the visual tool and any subsequent prototype tool, was used outside of the studio (and that which was observed). The network analysis demonstrated face to face connections and showed connections after software had been introduced to them (allowing comparison of before and after). Network analysis can therefore facilitate an insight into the impact a tool has upon the designer.

SNA is a particularly good at understanding group based interactions. Feedback is a group activity, occurring between people and existing within a network of evaluation sharing. SNA is thus informative for researching and developing software that supports social interaction, such as feedback between designers in a studio. An approach similarly used by Elrich and Chang (2006) to understand information seeking. SNA can show who people seek for feedback, the patterns that exist in a studio and the intricacies of social interaction, all which is useful information when developing software that supports a social model of design.

SNA combined with contextual observation can help to understand the social and organisational context into which software is to be used. This can be in terms of understanding software in the real world environment but also understanding people and groups dynamics as networks. Furthermore if SNA incorporates non human actors into the analysis then SNA techniques can be applied that looks, not only how users interact with each other, but how users interact with a system. This approach has been used with Actor Network Theory in the past (Latour 1992). Actor Network Theory primarily uses qualitative accounts rather than the statistical analysis SNA can provide. However it is proposed that SNA, which can also involve non-human actors, can achieve the same understanding of group interactions of software in use.

10.3 Findings from the prototype development and testing

The following text relates to key concepts and features that were brought to light by the designers who tested the software. The data was qualitative and discursive in nature, and in addition to considering the key core concepts, also describes their thoughts and feelings about the software as a whole.

10.3.1 Roles

Opinions on the identification of network roles were quite varied. One person actively disliked the idea: “isolates would get the sack”. Others perceived that the identification of roles would be quite useful. One designer thought that she would definitely be a go-between and it would be interesting to know who she wasn’t in contact with. A third viewpoint was that the identification of network roles would only be useful to certain people. The design manager, for instance, and the allocation of people to teams. This same individual, thought that network role may not be of interest, but other team roles might be, such as who the project manager was and who was a “facilitator”. However this might bring with it some issues surrounding power play (or the identification of power) that might be problematic. The idea of *network* role, in some instances, was confused with identification of team roles. No one mentioned the identification of roles as being useful in an educational context and that it may allow lecturing staff to identify potentially isolated students.

Taking the responses from interviews, the identification of role in any visualisation is not of paramount importance. It should possibly only be shown to project managers or lecturers who have a certain administration rights when logging in. The confusion surrounding network role and team role may mean that only a project manager or “facilitator” should be explicit. Network roles such as clique membership, isolation and being go-between, to some extent, can be seen from the visualisation without overt demarcation of the nodes involved.

10.3.2 Views

In general the differing views (designer, field, and domain) were seen as quite useful. Designers felt that they would like to see who they were connected to as well as the larger studio context. Other designers thought that views could enable the framework to which a designer works in, the team within the studio (and presumably overlaps). Most comments about using differing view related to usability. One designer thought it would useful to “drill down” to see how one person relates to the field and then to the wider domain. Another designer thought that it would useful to move the network and for the nodes to stay in position rather than springing back into place. It was also noted that the field view had many individuals which could become confusing (all the more so if the studio was even larger). Issues surrounding collision detection were discovered on development (it was basically incredibly difficult to implement) and this came up in the interviews.

Differing views should therefore, be included in the final software produced, however further investigation would be needed in order to look into over populated field views. One option would be to provide a slider facility that would filter the number of people viewed. Further work is obviously needed on the usability of the software, particularly in regard to viewing the different levels of the network and possibly trying to achieve this “drill down” approach.

10.3.3 Objects

In every interview, being able to view the work of others was seen as beneficial. Indeed all interviewees thought that design objects should be included but it brought with it some inherent issues. One designer thought that one static image is only a snapshot of the designer (in a way a caricature). Many more images would be needed and not just images either. Video, project websites and 3D representation of models should also be included. Of course, just having one image associated with one designer was only meant as an example for the prototype, but it was interesting to note that the interviewees felt that much more graphics should be shown. Particularly the build up of project work over time, and how they got to the end result. One comment that was made was that viewing objects would vary depending on the design discipline. Some disciplines would refer to objects by their feel and touch. This example was given by a fashion designer who would rely on a team of people from the fabric industry and she would need to know how the fabric felt rather than just an image of the fabric.

This point reiterates the importance of people with content (graphical in this instance). Using people to find graphical content and content to find people. In order to find people and content, needs access and awareness. Erickson and Kellogg (2002) maintained that only through the social networks of people can people get knowledge and resources needed. Content can become the link between people, two people having a similar interest in the same type of graphic for instance. There is argument that the network should potentially be multi-modal or that the visualisation is just about the graphics (with the links between graphics based on people). This link between people and their work, provides further argument that the digital production process of design work is the most plausible route in which to automate the input of network data.

Far more inclusion of designed objects (be it graphic, a website, images of models) would needed to be included in the more finalised software. Seeing the build up of work over time should also be included.

10.3.4 Time

The changing network overtime was seen as an important feature of the visualisation, particularly so when included with the graphical object element. This ability to see the transition of the network during the design process was felt as being especially useful. One designer suggested that there would be a set team in each stage of the design process, in which she would repeatedly rely upon. However, the issues that did arise surrounding time related to the aesthetic quality of the network. One designer thought that the networks changing over the design process was basically “five different networks”, which essentially it was and this is a well known issue when showing networks over time. When trying to overcome this with animations of interactions within a professional design studio, the response was very varied. One designer really liked the way it conveyed interactions between desks whereas another designer dismissed it as a “screen saver”. That same designer thought that networks changing over time could be linked to your calendar. Forecasting could also be useful, how was the team set up, and how has it ended up.

Showing networks morphing over time (particularly with a play function) is one possible way the software could be carried forward. Another option is for a project team to be demarcated as a certain time in the design process. A designer could see who they last relied upon, the last time they were marketing a product and the team would then be shown to them.

10.3.5 Location

Although there is a great deal of evidence in support of the inter-relationship between physical spaces and social spaces (Alexander, et al 1977), all designers (bar one) thought that viewing the location of people and their network of connections was not a factor that should be included in software visualisation. They suggested that networks of reflective communication can happen between studios, that people work with clients, and differing production staff (fabric cutters for example) that were based in various locations. One designer suggested that projects can be global, whilst another designer noted that people work increasingly from home and hot-desk. Freelance designers brought into a project for a short period of time, can sit in various different places in the studio. One designer stated that it would show the “dynamics of entrenchment”. The same designer did feel it would be useful, and thought it could be used to identify those people who you don’t sit anywhere near or that you don’t know. The location feature of the software will therefore not be included in a final software tool.

10.3.6 Other issues

A couple of people asked what is the ultimate purpose of visualising the studio of network connections, what would designers get from it, how could they use it to reflect? In the interviews, the answer given to this was to ask a question about reflection itself. What do designers gain from reflecting on their work? Fundamentally they seek to understand their previous work in order to improve their future work, they learn from experience (their own and others). In a sense this same idea applies to seeing other people’s work, the designer reflects upon other people’s work in order to improve their own work. Not only that, but the designer is explicitly revealed the influence of the social space upon the design space. The social context in which their work exists (or has existed) and potentially an understanding of how to improve their work in relation to other designers.

Another comment that was made is that visually revealing your connections, ties and team associations (formally or informally) aids people to feel engaged. Designers may take ownership of a collaborative team, informal or otherwise, if it is tangible identified visualisation. Informal, ad-hoc, amorphous negotiations about work becomes all the more real once they are identified, researched and shown.

The connection and the relationship between the actors, was another point that was raised. Although the software only showed connections between people who shared feedback, a couple of the interviewees felt that the scope could be widened beyond the relationship between people. Even if the sharing of feedback remained the connecting factor, other relationships should also be shown. One interviewee suggested that if the link was selected, it would reveal what that relationship was, such as friendship based or team based. Another option would be to colour the links between people depending on what other relationship factors were involved. This could also tie into the identified theme of levels (and their granularity).

One person asked, where the data came from. The data for the prototype visualisations came from the two case studies, the surveys (educational studio) and observed interactions (professional studio), but it is proposed that this data input should be from an automated source. This issue of input data is also discussed in more detail in the previous chapter.

Another comment referred to “knowing where you’re starting”. The software would be used an administrative tool to set up team structures. If the project was a lengthy one, the transition of the project could be charted to see how the team matched the original starting team. Using the visualisation as a administration tool could also reveal gaps and over burdened areas, in that sense people could be taken from one people and allocated to another. The would seem particularly applicable in the professional practice case study, when two interior designers left and the CAD professional who joined the company, worked on an interior design project. This would mean that actor nodes in the network would need to be removed, changed and added depending on the changing social patterns in the company.

Intellectual property was also seen as an issue. Would you want your project work seen by a colleague? This was perhaps, more of an issue in the professional practice, although one student requested that his work not to be publicly shown (outside of the university) until he had submitted. It was proposed that some design companies may house teams working on similar project, or that they were working on projects for competing clients. In response to this the data taken for the visualisation should be based on publicly marked folders. Private work would then be kept to private folder domains (a common practice in most organisations anyway).

Finally the question was posed, “do you want everyone to produce the same work?”. Perhaps it seemed that the software was aimed at achieving this. Indeed Jasperson et al (1999) proposed three ‘social appropriations’ (conformance, imitation, and mutual discovery) as social influences on individual decisions. Imitation cannot be denied as an potential outcome, but there is not enough scope in this thesis to give justice to the debate concerning imitation as a feature of creativity (see Piaget 1962 for more on this). The interviewee made the claim that “designers would look at each other’s work and do the same design, copying it”. In response to this, this may happen in the workplace naturally anyhow. It may also be a facet of the design process that arguably should be encouraged in order to use pre-existing work. Thus cutting down on time and resources of creating a design from scratch. Designers exist within a social environment and learn from one another (tacitly or otherwise), and may or may not imitate the work of their peers.

There were some comments by interviewees that related to the software being an end product rather than a prototype. A known problem when using prototypes during the software design process (Benyon, Turner and Turner 2005). These concerns centred around suggestions on how to improve the usability and aesthetics of the software. For instance, enlarging the nodes if they are more popular, clustering people together and 3D representations. Other issues that could be highlighted were areas of activity and also resistance. A concept that could be used for analysing the impact of new software introduced into the studio. Other general constraints to the network were issues of size. The field and domain view for example could easily become complex and difficult to design.

10.4 Findings in relation to previous research in the field

This section relates to how the above findings inform previous research carried in the field. The work of key academic researchers is reviewed in regard to how the findings from this thesis, confirm, contradict or add to their academic results.

The first of these is the work of Ashton (2001). She maintained that the social position (their network role), in a design studio “provides barriers and conduits to learning” (2001 p4). She found that students had a high allegiance to their year group that ‘leaders’ tended to be white, British and male, and gain higher grades. She discussed the issues surrounding isolated students and variation of attendance levels in the studio. She also found that students compared their work with others through observation, and that “observation when used as a vehicle for social comparison, is particularly powerful for those who are visually aware but may be impoverished by their lack of dialogue "(2001 p156). The research in this thesis has also found that network roles are facilitators and restrictors to learning. The research showed that go-between students were in a powerful position, with some evidence that they gained better overall academic marks. On the other hand isolates were restricted and gained poorer resulted. The research also showed that through using a visual tool, some barriers (such as needing to attend studio sessions to view work), were removed. This resulted in a more even, denser network, where there were no isolated students. The results also showed that those students who simply viewed a lot of student work, gained better grade marks. This further confirms the idea of the benefit of comparison through observation. Although the research showed the importance of role identification, when this aspect was incorporated into a prototype visualisation tool, the interviewees did not like this feature and preferred the roles to be more functional (team leader for example).

The second academic research to be cross referenced is that of Mival (2005). Mival carried out an ethnographically informed study in a design studio, to inform the development of software that supports creativity. His findings showed a level of frustration of designers taking on board research findings. Mival applied a "systems view" (similar to the DIFI framework – figure 4) to understand the flow of information from research to design to inform a creativity support tool that could bridge the research-design divide. Mival found a slightly differing reality in the case study he researched to the "systems view". The research in this thesis has also found this to be the case. In particular, the educational studio is more of a micro view of the "individual, field and domain" concept. This thesis has also highlighted how a social model of design can be applied to, and model, differing design studios such as Mival's product design studio and in an inter-disciplinary design studio.

The third academic research to be cross referenced is that of Shaw (2007). In his research Shaw looked at how shared representations enhance collaboration. He used an actor-discourse network framework to understand design interaction. He found that representations (drawings, models, prototypes), act to stabilise networks. The research from this thesis also found that representations (graphical images of work), helped educational studios to be more open, allowing for every student to access the work of others. Furthermore in the testing of the prototype network visualisation tool, it was shown that by revealing networks of association (links between people and their associated work), tied people together, bringing those involved closer with a collective sense of ownership.

There are of course many other academic works that can be cross referenced in light of the findings found. However, the above examples relate to the work of those who most closely align to this thesis, and whose work this thesis is built upon.

Conclusion

This section has begun to address the complex social issue of applying a combined approach to understanding the software requirements of a design studio. It has described the user requirements for the software based on a combined methodological approach, it has described prototype software that was produced in direct response to real world scenarios, and it has analysed the findings and issues gained from testing that software. The following chapter reflects on the findings of this thesis, the process undertaken and, in light of this, the future work proposed.

11. Reflections, future work and conclusions

The previous chapter discussed and evaluated the findings from the case studies, the appropriateness of the methodology and the results and issues associated with the software prototype and the testing process. The findings from the thesis are:

1. The identification and importance of peer feedback and reflection within software visualisation, through observational case studies and survey responses.

2. The use of network analysis in conjunction with contextual observations provides an effective way :

    - Of understanding and revealing interactions and group dynamics in a design studio

    - To develop software that supports creativity

3. There are various influences that had an impact upon the feedback process and how it should be articulated:

    - Roles - some evidence that there was a link between being a certain role and grades in the educational studio. In the professional practice, the importance of go-between roles in spanning teams and making companies inter-disciplinary was revealed.

    - Location - the seating arrangements, the studio location and the physicality of feedback sharing seems to have some influence.

    - Differing levels of social influence - feedback occurs between friends (people they trust) in an educational studio setting, and occurs with people on their team (and same discipline) in the professional setting.

    - Graphics and objects - feedback occurred whilst looking at a graphical symbolic representation. In the educational setting that was in print format, in the professional studio it was a mixture of printed and digital media. The tracking data from the VLE portfolio graphics showed a greater network density of views between students.

- Time and history - the network of social influence in the design studio was a consequence of pre-existing knowledge, context and friendships and the development of the network. Observations and interview data showed that the network studio is an evolving entity. The network evolves alongside the changing nature of feedback (team structures, friendships, personalities, formal into informal links and points in the design process)

In this chapter, the analysis and findings are discussed in the context of how well they met the initial research question and aims. This chapter reflects on the findings, the methodology used and the research as a whole, and with the ability of hindsight, proposes how the research could be improved and future work carried out.

11.1 Has the research addressed the initial research question and aims?

The research question of this thesis is:
How can a social model of design be supported through technological articulation?

Which had the following aims:

- To justify an understanding of design as a social model.
- To justify the theoretical and methodological stance taken in understanding the design studio.
- To justify how technology can support a social model of design.
- To understand and reveal the reflective and feedback process within a design studio, in order to technology articulate it in a realistic and purposeful way.

11.1.1 Understanding design as a social model

To address the research question, this thesis needed to argue the case for a social model of design, with reflection and feedback sharing as a key feature within it. This was achieved through the literature review in chapter 2. The observations and findings from the case studies also re-affirmed this model. The case studies showed that reflection and feedback is pivotal to the design studio, and this strengthened the arguments made in the literature review that this aspect of design is crucial to a social model. The research also showed the cyclical process within both studies, as described in the DIFI model (figure 4). However in the educational studio, it was observed that the interpretation of the differing levels of feedback were effectively a “micro” view (students, their peers and lecturers). Whilst in the professional practice, the levels of feedback relate to designer, adopters (field) and the wider environment, as originally specified by Sosa and Gero (2005) and the DIFI model.

11.1.2 The theoretical and methodological stance taken in understanding the design studio

The choice of methodological techniques was shown to be necessary in order to adequately understand a difficult, somewhat amorphous concept of feedback sharing. It was argued in chapter 4 that the balance of qualitative descriptions with quantitative data gave a thorough overview of the research case studies. The use of contextual observations and Social Network Analysis has enabled the sharing of feedback to be understood from the researcher’s perspective (through observation) and the designer’s perspective (through SNA). This strengthens the argument put forward for each and provides a rounded view of the research phenomenon. The methodology was particularly apt at identifying the intricacies of the social network in the design studio, enabling the development of a tool that articulated social interactions.

The methodological approach was also an appropriate technique for understanding a situation in which to develop and design software. SNA could also be used as a framework which the contextual observations adhere to, helping to make the research from contextual observations more specific. SNA diagrams can also be used to map to UML domain diagrams and how actors relate to one another. This is particularly so if non-human actors are also incorporated into the diagrams. If the system is seen as an actor in its own right, two mode network diagrams could be used to understand the relationships between people and the relationship between people and the system. Finally SNA could also be used to chart the impact of a system upon the network (surveys carried out prior to the introduction of the software and then after its introduction with comparisons made between the two networks). To some extent this was shown in the comparison of the VLE tracking data network to the face to face feedback network in the studio.

11.1.3 Technology to support a social model of design

In the literature review (chapter 3), it was argued that technology could support creativity, design and design as a social phenomenon. To support this view, the case studies researched the social structure of the design studio in order to develop software that would support it. This required contextual observations and SNA to be used as source material for designing and developing software. The contextual observations gave an insight into the complex social situation of the design studio which software would support. The research showed an understanding of the people involved, and the context in which they worked and how they worked together. It provided information that was used to develop personas, UML use cases and scenarios and enabled software to be developed. The SNA methodological approach facilitated a greater understanding of how people worked together and created a formal way of mapping how people interacted. This enabled a clearer understanding of how one user inter-related to another user and the impact this may have upon the system. The resulting specification and prototype showed how software could be used to support design by articulating the social dynamics at work in a design studio.

11.1.4 To reveal the reflective and feedback process within a design studio, in order to technology articulate it in a realistic and purposeful way

It was argued that visualising the social networks within a design studio increases the awareness of how designers are socially influenced. The prototype that was developed revealed the social interactions in a design studio, and was based on real world observations and network analysis. The software articulated the social influences within a design studio, it highlighted which people designers sought for feedback and those they did not, and the social role of the designer in the studio. It articulated the subtlety and intricacies of a design studio and supported how designers socially reflect. In the testing of the prototype, many issues came to light as to how the technology best supported the design process (in regard to certain key features). From the testing responses it can be claimed that the software made designers aware of their social network, and made their work available and accessible, and by doing so it supports a social model of design.

It is proposed that this thesis has met its research aims. Firstly by understanding the role of feedback within the studio, the dynamics of inter-disciplinary design in education and professional practice and how the methodological technique used has been an appropriate tool for ascertaining design as a social construct. Secondly the methodological approach has also been argued as a suitable technique in which to understand the complex social needs of a design studio in order to develop software that supports it. This has enabled the following contribution to knowledge.

11.2 Contribution to knowledge

This thesis contributes to the field of design by understanding reflection and feedback within a social model of an inter-disciplinary design studio, through network analysis, contextual observations and software tools. Using these techniques, this thesis has reinforced the importance of peer evaluation within the design studio. It has also revealed the complex social context in which design occurs, examining group behaviour and influential network roles on the reflective process within design. In articulating the social environment of the design studio, this thesis has shown that group structures are location and time dependent in nature, that shift and evolve depending on the design project and process the designer finds themselves within. The social context of the design studio was also shown to be multifaceted, with varying types and levels of connection that impacted on how designers evaluated each other’s work. The thesis also highlighted the role of artefacts within reflective group social structures, and how technology can be used to reveal images of design work that facilitate the evaluative process.

This thesis contributes to the field of computing by applying network analysis and contextual observations to the design and development of a socially reflective network visualisation tool. In creating network visualisation software, the development process requires an understanding of real world environments (in this case a design studio), in terms of what actually occurs, what people need and how any software can be used in a social context. This is particularly the case when the software in question is to reveal what is occurring in reality that is socially translucent and enhances group awareness. The “wild networks” approach (mixing social network analysis with contextual observations), enables the raw data to be used within the software tool. It also gives a broad overview of the social environment of the design studio by encompassing rich descriptions and statistical analysis. The production of the software itself enabled the methodological approach to be reflected upon and how the “wild networks” method could be applied to the development of software in general.

11.3 Reflections, caveats, issues

With any thesis that relates to the social, political or cultural it is very difficult to be categorical about any assumptions made. When research is based on qualitative descriptions, perceptions and the reality of a situation, assumptions and suggestions are all the more subjective. In light of this, there are caveats to the propositions put forward, in particular to the applied use of methodology.

Yin (1994) described four criteria that should be used when assessing the validity and quality of a case study. The two case studies are therefore questioned in regard to these criteria, in order to assess their successful use.

Construct validity: this criterion refers to the method being adequate for the research being looked at. The complex social situation of the design studio requires a technique that is suitably able to understand the setting it its totality. It looks at the whole social environment, rather than running experiments regarding a specific act or phenomenon. Also, because it was argued that design is a socially constructed concept with an evolving set of interactions and group relationships, SNA is an appropriate tool to understand actors, their relationships and the groups involved in the design process.

Internal validity: this refers to robustness of any correlations with previous or current data. The comparison of educational and professional are not like for like. Both case studies had their own subtlety that meant they cannot be compared like two laboratory experiments. It also means a suitable methodological technique was needed that encapsulated the intricate social structures at play in each setting. When numeric data was available within the network analysis, attempts were made to compare surveys between three different student cohorts, validating the claims from the network questionnaire data. The findings have also been cross referenced with previous academic research into similar areas.

External validity: this relates to the findings being generalised and applied to other cases. It is very difficult to offer generalised conclusions from field research that relates to a socially complex community such as a design studio. Each design studio is a product of its time, the specific people within it, the work they are doing, the technology available to it and a myriad of other influences that makes design studios unique. That is not to say the method used in the two case studies cannot be replicated in other instances. Within the field of software design the combined approach to understanding user needs and interactions could easily be used in many other contexts, with ethnography already successfully deployed as a requirements method and many SNA case studies used to understand how users interact with each other through a technological medium.

Reliability: this means that the case studies have attempted to minimise bias and error. The contextual observation aspect of the case studies involves a high level of participation in the field by the researcher. It is difficult to avoid the researcher not having an impact on the study. This however, is a recognised feature of ethnography. In describing the field site, the researcher should and must, recognise and address their own voice and viewpoint in the research. In both case studies a reflexive account is given before the ethnographic story unfolds. The impact of the researcher was diminished when surveys were given to students, although they may have a perception of how the surveys should be completed and analysis carried out. The

SNA data based on observations have the same issue of researcher involvement as ethnography, and these issues were addressed in the actual case study itself.

All research suffers from the practical constraints of the situation. If resources and time are no object, there are numerous ways that every research problem can be addressed more exhaustively. For example, multiple people could look at each case study and cross referencing could be made between them. The research carried out in this thesis had to work with the practicalities of life. There were large time gaps between the data being collected due to unforeseen personal circumstances. Site selection was based on what was available and who was willing to be observed (many people do not like being watched or video-taped). Also one case study will influence the second, as no research can be carried out in a vacuum and the thoughts and opinions of the researcher are always a facet. In light of this, the following section proposes how the research could be applied again in the future, and also how the current research can be developed further.

11.4 Future work

If only the linear process of this thesis could have been iterative, and researching the design studio could be carried out again. More interviews would have been carried out, more photos taken and network analysis applied before and after the Extricate office move. There are so many “what ifs”, that go part and parcel with real world research. Ethnography is best achieved through practice, and the second case study was far easier to begin than the first. Ethnography requires a great deal of confidence in being able to ask complete strangers what they think and feel and to observe the goings on without feeling uncomfortable. It is a skill that is best achieved through repeated field studies. The differing types of combination approach (ethnography leading SNA, or ethnography informing the SNA) both had their strengths and weaknesses. The contextual observations enabling the context for SNA surveys, gives numeric questionnaire responses, whereas the observed interactions that inform the SNA dataset, allow for the unknown to be discovered (even if that is through the eyes of the researcher). Ideally the exact same method would have been applied to both case studies, but there were practical and theoretical limitations to each case study. If this research was to be repeated again, automating the interactions in some way would make the second type of case study far easier. If the interactions were documented through video, or if tracking data was caught that related people to objects or other people, this would greatly help the observation process. It would objectify the network results and free up the time for the researcher to observe other aspects.

The research could simply be repeated again with some crystallising of methodology and formally adhering to Actor Network Theory rather than Ethnomethodology combined with SNA. The subtle difference between these two theories (see the methodology section for more on this) may make the methodological approach confusing. If Actor Network Theory had been applied as the only theoretical source, the argument could have been made more clearly, and non human actors, such as technology, involved in the analysis. However because of Latour's dismissal of SNA, the use of an Ethnomethodological approach to contextual observations combined with SNA was chosen for the research.

The research question could also have been applied with a different method (traditional requirements engineering techniques for example). However, the studio setting of the research and discovering requirements therein is a difficult situation to address and arguably the choice of methodology that was applied was the best suited for the task at hand. Repeating the research in both types of technique suits software that not only exists in a complex environment, but it also suits software that requires an understanding of interactivity. The contextual observation aspect to the methodology allows for the unknown to be uncovered particularly with social systems. The SNA method enables the interactivity of users between themselves and systems to also be analysed. The methodology discussed in this thesis could have been extended to discuss two mode networks and the role software plays as a "go-between" or "structural hole" in the network. Any future work should therefore include software as an actor in the network that Actor Network Theory puts forward (non humans have agency in the network).

The method used in this thesis could be applied to other environments particularly containing the following aspects:
-interaction between human and non human actors as a key feature of the software

-the site is socially complex
-potentially where stakeholders have conflicting views
-the issues at hand and supporting software is social in principle
-the problem in which the software seeks to meet is hidden, difficult to analyse or unknown to the user
-interaction is identifiable in some way (verbal interaction for instance)

The use of SNA and contextual observations could be used in other requirements gathering objectives, either relating to software that supports creativity or not. It is perhaps best suited for software that is often under the surface and not formally acknowledged and that is potentially vague in structure. It also probably suits software that relates to group and team work that can be formal or informal and where the interaction of key personnel is a major factor in the software's use.

It was also originally envisaged that instead of using a web based visual tool, the interaction data could be taken from physical human interactions with poster graphic work. Tracking data could then be taken from how the designers observed poster images (and also if two people conversed together about a particular poster). This would keep the interaction under question within the realm of a physical interaction around a poster or graphical representation. However, lack of knowledge in how to develop this, cost and practicalities meant that a web based prototype option was developed instead.

Another obvious way in which this thesis could be continued further is full development of the prototype software. Taking the interview test data, a new software example could be built that encompasses all of the findings, plus the insights gained from the interviews. Graphical input would need to be added, a few example annotated images are given below (figures 71 and 72) and analysis based on usability and eventually accessibility carried out. A full software requirements document for the next stage of development appears on appendix CD3.

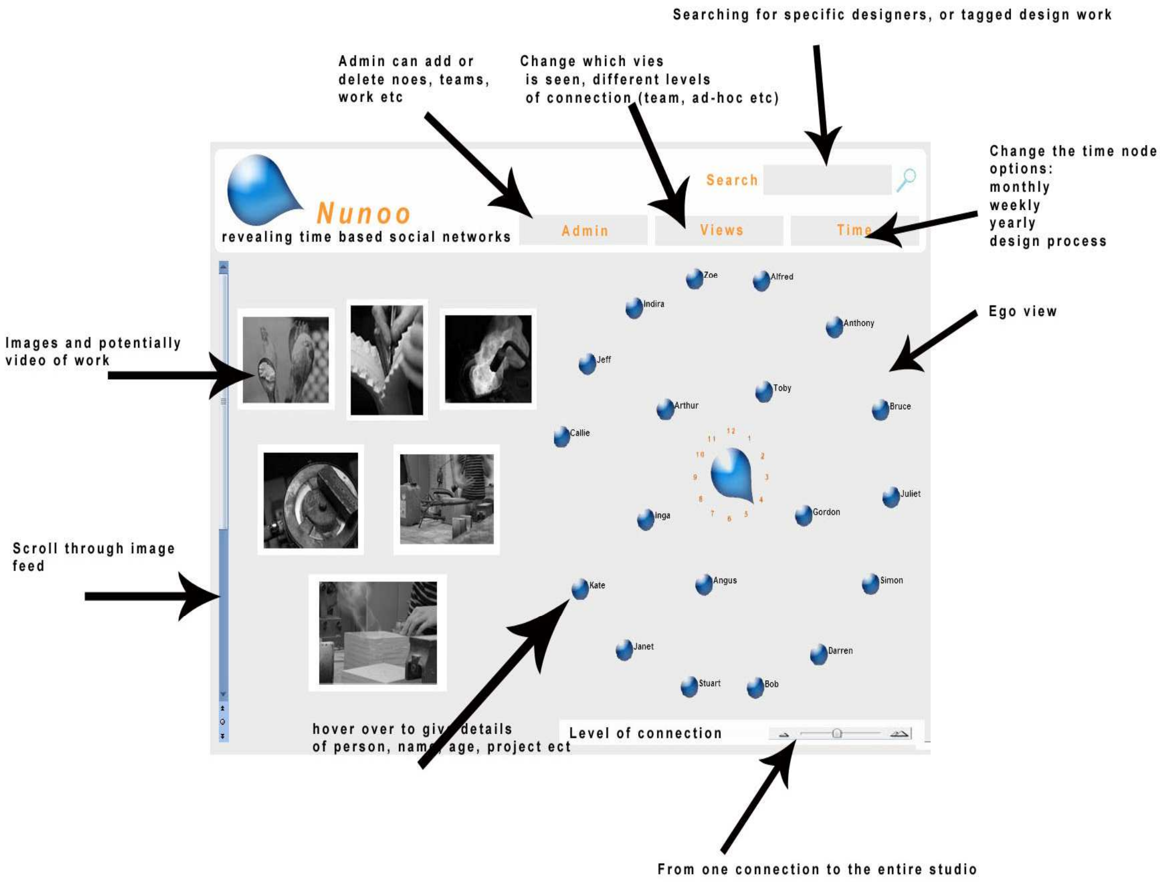


Figure 71: Next stage of prototype development

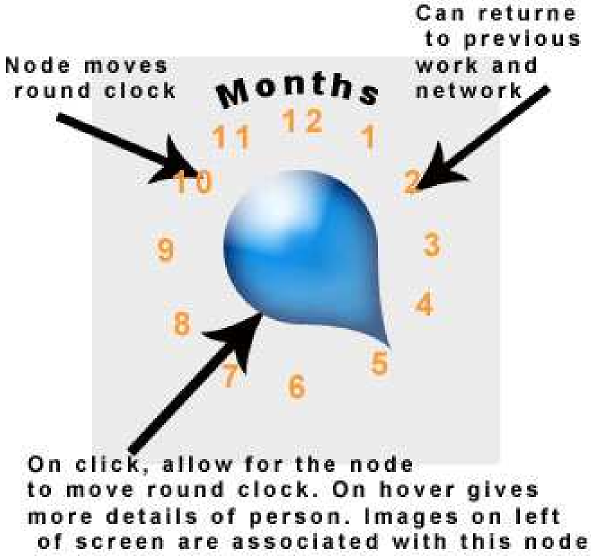


Figure 72: Close up of time facility of network visualisation

11.5 Concluding remarks

This chapter has reflected on what the thesis hoped to achieve and whether it met the initial objectives. It has also addressed the methodological and practical limitations of the research, and how in hindsight the research and findings could have been improved. This leads to the question of how to progress the research further, the practical lessons that were learnt, the studies carried out and how any repeated work could be completed. It has discussed how the methodological approach could be repeated within other domains (and the settings in which the approach was most appropriate). How also, the same methodology could be used to elicit user needs to design software generally.

This chapter has tried to summarise the thesis in terms of how it addressed the research question. It has also commented on the issues and caveats associated with the thesis. There are many personal reflections that can be made about the research. The concept of feedback sharing was a difficult one to encapsulate, to study and technologically support. Perhaps it would have been easier to study an area that was more obvious and less challenging, but then again there is an argument that doctoral research should seek to understand matters of complexity. The methodological approach was also an area that tried to balance differing perspectives. It was not one clear cut methodological technique, which again made the task of explaining and applying the technique all the more difficult. The structure of the thesis was also not straightforward. The case studies informed the development of the prototype software but also the findings from the case study and from the prototype in their combined totality provided insight into the articulation of feedback sharing in the studio.

This thesis is not a straightforward one. It has tried to

- describe complex social phenomenon
- understand it through differing theoretical and methodological viewpoints
- produce software that not only is informed by the preceding research, but also adds to the general understanding of design as a social construct

Needless to say, the thesis, like the social system it has sought to describe and support, is multi-faceted. It is “designing in the wild”, a “turn to the messiness” (Rogers 2010, keynote speech). Although it can be complex in places, it is hoped that it has explained the research intentions, processes and findings. All being said and done, the research has articulated a real world design studio environment and produced software that visualises the sharing of feedback, to enable reflection in a social context.

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