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Web Designer / Client Communication:
An in-situ development and evaluation of tools and methods to support the collaborative design of interactive technologies

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Abstract

This thesis explores the nature of communication within web design businesses, specifically the support that computer mediated communication tools can provide for collaboration between designers and clients. The research seeks to understand why, despite years of research into computer-supported collaboration systems; new methods of digital communication are not in widespread use within this environment. The research question is, therefore, how can new communication tools be designed to effectively support designer-client communication within web design businesses?

The web design industry is a modern and emerging service-oriented field that focuses on the design, development and marketing of web sites, applications and media. These services are most commonly used by small to medium enterprises (SMEs), which do not have the internal skills or resources to develop their web presence. To support this work, web design businesses rely on continual and rich communication with their clients. This communication is conducted through a variety of Computer Mediated Communication tools such as email, phone calls and Skype, which are already in use by both designers and their clients. This ecosystem of general purpose tools allow clients and designers to communicate without the overheads of face-to-face meetings; however the lack of awareness and context specific functionality mean that these tools do not support the web design process as effectively as they could.

Academic and industry fields such as Computer Supported Cooperative Work (CSCW) and Social Software focus on the problems associated with designing communication tools, often focusing on how to enable new methods of communication within a specific context. While the approaches to some of these problems have been successful in enabling methods of communication in a rich and context-aware manner for social interaction, tools integrating these approaches have not yet been widely adopted by web design businesses in their day-to-day

communication with clients. There are a number of reasons for this lack of adoption of new communication tools to support work processes, but prominent among them is that they compete with existing methods of communication, rather than build upon them.

A multi-staged approach is taken to address this question: understanding current practices through contextual interviews and participant observational studies and the incremental design and development of a middleware platform to facilitate the creation of new communication tools. The platform enables communication tools to build on the knowledge and processes contained within existing channels of communication, rather than attempting to replace them. The findings from these studies are synthesised to yield a set of design challenges that have been identified, and embodied within a visual representation known as the Designer-Client Communication Tool Canvas. The canvas serves two purposes: it is an encapsulation of the problems that tool designers face in creating tools for this context, and it is a guide for these tools designers to assist them in understanding the context for which they are designing.

There are a number of contributions that this research makes to the fields of CSCW and HCI. This research provides an insight into the ways in which designers and clients interact within the web design industry. Additionally, it analyses the scope of tools that are available which are either aimed at supporting this work, or tools which are already in use within the web design context. This research highlights a number of challenges for the design of technologies to support designer-client communication, in particular the problems associated with web designers adopting new technologies to support communication with clients. The thesis also provides an example of how two-way integration technologies can assist in negating these problems, as well as a number of considerations that designers of communication tools should acknowledge when designing for the web design context.

Declaration by author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly authored works that I have included in my thesis.

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Publications during candidature

Dekker, A., Worthy. P., Viller. S., Zimbardi. K., & Robinson. R. (2014, December). Designer client communication in web design: A case study on the use of communication in practice. In Proceedings of the 27th Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction (pp. 440-443). ACM.

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Contributor	Statement of contribution
Andrew Dekker (Candidate)	Designed experiments (70%) Conducted data gathering (70%) Wrote and edited paper (60%)
Peter Worthy	Designed experiments (20%) Conducted data gathering (30%) Wrote and edited paper (10%)
Stephen Viller	Wrote and edited paper (10%)
Kirsten Zimbardi	Designed experiments (10%) Wrote and edited paper (10%)
Ricky Robinson	Wrote and edited paper (10%)

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Contributor	Statement of contribution
Andrew Dekker (Candidate)	Designed experiments (100%) Conducted data gathering (100%) Wrote and edited paper (100%)

Contributions by others to the thesis

The thesis was composed entirely of writing conducted by myself, and any contributions by others form quotes that are referenced. The work documented in Chapter 3.5 and 3.6 were a collaborative effort between myself, Peter Worthy (Chapter 3.5) and Skye Doherty (Chapter 3.6), and contributions are highlighted specifically in these sections.

Statement of parts of the thesis submitted to qualify for the award of another degree

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Table Of Contents

List Of Figures

List Of Tables

List Of Abbreviations

CMC   Computer Mediated Communication

CSS   Cascading Stylesheets

COTS   Commercial Off The Shelf software

CSCW   Computer Supported Cooperative Work

DCCT   Designer-Client Communication Tool (Canvas)

GDSS   Group Decision Support Systems

HCI   Human Computer Interaction

HTML   Hypertext Markup Language

IxD   Interaction Design

SME   Small to Medium Enterprises

SOHO   Small Office Home Office

Glossary

Term	Definition
Account Manager	The role within a web design firm that deals with the payment and project management, primarily dealing directly with clients and the design team.
Canvas	An encapsulation of considerations which designers should be aware of when creating new tools for the context of designer-client communication within web design.
Clients	A client is an individual or a member of a business who engages with a web design firm to create a new product or service. The client may be someone in direct communication with the designers, or have some direct connection (such as the business which has engaged the web design firm) to the designer.
Communication	The method in which two individuals or groups transfer knowledge or discuss processes to achieve a certain goal.
Communication Channels	A method of communicating between individuals, usually through a certain technology. The communication channel is not necessarily a specific type of technology, rather an isolated and distinct method of communication.
Communication Ecosystem	The combination of communication technologies within a web design context, and how they are used in conjunction with each other. The ecosystem is unique to the context.
Content Manager	The role within a web design firm that focuses on the generation of content for the product being created.

	Content managers work closely with clients to develop content which best represents the clients goals.
Designer-Client Communication	The act of clients and designers interacting with each other for the transfer of information or knowledge. Primarily this communication is done through digital technologies, but may also be conducted face to face.
Designers	In the context of this project, a designer is any individual who works within a design firm. Designers in this context may have primarily a development role, a graphic design role, or a management role.
Digital Director	The role within a web design firm that primarily deals with the internal management of the web design group, in particular communication between divisions such as developers, graphic designers and web designers.
enSense	A middleware platform that provides a REST API to existing methods of communication within a design firm. This allows new communication tools to leverage and build upon the existing collection of knowledge.
Product Manager	The role within a design firm that deals with the project management, primarily communication directly between clients and the design team.
SMEs	Small to Medium enterprises are businesses that are businesses with less than 100 employees, and those who do not have the internal resources to have an internal web design team.
Stakeholders	Any individual or group of individuals who have a vested interested in the creation of web design products and services.
Tool Designers	An individual of business who has an interest in creating new communication technologies for

	supporting designer-client communication within web design.
Tools	A tool in the context of this thesis is a technology that provides the ability to communicate between designers and clients.
Universal Communication Tools	Communication tools that are in everyday/ubiquitous use
Web Design	A service-oriented industry that other businesses and individuals engage with to create interactive systems, primarily web based systems.

Prelude

"A morning in the life of a web designer"

John is a 28-year-old web designer, a computer enthusiast, obsessed on fonts styles and Apple products, has been working for "Best Designs Pty. Ltd." for 4 years now. He's been in web design since he first learnt HTML in high school. Which then followed with him receiving a degree in Computer Science. There is so much that he enjoys about his job: space for creativity, great people, interesting projects in a variety of contexts and a good salary. However, there are some moments that doesn't enjoy so much…

Today he wakes up at 7am, showers, eats his breakfast and commutes to work, arriving there at…

09:30

Like most mornings, he begins his day catching up with his colleagues informally, chatting about what happened over the weekend and their plans for today. After, John gets to his desk and starts the day by opens his email to see if there is anything urgent. He sees that a client have sent through an email:

> *Hi John,*
> *Sorry that we haven't been in contact lately, we have been completely swamped. We will get you the content that you asked for soon. In the meantime, could you please update the logo on our site with this new one that we have just received. Also, is it possible to make the website multilingual and add Chinese? I'm sure that shouldn't be too hard.*
> *Regards, Sam*

omg, what? adding Chinese is another whole project.

Good morning Sam,

Passed the logo to the graphic designer, so hopefully the website will be updated with new logo by the end of today. There are few things that need to be done to add Chinese:

We will need to hire translator, average rate is $90 per hour. We will need to get a quote for the entire content of the website.

Also, the Server side will need to add more functionality to be able to query user-entered data in Chinese.

By Chinese do you mean Mandarin or Cantonese? or both?

Would you want admin panel to show data visualisations for Chinese user data as well? This will need modification as well.

Would you like to do SEO in Chinese? We will need to setup a meeting to identify which particular market to target.

Yours Sincerely,

John

John then forwards the email to the graphic designer, to ask them to clean up the logo ready for including it into the website. John flags an alert to this email, to get notification when client replies back.

Really really hope they will back off with this Chinese language integration, we haven't even finished the primary website yet.

John,

We have looked through the design sketches that you have sent through, and we really like the third one, however could we have it a bit more like this website (http://joescakes.com) - we have discussed it with our management and we really like how it is designed.

Frank

John opens the websites, and compares the website which Frank has said to the current design. John is unsure exactly which aspects of the design Frank likes.

Good day Frank,

I will need to know which of the following you liked about the third sketch and the website: colour scheme, layout, fonts, style, usability, aesthetics. Maybe it is best to discuss over a Skype meeting? I can squeeze in a window of 10 minutes anytime this afternoon or tomorrow morning.

Yours Sincerely,
John

10:30

After going through couple more email, he sees a notification form old Basecamp discussion came in, from Stephen:

Hey guys,
I appreciate your hard work, the website is looking amazing so far. I was just wondering if it is possible to add a login button on the keyboard of my android device?

Hmmm, this is weird. why is he posting this here.

Hi Stephen,
That sounds good, I will add it to my to-do list for today. I would advise you to create a new discussion every time you have a new point, since this discussion is dedicated to feedback for logo.
John

11:00

New Email from Basecamp:

Stephen Jefferson has assigned you a to-do: "Testing new discussion"

ah, I really need to go through Basecamp functionality with him again…

Hello again Stephen,

Could you let me know when you have 30 min for a quick Skype, I would like to have a quick catch-up about the current task list on Basecamp.

John

Hey John,

I still can't get my head around Basecamp so that sounds great. Unfortunately, I don't have a Skype account. But I can set it up if you would like? How about I come by office for lunch, and we can discuss it over the meal?

Stephen

John replies immediately:

Stephen,

That sounds good Stephen. I will meet you at Campos at 2pm?

John

11:30

> *Wow, it's 11:30! And I haven't touched my actual work yet.*
> *I have an hour before lunch… there goes one half of my day…*

John decides to close down his Email client for a few hours to get some work done before his meeting with Stephen…

Chapter 1 - Introduction

1.1 - Motivations

With over 83% of Australian homes with Internet connectivity (Australian Bureau of Statistics, 2014), the Web has become a primary method for businesses to promote themselves and develop relationships with their customers. To meet this need, a large number of businesses have emerged to design and create web sites and other online products for these clients. These web design businesses work closely with clients through various communication tools to create products that can effectively target and assist the client's audience. The web design industry has become a major part of the IT industry.

The motivation of this research is that despite the rapid technical innovation in this area, the tools in which designers communicate with clients are archaic and generic communication technologies not suited to supporting rich remote communication. This is due to the current lack of understanding regarding designer-client communication in the web design industry. Despite many new communication tools being created to assist contexts such as designer-client communication, these users continue to use older methods of communication such as Email and Skype. Many web design firms trial these new tools with hopes that it will improve the methods in which they communicate with clients; however, the adoption of these tools for the most part fails. Additionally, web design firms often have trained programmers and designers who have the ability to create new communication technologies; nonetheless, they continue to use off-the-shelf solutions. The motivation of this thesis is to identify the key requirements that designer-client communication tools need to consider, to improve the chances of successful adoption by web designers and their clients.

There is little formal knowledge and understanding of designer-client communication within the web design context. As discussed in later chapters, the web design context is unique in the organisational and collaborative nature between designers and clients. Unlike many design disciplines, the web is primarily a communication platform, where the clients are the domain experts with extensive knowledge of their target audience.

Web designers are professionals who participate in and facilitate the creation of design. They accomplish this through enacting a series of methods and practices that is known as the design process to create solutions to problems (Lawson, 2005). The design process is not an enforced series of steps; rather, it is a reactive, adaptive and reflective process that is enacted based on the changing requirements of the design (Schön, 1983). As different from forms of art, design is not a formalisation of creativity; rather it is a series of processes created to solve tangible and real-world problems (Norman, 2002). "From the moment [people] wake up, almost everything that fills their world has been designed, one-way or another" (Hustwit, 2009, interview with Alice Rawsthorn). Web designers follow a design process through a series of tasks in creating products and services for their clients (Newman & Landay, 2000); however, the process varies between each firm (Hecker, 2004).

The design process is not unique to web design: Architecture, Industrial Design, Product Design and other fields follow similar processes. Each of these industries exists to commercialise their expertise in the design process as a service to other businesses and individuals. However; the nature of web design lends itself to remote collaboration in ways that other design fields cannot, due to the artefacts and the outputs being created are digital. Additionally, rather than being solely the end user of the resulting product, the clients in the web design process provide the expert knowledge of the domain.

Web design businesses offer a number of services for their clients. While traditionally these services were limited to the creation of web sites, the collective expertise within web design businesses has led to an expansion of services offered to include product types such as:

- Web presence - small websites which act as an advertisement of the clients business with relevant information (stereotypical corporate web site)
- Web site - a larger website which includes dynamic content and interactivity, such as updated news or the ability for customers to interact with the company online
- Web application - a large web based service which is designed to help a client's customers achieve a specific task, or is run by a business, which then offers the service to other parties
- Branding and Media - working with the client to develop other forms of media such as logos, print media, multimedia and online marketing
- CMS (Content Management System) - a protected website to assist clients in managing their website
- CRM (Customer Relationship Manager) - an internal website to manage customer information for the client
- Mobile websites - websites designed for viewing on mobile devices
- Mobile applications - native applications that have been designed for specific mobile platforms (such as Apple iOS and Google Android) which are then offered to other parties

Web design businesses that primarily create products for external clients work with the client to identify the problem that they are trying to address, design a solution to the problem, implement the solution and evaluate the success of the solution. In addition, the solutions that are designed and implemented must be supported and maintained by the web design business afterwards. The web design industry is diverse, and works with a variety of clients, ranging from individuals, to large enterprises, or alternatively working exclusively on a single website (internal web design teams). This thesis is concerned with web design businesses that work

primarily with external clients who engage with the web design business to create products. Within these businesses, a variety of roles are used to sub-divide the work. While these roles are malleable and change based on the individual business they often include:

- Back end developer
- Front end developer
- User interface designer
- User experience designer
- Database designer
- Project manager
- Mobile designer
- Mobile developer
- Media designer

This is not an exhaustive list of roles (see Chapter 3.3), and a single person may fill many of these roles; however, it provides an idea of the scope and diversity of areas of expertise that are required in the web design process.

The web design industry is a relatively new and emerging service-oriented market that focuses on the design, development and marketing of web sites, applications and media (Lin, Newman, Hong, & Landay, 2000). Web design services are commonly utilised by Small to Medium Enterprises (SMEs) and Small Office Home Office (SOHO) businesses that do not have the skills or expertise to develop solutions to design problems internally. Additionally these collaborations are lightweight and short-term arrangements (weeks), as opposed to other larger software development collaborations between enterprises (months).

Within the design disciplines, several approaches have become popular for designers to follow. Specifically, in the design of software technologies (e.g. web design), two methods are popular: the waterfall method and the iterative method (Larman & Basili, 2003) (Figure 1). In practice however, the design process is more

likely to be an adaptive and reflective process that is adjusted by the designers based on the situation. Meinel and Leifer (2010) found that the more experienced a design team was, the more likely they were to be adaptive during the iterative design process. This is also reflected by the increased focus of web design firms moving towards an agile development process when developing products (Beck, Beedle, Van Bennekum, Cockburn, Cunningham, Fowler, et. al., 2001). In the context of web design, the clients who initiate the work are also an active member of the team in these methods.
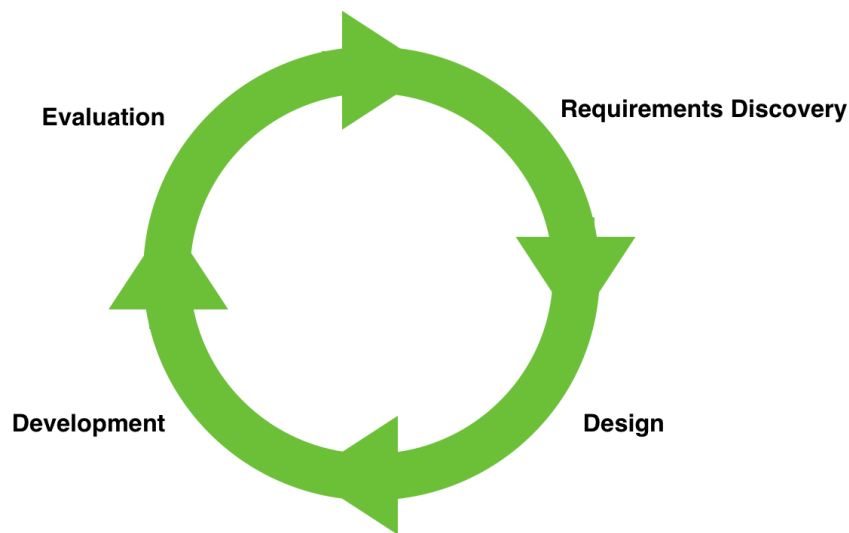
Figure 1: Iterative Design Process

Social planning (Rittel & Webber, 1984) highlights the idea of "wicked problems" - that is problems that are ill defined and cannot be fully understood or solved due to their nature. Additionally, by creating a solution to the problem, the problem itself adapts and changes, creating a new problem. Buchanan (1992) identifies that design as a discipline focuses on creating solutions to these wicked problems. A major factor in understanding these problems is that requirements are often gathered not first hand by the designers, but rather by the clients that hire them. Because of this, clients are not simply the "source of the brief", but rather "a creative partner in the process" (Lawson, 2005, p.85). When designers are engaged to solve a specific set of problems, the problems have been (to an extent) already identified by the

clients who hire them. Designers must engage with these clients throughout the design process (Figure 2), through face-to-face meetings and other methods of communication to (see Chapter 3 for more detail):

- understand the problem space,
- gather requirements which the solution must address,
- set the scope of the design,
- mediate communication with other stakeholders of the problem (such as contacting customers),
- receive assets and content (such as branding or website content),
- inform clients of progress of the work - especially in iterative design where the work may appear unstructured,
- perform administrative tasks (such as approvals to the design and contracts),
- receive feedback which assists in the decision making aspect of the design process, and
- perform user evaluation and user testing.
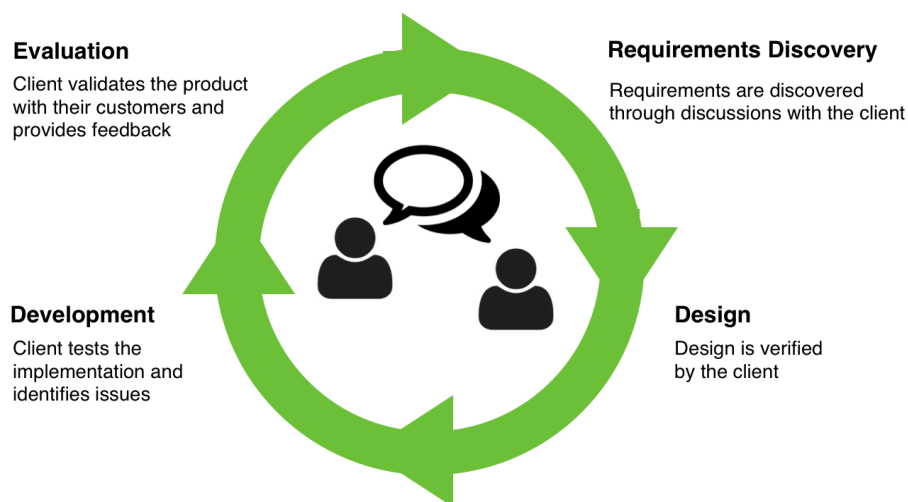
Figure 2: Designer-client communication process

While web designers may dedicate a large amount of time to managing and performing communication, clients have other priorities that limit their ability to communicate with the designers. Because of this, it is important for the designers to

establish communication channels with the client that are both efficient (in terms of time), but also effective. While face-to-face meetings provide a rich medium for collaboration, the extra time and organisational overheads required means that digital communication is either required or preferred (Dekker, Viller & Tan, 2009).

The practice of web design is two-fold: one is as practitioners of creating products, and the other is understanding the target audience which they trying to reach. Both of these are focused on the collection, understanding and usage of knowledge. To gather this knowledge, web designers are required to engage in continual and rich communication with clients and stakeholders (Diffily, 2008; Williams, 2008), the domain experts, to establish a common ground (Convertino et al., 2008).

The major factor in determining how designers and clients communicate is based on their previous experience with communication technologies. Both parties (a client business and a design firm) each come with their own culture of communication that exists within their respective businesses, and with the workers within the businesses. Because of this, negotiation is required to determine which technologies will be used to support communication throughout the collaboration. While some negotiation is possible, most often tools that are already in use will be selected either through explicit or implicit agreement. As a result, universally used tools (such as Email, Skype and Instant Messenger) become either the default or backup communication technologies. However, the tools that are currently in use to support designer-client communication fail to effectively support a number of aspects that are critical in the design process (more details of these can be found in Section 5.2):

1.1.1 Documenting Communication

A critical aspect to design work is the ability to document and reflect on the communication process as it occurs. Because of this, communication technologies need to document communication between the designer and the client. While digital communication lends itself to auto-documentation (as opposed to communication mediums such as face to face which require notes to be written), this also results in documentation processes becoming ignored, and often-key communication is lost

within communication archives, and not surfacing until needed later (introducing issues of searching). Current tools do not effectively document communication, instead relying on designers and clients to manually search through previous conversations.

1.1.2 Providing Awareness

Throughout the design process, the awareness of the ongoing conversation and project progress between designers and clients is of utmost importance. Continually, the design process involves one party waiting on another, and having an awareness of what is going on can streamline the process. Current tools provide little to no awareness, instead relying of the intuition and assumptions of clients and designers. Often, the communication is not direct between two stakeholders (for example a back-end developer and an end-user), requiring communications to be forwarded through multiple people. This can introduce issues of latency into communication, which the stakeholder must be aware of.

1.1.3 Rich Collaboration Support

In digital forms of design most communication does not occur in separation from the work, but rather around and through design artefacts. These artefacts may be physical, such as sketches or prototypes, or digital, such as a website or graphics. Communication tools that designers use to communicate with clients do not consider the nature of these artefacts, and instead treat them simply as binary files. Discussion around these artefacts is often disconnected from the artefacts themselves, instead relying on reference to the artefacts or through representations such as screenshots or generated diagrams. Additionally many assets and resources may be required from clients, such as branding information or content, requiring the clients to send artefacts digitally to the designers.

1.1.4 Negating Communication Overheads

Asynchronous communication is the primary method of designer-client communication, and leads to additional overhead in the design process. There are many benefits of this kind of communication; however, decisions may not be resolved immediately and the process stalls, waiting on correspondence from one or more parties. Additionally the disconnect between conversation and the artefacts leads to additional work required to achieve a common understanding between participants.

1.1.5 Support Knowledge Sharing

When new individuals become involved in an ongoing design project, they must be given an overview of the current progress of the design process as well as an understanding of the communication process thus far. Current tools used to support designer-client communication have no built-in ways to share the existing knowledge. Designers and clients need a level of transparency so that previous communication can be easily shared to provide a smooth transition into the design process.

Despite the advantages that new technologies may offer (many of which are already available), designers continue to use generic and less suited methods of communication. This thesis is concerned with understanding how designers of communication tools can approach this context to create new methods of communication that are suited to this context, and are more likely to be adopted by designers.

1.2 - Research Background

This research project builds upon a large body of work that examines how technologies can support collaboration, communication and coordination between individuals and within groups. In particular, this thesis is situated within the research field of Computer Supported Cooperative Work (CSCW). For a more comprehensive overview of Computer Mediated Communication (CMC) and CSCW research see Chapter 2.

This thesis approaches CSCW from an Interaction Design (IxD) perspective, focusing on the exploration of the web design process and its intricacies (Buchanan, 1992); however, there are multiple relevant bodies of literature that are of interest in this research context. These range from business focused areas including Business Process Management, Systems Thinking and Knowledge Management to more engineering/technology driven research such as Requirements Engineering, Information Systems, System Design, Service Oriented Architecture and Expectation Management. While all of these fields are relevant from a multi-disciplinary design perspective (Bannon & Schmidt, 1991), this research predominantly draws on work surrounding the design of CMC systems for specific contexts. Within CSCW, the design and implementation of communication systems is focused on facilitating human interaction (Ellis, Gibbs, & Rein, 1991), and is in particular designed to support cooperative work in small groups.

While there has been research into the study of web design (Ames, 2001; Dorn & Guzdial, 2010; Duyne, Landay, & Hong, 2002; Lin, et. al., 2000), these studies have not focused on unpacking the communication or working processes within the context, rather they have focused on the technical practice of web design. Additionally, there is much research into supporting distributed small teams in a work context; however, web design teams sit across a variety of companies over a short term interaction.

To understand the context of web design, a number of methodologies and theoretical frameworks (Greenberg, 2001) are adapted including Ethnographic Action Research (Tacchi, Hearn, & Ninan, 2004), Participatory Design (Muller & Kuhn, 1993) and Design Thinking (Brown, 2008), and are examined and drawn upon throughout this thesis.   However, rather than follow a specific methodology directly, a design exploration approach is be used as the basis for this research, using a number of Interaction Design methods (Benyon, Turner, & Turner, 2005; Preece, Rogers, & Sharp, 2007; Saffer, 2006). The research methodology that was followed using these Interaction Design methods can be found in Chapter 2.7.

1.3 - Research Questions and Aims

This research seeks to understand why, despite years of research into computer-supported collaboration, newer and more tailored communication technologies are not in widespread use within this context. The research question is therefore:

How can communication technologies be designed to effectively support designer-client communication within web design businesses?

The research question does not imply that current communication technologies aren't successful in supporting communication for this context, rather it seeks to explore how these already in practice tools and methods work (successfully and unsuccessfully) to support designer-client communication, and how new tools can be designed to support the context. There are a number of existing problems that affect designer-client communication, this research aims to understand these issues in detail, and evaluate methods for negating or limiting their causes.

The research question is broken down through an examination of the following four research aims:

Research Aim 1: Show the existing designer-client communication process with a focus on the tools and methods that they employ.

Research Aim 2: Identify current issues with designer-client communication; specifically how existing tools in use contribute to these issues, and the challenges that the uses of these tools introduce.

Research Aim 3: Demonstrate how a middleware platform can be designed and deployed to assist in the creation of new tools to support designer-client communication by web designers. While a primary focus of CSCW in the design of

new tools to support cooperation, little work is focused on the architecture of these systems (McDonald, Dokhman, & Zachry, 2012).

Research Aim 4: Categorise the issues with creating new communication technologies for supporting designer-client communication within web design. Develop these insights into a guide that assist designers in awareness and mitigation of these challenges when designing new communication technologies.

A multi-stepped approach will be taken to address these goals: a) understand current practices through contextual interviews and observational studies, b) examine the current state of the art of communication tools and c) incrementally design and evaluation a prototype enabling platform which helps support the creation of new communication tools with respect to the designer-client context. The results of these processes are synthesised to yield a set of design principles that are embodied in a guided set of design recommendations that assists in designing CMC tools within the context of supporting design.

There are five primary contributions that this research brings to the CSCW community (Chapter 9.2):

- A deeper understanding of the designer-client relationship within web design
- A broad review of the tools which are designed to support designer-client communication within web design, and the categorisation of these tools
- The identification of lack of integration being a large challenge to new tool adoption and the importance of having a collated narrative of communication
- An exploration of how integration with other communication technologies can be addressed
- Categorisation of the challenges for tool creators designing for designer-client communication within the web design context

This research also produces an output: the Designer-Client Communication Tool (DCCT) Canvas. The research methodology (Chapter 2.7) outlines the details of the approach that this thesis takes in accomplishing these aims.

1.4 - Research Scope

This research focuses on designer-client communication within web design businesses, The justification for scoping this research is to pinpoint what areas this research is most relevant for. This is not to say that other areas may not place value in the findings of this research, rather the research does not aim to provide significant contributions to research outside the scope. Aspects of this research study which limit its scope are:

1) The thesis assumes that in the designer-client relationship, there is both in-depth design and development work involved. That is, this research does not focus on work where a specification sheet is created by the client and given to the web designer to complete. The research focuses on relationships where the client employs the designer based on the designer's expertise within the web design field, as opposed to subcontracting out web development work.

2) The thesis is concerned with a subset of web design businesses and is not targeting all individuals who create websites (freelancers) as a hobby or web designers working internally within businesses where there is not a distinct separation within the business. The web design industry is a diverse area, and this research is specifically focused on design firms that work with external clients.

3) The thesis is focused on investigating the digital technologies and tools that support designer-client communication. This may include hardware devices such as mobile phones and computers; however, the focus is on communication software, applications and digital services. Physical artefacts that facilitate communication (such as whiteboards), while discussed, are not explored in detail.

4) The thesis assumes that each web design business operates in varying ways, but uses a combination of physical and digital communication methods. While it is valid to have designer-client relationships that happen entirely digitally, or entirely

physically, the design firms that will be focused on in this research are those which employ both forms of communication. The reason for this is that a majority of design firms will have some form of direct contact with the client (whether that is through face-to-face meetings or phone conversations).

5) The thesis is about communication methods and tools to better support web design industries current business processes, not to recreate them. The research assumes that there are pre-existing communication tools and technologies already in use within the business to support designer-client communication. The research will also examine the reasons why these tools were originally introduced into the designer-client communication practice.

6) The thesis is not about examining the communication process itself in detail. Rather, the focus is on the methods and tools designers and clients employ to perform communication. This research does not seek to provide an in-depth analysis on how designers and clients communicate (from a strategic perspective); however, the content of the communication will be investigated. Trust and other aspects of person-to-person relationships are acknowledged as a contributing factor within group dynamics (Al-Ani, Redmiles, de Souza, Prikladnicki, Marczak, Lanubile & Calefato, 2013); however, it is not one which is unique to web design client relationships compared with other business-to-business interactions.

7) The thesis is also about the practicalities of how web designers act, rather than a systematic view of how they are supposed to act. The focus of the investigation into designer-client communication is to understand the issues that they have as a result of the technologies that they use, rather than innate sociological/psychological states of the people themselves. While personality is a contributing factor to any form of communication, this research does not seek to take this into account based on the findings from individual cases.

For additional reflections of these scoping limitations please see Discussion and Future Work.

1.5 - Thesis Structure

The structure that this thesis follows is based around the research aims identified in Section 1.3. These aims are further broken down to detail the approach:

- Identify and evaluate the existing literature within the fields of Computer Supported Cooperative Work (Groupware) and Social Software with regards to designing contextually aware communication tools which support design processes (Chapter 2),

- Analyse and document the internal and client communication processes within specific web design businesses (Chapter 3 and Chapter 4),

- Identify existing problems with developing and introducing software to support communication within these businesses and their clients (Chapter 5),

- Investigate how a platform can be designed to assist in developing and introducing these tools into existing business infrastructure Chapter 6),

- Explore how the prototype platform can be used to constructing new communication tools and methods to support existing business processes (Chapter 7),

- Evaluate these new tools in relation to the already in-use general purpose tools through interviews and observation and how they leverage the existing communication ecosystem (Chapter 8), and

- Evaluate the findings of the previous studies through the development of a guide (a Canvas) that is a encapsulation of the factors which tool designers should consider when designing in this context (Chapter 8)

- Determine the impact bridging between existing general purpose tools and new communication tools, and how new tools can mitigate challenges found within designing designer-client communication tools (Chapter 9).

Chapter 2 - Foundation: Computer Mediated Communication

2.1 - Introduction

This research builds upon the foundations of Computer Mediated Communication (CMC), which is the ways in which computers and other technology can support communication between people. December (1997) defines Computer Mediated Communication as "a process of human communication via computers, involving people, situated in particular contexts, engaging in processes to shape media for a variety of purposes" (p. 1). Digital technologies are the everyday form of communication that designers use when collaborating with clients and each other, through a variety of methods and tools that are common between the designers and clients. While face to face meetings and phone calls are essential to designer-client communication, practicalities emphasise the usefulness of digital communication. Understanding the existing work in this area is essential to understanding how these technologies can be used, and are used, to support designer-client communication. This chapter provides a review of the literature associated with CMC, in particular around supporting collaborative work.

Computer Supported Cooperative Work (CSCW) is the dominant field of how CMC can be used to support the type of work that is done within the web design workplace. Chapter 2.2 covers the foundations of CSCW, and the aspects of CSCW that are relevant to this thesis. Groupware - tools that are designed to support groups have a long history of study and evaluation and this literature is examined in detail. Following Groupware (due to the ubiquity of the internet), broader scoped and more pervasive methods of communication have become popular, termed Social Software (also known as Social Networking Systems). In these systems, large groups of users are enabled to communicate and collaborate - and of particular

interest these networks of users are designed for the general population (which both clients and designers are part of). These tools that aim to support communication are covered in Chapter 2.3. A primary concern when creating tools to support work through communication is providing awareness to the team (including passive awareness), while at the same time addressing privacy concerns, both of the individual and the business (Chapter 2.4).

As the context of this thesis is focused on supporting the designer-client communication process, Chapter 2.5 examines the literature related to the web design context. In particular, it examines web design work as a form of knowledge work, to understand the considerations of knowledge workers in this context. While web design is focused on the collection and use of knowledge to develop new solutions, much of this knowledge is collected from communicating with clients - who are considered an expert within their field. This communication is essential in developing these solutions (Chapter 2.6).

2.2 - Research Foundations

2.2.1 CSCW

Computer Mediated Communication has been a critical topic in research for Social Scientists, HCI (Human Computer Interaction) Researchers and Computer Scientists since the adoption of computer technologies by the general population. Computer Mediated Communication can be defined as "communication that takes place between human beings via the instrumentality of computers" (Herring, 1996) or as "a process of human communication via computers, involving people, situated in particular contexts, engaging in processes to shape media for a variety of purposes" (December, 1997, p.1). As computing has become more prevalent within society, the interest in how these technologies can assist in everyday life and communication has become of increasing interest.

This interest in how technology can support workplace communication has been so prevalent that fields such as Computer Supported Cooperative Work (CSCW) have emerged to further study CMC and its role within the workplace. In 1984, a workshop was organised which investigated group communication issues, coining the term Computer Supported Cooperative Work (CSCW), a new field to investigate "a set of concerns about supporting multiple individuals working together with computer systems" (Greif and Cashman, 1984).

The field of CSCW is a body of knowledge that draws and expands on traditional HCI body of knowledge. CSCW has become an umbrella term around the design of systems to assist groups of users in their work from an multi-disciplinary perspective: drawing on the literature, roles and problems within fields such as HCI, Artificial Intelligence (AI), Distributed Systems Communication, Economy and Social Theory (Bannon & Schmidt, 1991; Ellis et. al., 1991; Grudin, 1994a). CSCW draws from both Organisational and Individual system designs, differentiating itself from Information Systems by focusing on smaller groups, which are focused on communication rather than simply for coordination tasks. "Members of small groups

usually share key goals, so product developers can anticipate relatively little friction among users and can assume a cooperative approach to technology use" (Grudin, 1994a, p.22). In recent years the CSCW area had broadened to cover much more diverse and non-work settings (encompassing home, street, entertainment etc. contexts); however, the focus in still on the core CSCW concepts and approaches (Crabtree, Rodden, & Benford, 2005).

Figure 3 outlines the original focus of CSCW within the scope of developing digital communication and group support systems. Within the scope of this research, CSCW is the most appropriate discipline to study this context as it focuses on the common goals and tasks, and a similar nature of group processes which are comparable to those enacted within design focused small businesses. Additionally, like Individual, it is not tied to an over-arching organisational architecture. Although this figure is historic, with CSCW now covering a broader area, the environment of designer-client communication fits within the original space of CSCW. Within the context of web design, while designers and clients may have different backgrounds and different motivations for achieving the goal, the end goal of the creation of the website or other artefacts is shared between clients and designers.
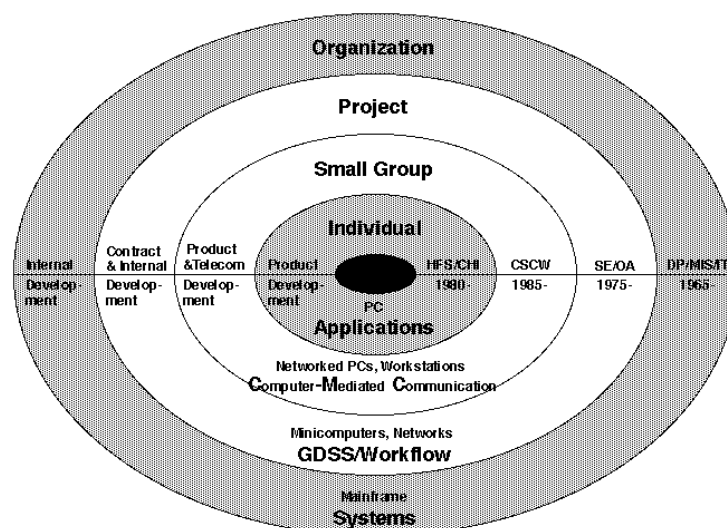
Figure 3: Computer Mediated Communication (Grudin, 1994a)

An alternate field that may be considered relevant when investigating designer-client communication is Group Decision Support Systems (GDSS), which focuses on the decision making process within group collaboration. However this field primarily is

situated within organisational structures, and tackles the issue of group communication from an organisational point of view. The focus is on larger businesses, building upon literature within Information Systems (IS), and acting as a cottage industry within the Management Information Systems (MIS) field (Gray et al 1999, Dennis et al 1988).

2.2.2 Research Methods

The foundation of CSCW research is the emphasis on understanding the context of a workplace in being able to design solutions that fit within the environment. Greenberg (2001) examines three frameworks/theories that involve designing around a specific collaborative context: Situated Action (Suchman, 1987), Activity Theory (Nardi, 1995) and Locales Framework (Fitzpatrick et al., 1996) and identifies that these factors are not only important when realising the context, but that the context is dynamic, adapting over time to both internal and external situations. While none of these theories are used in detail in this research, their focus on the dynamic nature of context is a major consideration in creating design client communication technologies.

Studying environments such as designer-client communication is complex from a number of perspectives, including the sensitive nature of these relationships, commercial privacy issues, the distributed nature of communication and the messiness of the communication. Twidale, Weber, Chamberlain, Cunningham & Dix (2014) conducted a workshop where they discussed the issues related to methods for studying complex contexts such as designer-client communication from a CSCW perspective, where they suggest that there is a "need for more rapid, lower cost, exploratory, lightweight, responsive and revisable methods that can help with discovery based research in CSCW" (p. 343). The authors suggest that researchers investigating these areas may need to compromise, to allow for the complexities of the setting.

Deep and thorough techniques of observation and evaluation, such as traditional ethnography have limitations in the context of studying communication, due to their

long turn around time. "Though techniques exist for understanding collaboration, such as ethnography, these are time consuming and unlikely to be performed for every product development effort. Furthermore, we lack methods for translating the understanding gained through such studies into reusable design tools for collaboration." (Judge, Matthews & Whittaker, 2012, p. 1). Instead, observational studies, and more specifically quick and dirty ethnography (Hughes, King, Rodden, & Andersen, 1994) are more practical for understanding collaboration within a context. These quick and dirty observational methods are used in Chapter 3 to examine two web design projects in context (3.5 and 3.6).

Design Thinking (Brown, 2008) is an approach that focuses on "the full spectrum of innovation activities with a human-centered design ethos" (p. 86). Design Thinking comes from architecture and art disciplines, and assists in understanding how the design process can be applied in other areas. This approach is user centred, but also has a focus on exploration, experimentation and multi-disciplinary collaboration (Brown, 2008). One method which is common within design thinking is the concept of the Unfocus Group (Kelly & Littman, 2005), which is similar to a focus group, but instead focuses on recruiting participants who are specifically not users of the service or product. This approach helps designers gain a broader understanding of their product outside of the target audience. The design thinking approach is used in the design of the enSense platform in Chapter 6.

Participatory design (Muller & Kuhn, 1993), or co-design, is a user centred design process where designers engage directly with potential users in the design process. In this method, participants have some sense of control and ownership over the design, and can inform designers directly about their context of use. As opposed than more traditional methods of user studies, users are an active participant in the design process, rather than merely a source of information. To evaluate the enSense platform, a competition is run (Chapter 6.7) to engage in a participatory design approach.

EAR is an approach which focuses on iteratively designing for users within a particular context. Tacchi et. al. (2004) defines EAR as a combination of ethnographic and action research methods: "we use ethnography to guide the research process and we use action research to link the research back to the project's plans and activities" (p. 1). EAR is used by Communication Ecology (Foth & Hearn, 2007), a conceptual model focused on the relationship between communication and technology within a specific context.

Topic Evaluation Analysis (TEvA) (Introne & Drescher, 2013) is an example of the ways in which researchers are approaching conversation analysis to understand collaborative knowledge processing within groups. TEvA is described as an "imaging device for a socio-technical organism", which looks at the co-occurrence of words within communication, and tracks their evolution over time, to develop an understanding to the evolution of the narrative. TEvA is used as an approach to understand communication within the context of enSense.

CSCW also examines the potential for remote collaboration to support physical artefact collaboration (Garbay, Badeig, & Caelen, 2012), however this is not a focus of the study, as the practicalities of retrofitting these technologies with short-term clients is impractical.

2.2.3 Categorising CSCW Technologies

A major aspect of CSCW is the design and evaluation of technologies to support work. Within CSCW, these technologies (groupware) can be categorised into three areas of focus (Grudin, 1994a):

- Tools to support communication
- Tools to support collaboration
- Tools to support coordination

While many tools provide an overlap of more than one of these areas, distinguishing the area of focus can help isolate the role of technology to support work, to assist in evaluating or designing new communication tools.

Many CSCW/HCI studies are conducted to understand which technologies are beneficial or ineffective in specific contexts (Yarosh, Markopoulos, & Abowd, 2014). Within the scope of these fields, this research is focused specifically on the web design industry, and in particular is concerned with technology to support communication between web designers and their collaborators. Both collaboration and coordination are important to web designers in their work, however communication within web design is unique because of the constraints it introduces when introducing new communication technologies.

Rather than researching and categorising users in terms of how they manage and monitor their communications (Grevet, Choi, Kumar, & Gilbert, 2014), this research investigates how users communicate through email and other technologies to work with clients, other designers, and other stakeholders to design and develop web applications.

2.3 - Tools to support communication

2.3.1 Communication Tools

Within CSCW, the design and implementation of systems to support communication were referred to as Groupware. While there are numerous definitions of what is and is not Groupware, a broad classification is that Groupware is "the class of applications, for small groups and for organizations, arising from the merging of computers and large information bases and communication technology" (Ellis, et al., 1991, p. 39).

While Groupware (and more recently Social Software (Shirky, 2003)) has been an effective method of realising CSCW theory, there have been problems in real-world adoption of these tools. "Email and b-boards are well known, but few other groupware prototypes and products have done as well despite considerable effort. Successes exist, but progress is slow and can lead in unanticipated directions" (Grudin, 1994b, p. 93).

There have been a variety of methods used to classify Groupware (Grudin, 1994a; Johansen, 1988). Ellis et al (1991) states that there are three main interactions that Groupware supports: Communication, Collaboration and Coordination. Penichet, Marin, Gallud, Lozano, & Tesoriero (2007) propose a flexible method of classifying Groupware/Social Software by combining these interactions with the time/space matrix (Johansen, 1988). This method of classification uses coding to identify the type of Groupware (e.g. B-5 for email), which assists in categorising similar types of communication tools. This method of categorisation is used within this thesis to better understand current state of Social Software and Groupware (see Appendix 1: Review of Existing Designer-Client Communication Tools).

Groupware is required to fit in within existing business processes, as well as be able to adapt to these processes over time. Grudin (1994b) states that to develop successful Groupware, designers must "identify a group's problem and match the

computer solution to it" (p. 102). Grudin outlines eight challenges that Groupware designers/developers must take into account when designing new communication tools. These challenges are significant within this research, and are unpacked in Appendix 2: Grudin's Eight Challenges in relation to the web design environment.

Most communication tools currently used within SMEs are general purpose, and are targeted either to individuals (such as Email and Instant Messaging) or for coordination within larger enterprises (including Microsoft Sharepoint, Lotus Notes and unified communication platforms (Lei & Ranganathan, 2004)). However, there are a number of Groupware and Social Software solutions that have been designed to better support communication, collaboration and coordination within businesses. An analysis of CMC tools such as Sharepoint, Email and Google Wave can be found in Appendix 1: Review of Existing Designer-Client Communication Tools.

Many communication methods, in particular email, are not simply conversation but contain a wide variety of information related to tasks which workers are required to complete (Kokkalis, Köhn, Pfeiffer, Chornyi, Bernstein & Klemmer, 2013). An individual message does not exist in isolation; rather it exists in the larger narrative. "One communication act, such as an email or a phone call, is often part of a larger communication context" (Turner, Qvarfordt, Biehl, Golovchinsky, & Back 2010, p. 2).

These forms of digital communication can also be perceived as a burden to getting tasks done. Mark, Voida & Cardello (2012) conducted a study in which participants were observed and monitored when being cut off from email communication within an organisation. They found that participants become more productive without email. However they did notice that participants were more likely to be "able to get the information I needed to conduct my work today" when email was in use. The study notes that when email was not in use, participants gathered information through communicating by other means. This implies that within organisations, email may be substituted with other forms of synchronous communication (telephone and face to face). "Email management means triaging a never-ending tide of

incoming requests." (Kokkalis et. al., 2013, p. 1291). However within the web design interactions with clients, asynchronous communication is often necessary due to location and other commitments.

A primary focus of CSCW is to support situations where face-to-face collaboration is preferred, but may not be practical in the particular context. Commonly, technologies are created to provide a representation of physical communication systems digitally (Gumienny, Gericke, Wenzel, & Meinel, 2013; Li, Cao, Paolantonio, & Tian, 2012). However, these communication technologies are not well represented through commonplace computers, and more successful systems require the introduction of new technologies to the context.

2.3.2 Relevant communication tools

Classical Groupware systems such as The Information Lens (Malone, Grant, & Turbak, 1986) assisted workers in sharing information with colleagues. "One of the key problems that arises when any group of people cooperates to solve problems or make decisions is how to share information." (Malone, et al., 1986, p. 7). While the technical implementations of these systems have become long out-dated, there are a number of identified issues that are still relevant with current communication tools. By constructing rule sets that allow systems to filter communication, semi-structured messages [similar to the speech acts used by the Coordinator (Winograd & Flores, 1985)] can be categorised and implicitly shared to colleagues without manual intervention. This meta-information provides the potential to create user-defined connections between seemingly unrelated communication messages, similar to the associative trails of the Memex (Bush, 1945).

Google Wave (now Apache Wave)[1], a general purpose tool which examines what *would email look like if we set out to invent it today*, was an example of creating a new method of communication which focuses on the limitations of current popular

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[1] http://en.wikipedia.org/wiki/Apache_Wave

tools (Rasmussen, 2009). While Wave was not specifically designed to support web design work, there are a number of features that extend beyond existing general-purpose communication tools (Figure 4). Wave utilises Operational Transformation (Nichols, Curtis, Dixon, & Lamping, 1995) and server federation techniques to allow businesses to communicate synchronously across business domains. Wave allowed for the sharing and interaction with rich media, and allows designers access to create context specific tools within the Wave interface. Despite its feature-set, Wave had limitations within the context of web design businesses as it does not build on existing communication methods. Wave applications also lived within a web-based interface, limiting the extendibility of the service (Dekker et. al., 2009). The negative response to Google Wave from the general public highlights the problems with the needs for interoperability and understanding of Social Software within a business context. In a study conducted by Kaewkitipong (2012), the failure of Google Wave was a combination of its complexity in relation to its usefulness compared with other tools such as Email and Google Docs. Additionally, the author mentions that the lack of integration with these tools limited its adoption and continued use.
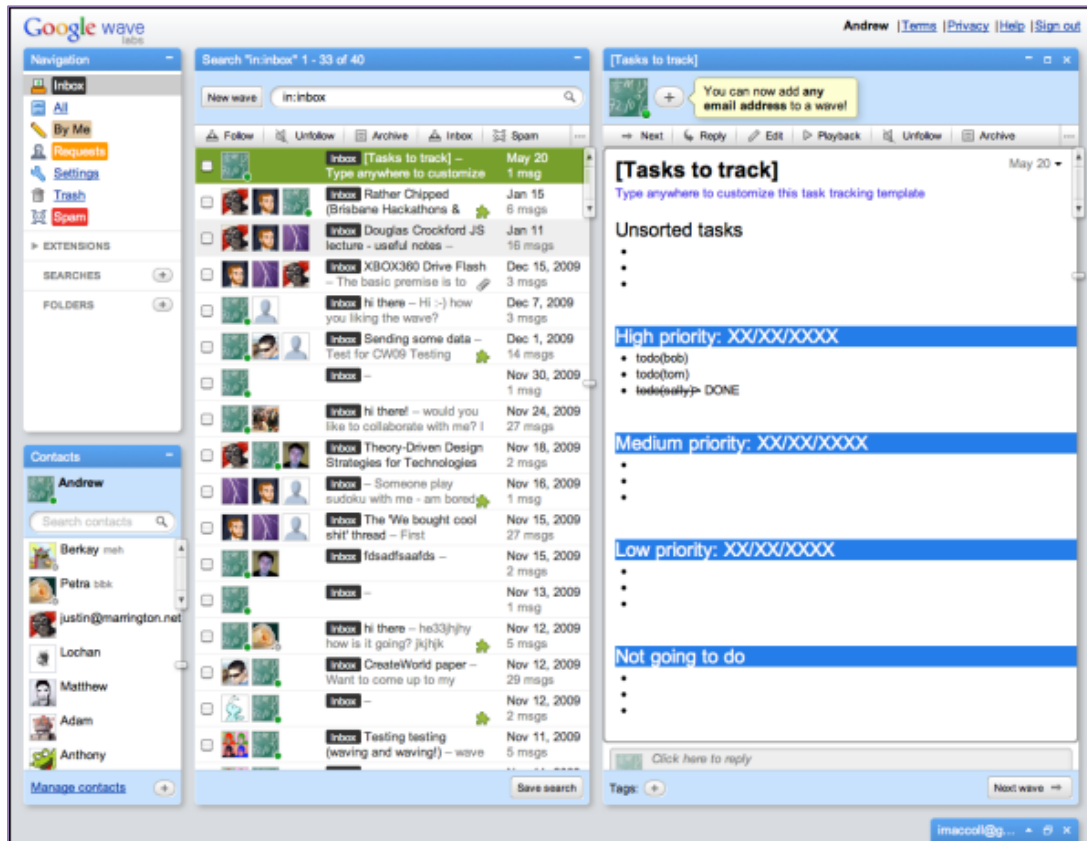
Figure 4: Google Wave interface

Some communication tools have been specifically designed to deal with the types of issues that occur in contexts such as designer-client communication. Basecamp[2] is a commercial tool, which has been created specifically for coordination within smaller businesses, and in particular web design businesses (Figure 5). Basecamp allows web designers to create to do lists, communicate with clients, and keep track of project information. A large reason for the success of Basecamp is due to its email integration, whereby web designers can email a client from within Basecamp, and any replies from the client are added directly into the system. This allows web designers to keep track of conversations within a single interface. While Basecamp is designed to support methods such as designer-client communication, it has limited extendibility, and relies on all emails to be sent to and from the system, rather than integrating directly with the business's existing email system which leads to a

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[2] http://basecamp.com

number of problems (see Chapter 4.2 for interviews with designers on their use of Basecamp). Another recent tool that provides a more streamlined interface for supporting communication specifically is Slack[3], which provides a topic based chat interface with support for rich media and plugins. However, tools such as Slack require all users to be registered and trained in the use of the tool, making it less than ideal for supporting designer-client communication.
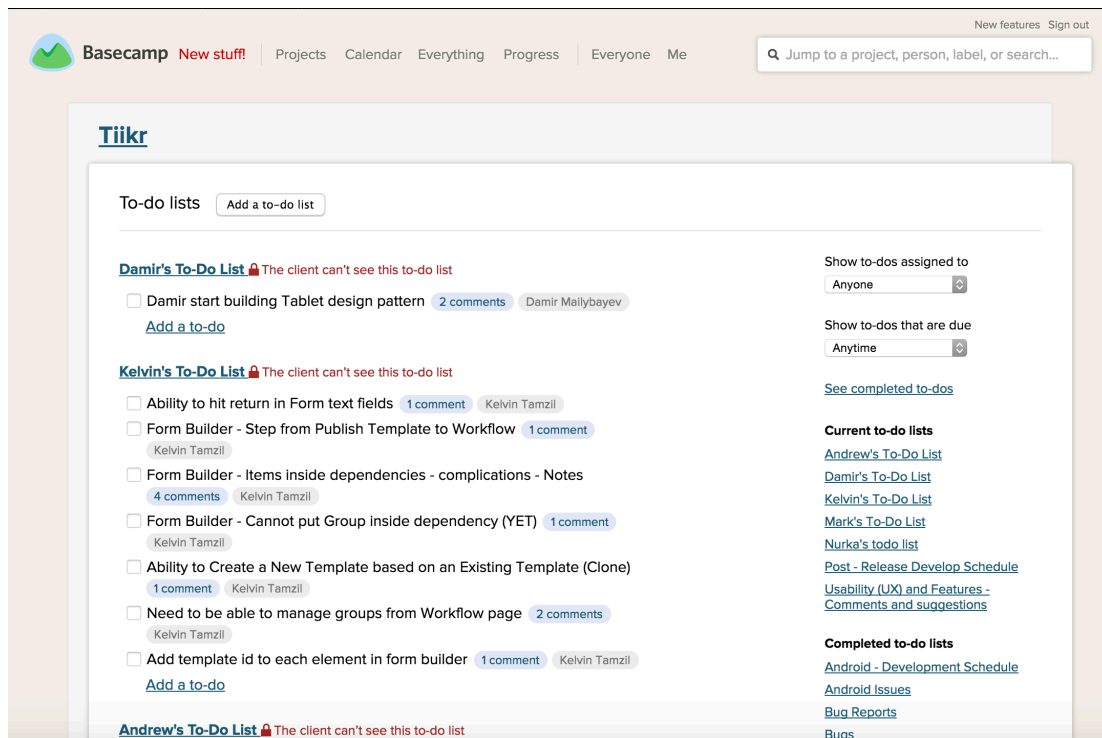
Figure 5: Basecamp Interface

2.3.3 Email

Ducheneaut & Bellotti (2001) conducted a study in which they examined how email was used in the workplace, reflecting on it as a habitat for knowledge workers. They found that email was not only used for text communication, but often serves as an in the moment method of sending files, collaborating on documents, and as an automated recording keeping system. Universally used methods of communication

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[3] https://slack.com/

such as email are now not only a means of communication, but also a personal information management interface (Ducheneaut & Bellotti, 2001).

The concept of communication and email overload (Penz, Pouliadou, Mauk, Qian, & Fang, 2013) is not simply the quantity of incoming messages, but rather the status of incoming messages, which are contextual and complex (Whittaker & Sidner, 1996). "Email is not only used to exchange information, but can also keep a personal archive of past projects." (Penz et. al., 2013, p. 411).

Email is not necessary universal within internal design teams. Johri (2011) discusses a study in which a design and development firm use other methods of communication instead of email for their primary method of collaboration. In particular, the use of active blogging by collaborators greatly assisted in providing cross-institutional awareness, while other tools such as IRC (Internet Relay Chat) and Skype provided synchronous communication between collaborators. However the choice that was conducted in this case was done internally within the organisation, and was achieved through mutual agreement between collaborators. However this is far more challenging when collaborating with stakeholders external to the organisation. Johri (2011) states "the use of technology for communication is driven largely by social norms which support the appropriation of innovations within the fabric of existing work practices" (p. 308).

Prior (2013) presents a case study in which a development organisation was studied to better understand how agile development is conducted within the software industry. Noticeable within the study was that the majority of communication that was done *ad hoc* was done through email, in particular interactions that involve clients. Although the case study shows how the infrastructure for communication handling changed over time (by implementing more systems to manage communication), communication regarding clients remained with email and phone.

2.3.4 Combination of use

Turner et. al. (2010) state that although many forms of communication technologies have been studied in the context of the workplace, there are few studies which

examine how these technologies are used in conjunction with other technologies. The authors' study suggests that workplaces are using more kinds of communication technologies based on their needs, but note that Email is still the backbone of communication within the examined organisation due to its strengths. Additionally, the authors found that new communication technologies in use did not replace existing channels, but rather were used to compliment them. "This behaviour stands in contrast to how most communication tools are built, that is to be the only instance within a specific class of technologies. Yet the most successful communications technologies, email and phone, allow interface innovation to co-exist within a well- defined communication channel." (Turner et. al., 2010).

Jarrahi & Sawyer (2013) states that "studies of technologies in the workplace traditionally center on the use of a handful of technologies" (p. 34). The author suggests that due to the ease of adoption and transition between tools, the focus of studies of communication technologies should instead be on the ecosystem of communication and social technologies. Jarrahi & Sawyer highlights that when the use of these tools are researched, they are done so in isolation rather than how multiple forms of communication are used in tandem:

> ...we should be focusing scholarly attention towards how people combine multiple ICTs to meet their goals, moving beyond studying the adoption of a single ICT in isolation. Different social technologies may be independent and discrete. But, their interoperability in day-to-day use makes such distinctions less meaningful in practice. In practice, interoperability among multiple social technologies serves as combinatory material scaffolding. For many knowledge-sharing problems, people take advantage of the differing capacities and capabilities of various social technologies. (Jarrahi & Sawyer, 2013, p. 31).

> ...despite this proliferation of tools, one tool is often not enough to satisfy all the collaboration needs of a single group. As a result, groups often cobble together multiple tools to serve their collaboration needs. Using multiple tools

for collaboration adds complexity to members' lives, when they already have limited time to learn about and access these tools. These factors lead to an adoption problem, which is demonstrated by the continued use of email. (Chi, Liao, Pan, Zhao, Matthews, Moran, Zhou, Millen, Lin & Guy, 2011, p. 163).

Similarly, there is little research on how organisations use informal and *ad hoc* methods of communication with technologies in similar cross-organisational collaborations such as in non-profit organisations (Stoll, Edwards, & Mynatt, 2010).

2.3.5 Social Software and Social Networking

In addition to the core CSCW body of knowledge is the extension of Groupware into Social Software, which is a recent term which is based on ideas within Web 2.0 (O'Reilly, 2007), and is used to describe "software that supports group interaction", rather than point to point methods of communication (Shirky, 2003, para. 2).

Whereas CSCW/Groupware is primarily academically based and traditionally focused on the context of activities within the workplace, Social Software is focused on industry led Web 2.0 style commercial tools with individuals participating in social groups, including services such as Facebook and Twitter (social networks). While these fields approach contextual communication problems from different directions and philosophical backgrounds, "the overall aims of groupware and Social Software systems are very similar" (Pinkwart, 2008, p. 230).

Social Software has unique implications within the context of this thesis, as its wide spread adoption by the general public has led to new considerations and practices with regards to communication tools, including Cloud Computing (Vaquero, Rodero-Merino, Caceres, & Lindner, 2009), the Hype Cycle (Gartner, 2008), awareness and privacy (Acquisti & Gross, 2006; boyd & Ellison, 2007). An extension to the study of Social Software is the developing field of Enterprise 2.0, which "describe how these same [Social Software] technologies could be used on organizations' intranets and extranets" (McAfee, 2006). This area focuses on the context of working

environments in a similar way to CSCW, however there is currently a lack of connection between the fields (Koch, 2008).

Tools to support designer and developer communication have matured and integrated social networking features to better support the larger social web designer community. Wu, Kropczynski, Shih & Carroll (2014) conducted a study to examine the social aspects and effects of GitHub, which is a code repository service that also provides social features (Figure 6). The authors found that while the social features were similar to social networking sites such as Facebook, social features are not used in practice on GitHub for connecting with other developers and developing relationships, they are instead for providing awareness between developers of updates and changes to projects.
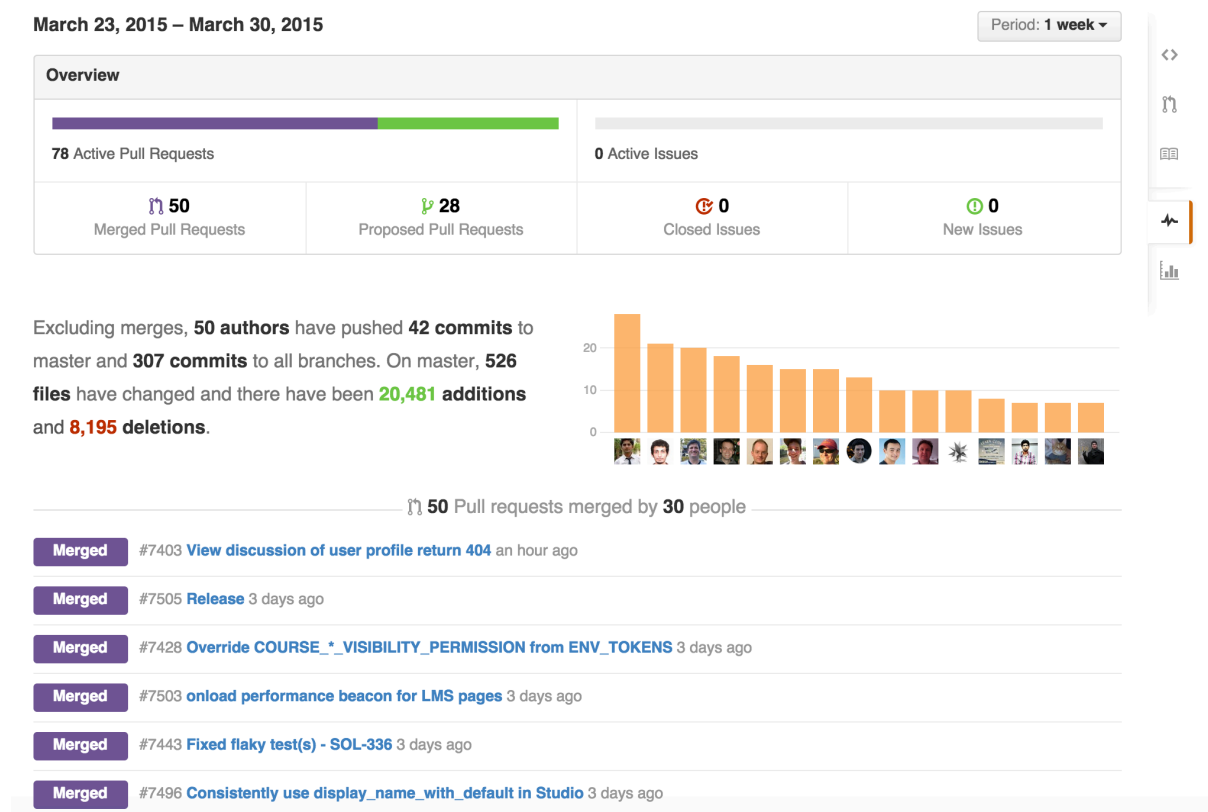
Figure 6: Github awareness

Recently, there has been an emphasis by enterprises to develop and adopt social-software platforms for use within the enterprise, enabling employees to keep up to

date across the enterprise. These platforms have many benefits for the enterprise (Guy, Steier, Barnea, Ronen, & Daniel, 2013), however these technologies are focused on larger enterprises where knowledge and news may not be spread otherwise. The evaluation of Social Networking and other new forms of communication technologies within the CSCW community have been done within organisational boundaries (Marlow & Dabbish, 2014).

A popular feature of Social Software is the consideration of extensibility, through the use of Application Programming Interfaces (APIs), which allow developers to manipulate and utilise information within Social Software for their own purposes. The maturity of these APIs has led to the concept of mashups, "a web application that integrates data from multiple web sources to provide a unique service" (Tuchinda, Szekely, & Knoblock, 2008, p. 139). A large benefit of introducing Social Software mashups into businesses is the opportunities that they offer "for solving some immediate business problems" (Hoyer, Stanoesvka-Slabeva, Janner, & Schroth, 2008; Jhingran, 2006; Vrieze, Xu, Bouguettaya, Yang, & Chen, 2009). While a majority of mashups are focused on already-public information (Tsai, Lee, & Tang, 2009), there is potential for users to be able to create mashups based on the knowledge stored within private and general-purpose communication tools such as email.

Social Software (in the sense of Social Networks) focuses primarily on individuals communicating in a public arena, and much of the innovation in recent communication tools is focused on this area. Therefore, it is important to acknowledge and understand the context that Social Software is designed for, and how it can be adapted to designing business communication tools, in particular with respect to privacy, discovery and awareness sensitivities of the context.

2.3.6 Developing new tools

Development of new technologies to support communication requires a large investment in their development, and relies heavily on the intuition of the designer (Grudin, 1988). Introne & Drescher (2013) state that a major challenge in designing

communication technology is how to "reliably improve a community's ability to exchange and fluidly recombine its available information to develop new insights" (p. 341).

When designing communication tools, perhaps the most important understanding is the context in which it will be used. One approach is to design applications based on observations and real world work place practices within the distinct environment, an argument that is strongly advocated by researchers who take an ethnographic approach to understanding the context of use in order to inform design (Hughes, Randall & Shapiro, 1992; Suchman, 1987; Crabtree, 2003). The importance of designing applications for the environment is particularly important within the web design context, due to its unique nature of rich remote collaboration and transfer of knowledge between designers and clients. Although communication channels are not traditionally context-aware, their methods of use change based on the context in which they are operated.

Adams (2010) suggests that when designing for communication between strong ties, designers should "think about their existing means of communication… [people with] strong ties already have established ways to interact; we should support them, and not try and replace them with our own messaging systems" (Adams, 2010, When designing for strong ties para. 1). The introduction of new communication tools into existing contexts of work is a high interest within the CSCW community; however, the adoption of tools into the workplace is often done within smaller groups, with key individuals *shepherding* other team members into new methods of communication (Quinones, 2014). Additionally, this adoption process is done over a period of time, to change the communication culture of the workplace over time.

A challenge of designing communication technologies is how to design for the context in which the tool will be used. The Groupkit framework (Roseman & Greenberg, 1996) was a framework that aimed to assist designers of Groupware and Social Software to design applications, which gather knowledge already existing

within the environment. Groupkit is broken down into five pieces of functionality: contextual widgets, interpreters, aggregators, services and discoverers.

The main emphasis of the Groupkit framework is that applications must be sensitive to the world around them, and must be flexible and adaptable to the changing context. There is a clear differentiation between the collections of data, how it is interpreted and aggregated, and how services utilise this aggregated data. It is important that tools and services can identify and react to changes in context. Greenberg (2001) concedes that this framework does not negate the issues with designing contextual applications, but rather makes explicit the nature of context within Groupware design. This work highlights the importance of designing tools that support the context rather than ignore it or assume a particular situation.

In terms of evaluating communication, there are complexities that must be considered. The analysis of digital conversations is complex, and depends on a variety of factors, including the individual conversations, the surrounding social context, and the technical system context (Erickson, 2000). Restructuring communication, either as a manual process or through automatic means requiring a large amount of manual work by the user, or else there is a high risk of unreliability (Kokkalis et. al., 2013). Recent approaches of analysing large amounts of communication data have focused on Social Network Analysis; a method used to examine the effect communication has on remote software development (Wasserman & Faust, 1995).

2.3.7 Adoption of tools

The adoption of communication tools is "an entangled, cooperative process of searching, becoming aware, installing, configuring and learning how to use new tools" (Draxler, Stevens, Stein, Boden & Randall, 2012, p. 2835). Communication technologies are often adopted within larger enterprises due to mandate by the company (Grudin & Palen, 1995), however designer-client communication can not mandate specific tools (due to the involvement of the design firm and client business), and instead choose tools which are universally adopted across both

designers and clients. Remote communication is more complicated when communicating across boundaries (Ehrlich, 2014).

Often, the appropriation of technologies is done by those who the technology was not originally designed for, and in ways in which the designers did not anticipate. Quinones, Teasley & Lonn (2013) describe this appropriation of technology by unanticipated users within the context of learning management systems (LMS) and how they are used to support non-learning tasks. Due the familiarity of the technology to users, the users adapted the technology to other tasks which were not related to their primarily use of the tool. This is similar in the web design industry, where generic communication technologies are appropriated for other means, such as brainstorming, collaborating and guiding clients through technical issues. Quinones et. al. (2013) state that a large factor that enabled the appropriation of the LMS was the flexibility of the system, and this sense of flexibility can be seen in generic tools such as Email, Skype and Google Docs (as opposed to more tailored tools such as Basecamp).

2.3.8 Presentation of communication

An important aspect of communication is how it is presented and visualised to the user. Hong, Convertino, Suh, Chi & Kairam (2010) demonstrate how content from traditional sources (in this case RSS) can be analysed and visualised in a way that changes how they are perceived and utilised by users. FeedWinnower provides an interface to RSS feeds (website feeds), which adds meta-information (topics, users, source and time) to assist users to contextualise the content in relation to the wider population (Figure 7). This customisable interface allowed users to focus on various kinds of meta-information based on their current task. In their evaluation, they found that "15 enterprise professionals saw the value of being able to dynamically combine the four facets, and rapidly adopted different combinations of facets to fit their diverse tasks." (Hong, et. al., 2010, p. 950).
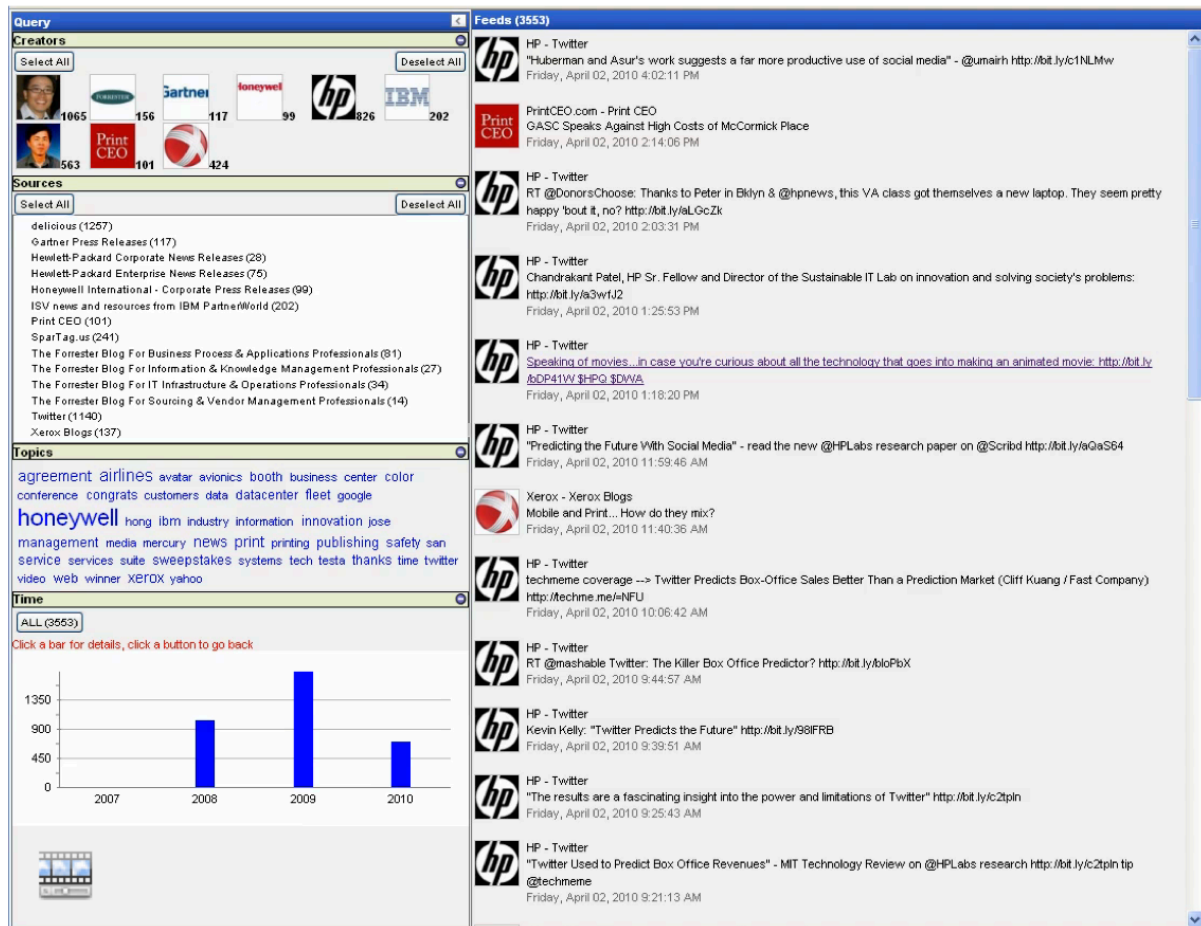
Figure 7: FeedWinnower Interface

FeedMe (Bernstein, Marcus, Karger & Miller, 2010) is a system that incorporates email to provide in-the-moment access to disseminate knowledge while browsing RSS feed content using Google Reader. FeedMe uses a combination of technologies to provide recommendations to users of when a piece of content should be shared with colleagues. The system extends the existing Google Reader application to allow users to email the relevant people in the moment, through two clicks, but still requiring human intervention so that the message was explicitly sent. Bernstein et. al. (2010) also highlight that while social media is becoming more common, "email is still preferred due to its ubiquity and consistency", noting in particular the importance of email being consistent in how users check for new messages. The authors note the importance of sending information to specific users as well, rather than simply sending to a large group of people who may or may not be interested; however, participants still had concerns towards email being used as a method of spamming their contacts. "Primary among sharers' concerns was an

69

aversion to spam: participants are hesitant to share too much via a non-ignorable feed such as e-mail. Unfortunately, there is no low-priority queue for receivers as pervasive as e-mail." (Bernstein et. al., 2010, p. 979).

Sonderegger, Lalanne, Bergholz, Ringeval & Sauer (2013) conducted a study to examine how visually representing participants moods between remote and collocated work collaborators affected teamwork. The authors found that by providing "mood feedback", participants were able to better gauge others emotional states, and react accordingly, allowing for less issues when communicating.

The discipline of CSCW and social software focus on the design and study of communication tools in context of small groups. Communication tools are a vital aspect of web design and there are a wide variety of tools that are available (Chapter 4.4). However many of the tools that are in wide spread use are not tailored towards designer-client communication. Additionally, these tools are not used in isolation; rather they exist as part of the ecosystem that exists in the web design firm. When developing new tools to fit within this ecosystem, a major consideration is the adoption of these tools and how well they co-exist with other tools.

2.4 - Awareness and Privacy

This section outlines two aspects of communication technologies that are essential to consider in the context of supporting business-to-business relationships: awareness and privacy. Awareness is required due to the distributed nature of the relationship between designers and clients, while the sensitive business nature of the communication means that privacy is a top priority. Understanding the requirements of both of these areas is essential for the successful adoption of communication tools by designers.

2.4.1 Awareness

Studies have shown that by providing awareness of work through collaborative software, users can make a "surprising rich set of social inferences" which aid in cooperation (Dabbish, Stuart, Tsay, & Herbsleb, 2012, p. 1277). The ability for knowledge workers to be able to generate and share knowledge with each other (coined expertise sharing) "increasingly play[s] a crucial role" in organisations (Ackerman, Pipek & Wulf, 2003, p. xi). Leveraging communication to provide awareness is useful, as it reduces duplication of effort (Olson, Grudin, & Horvitz, 2005), but the willingness to share information depends on the type of information being shared, and the type of people that the information is shared with (Olson et. al., 2005). Additionally presence, which provides visibility of availability, is "complementary and interdependent" with awareness (Fitzpatrick, Mansfield, & Kaplan, 1996, p. 37), and can be useful in mitigating risks of miscommunication.

While the sharing of already public information is supported by a number of tools, sharing private or confidential information to friends and colleagues is a unique challenge (Gross & Acquisti, 2005). Awareness through communication tools has different complexity when compared to face-to-face situations. In contrast to face-to-face interactions, the 'object at first is not brought to attention by the other, it announces itself through audible notification. Hence, there is no social obligation per se for the recipient to deal with a notification, 'ignoring' at this point is understood as

a socially legitimate practice by the co-participants. (Fischer, Reeves, Moran, Greenhalgh, Benford, & Rennick-Egglestone, 2013).

Popular Social Networking Services such as Twitter and Facebook leverage the benefits of awareness, to present users with an aggregated view of their social network in a Lifestream (Orita & Hada, 2009). The design of these systems is focused on facilitating communication to a wide audience, with the users view showing a tailored stream of content based on social relevancy. These systems work in contrast to more professional methods of communication (such as email), which focus on maintaining streamlined communication to one or more users. While the popularity of these Social Networks has rapidly increased, their adoption to support work has lagged due to their focus on providing broadcast awareness rather than private conversations.

Alcántara, Markopoulos & Funk (2015) conducted a study of the communication tools used in web design firms to support communication, and find that generalised methods of communication (including social networking tools) are commonly repurposed to support design collaboration. However, the authors note that these tools are often cumbersome in their approach to collaboration support.

Kim, Hinds & Pentland (2012) discuss the issues of distributed communication due the lack of social awareness, and highlight the issues which result of the participants inability to reflect on their own communication as part of the larger groups:

> The lack of social signals makes it difficult for group members to understand the current state of the group communication, and how individuals should behave accordingly. Additionally, the lack of feedback expressed through social signals among the group members makes it difficult for group members to reflect on their behavior (Kim et. al., 2012, p. 1237).

To address these issues, the authors present the Meeting Mediator, which is a method of visualising the verbal contributions of each participant in communication,

by showing the most prominent speakers, and also visualise how often turn-taking occurs. By providing this awareness, studies showed that distributed (and collocated groups) were most focused in their communication, and were guided based on their awareness to more effective communication - more towards face-to-face turn-taking interaction. The authors also found that by providing this awareness, the shift between face-to-face and distributed communication was lessened:

> We found that sociometric feedback can not only help distributed groups to have a communication pattern which leads to higher performance, but it can also help groups to sustain that pattern of behavior even when they oscillate between being co-located and distributed, as many distributed groups do. The sociometric feedback appears to successfully reconstruct some of the functionality of the lost social signals in distributed collaboration, improving the performance of distributed groups (Kim et. al., 2012, p. 1245).

Designing systems that support awareness need to be carefully considered in the context in which it will be used. Erickson (2006) discusses awareness and sharing of information in groups as GIM (Group Information Management). This concept builds on the idea of PIM (Personal Information Management), and is concerned with organising information that is to be shared within a group. The author states a number of implications of systems which perform sharing, in particular understanding the dynamic nature of groups (in what happens to information when people join or leave groups once the information is shared), the roles of the individuals who it is being shared with (rather than specific individuals), and how the information will be used (it may be used in other ways than originally intended). The design of sharing systems need to address these implications, if not technically then by providing awareness to the user about how their information is being shared.

2.4.2 Awareness - Social Translucency

Erickson & Kellogg (2000) discuss the concept of a social translucent approach: that is a way to design systems which focus on visibility, awareness and accountability, to allow users to gain an understanding of other participants, leveraging their "social

experience and expertise" (Erickson & Kellogg, 2000, p. 59). Rather than providing complete awareness and transparency, the authors suggest that to design constraints in ways that are natural to the users (to allow quick understanding), which provides awareness, visibility and accountability without negating privacy. The nature of the physical world affords this (such as talking in a corner of the room), and digital systems can be designed in a similar manner. These constraints are not unique to remote collaboration, and are similar to collocated multi-user interfaces (such as table-top interfaces), where interaction should focus on awareness, control, and availability, which are provided through constraints (Yuill and Rogers, 2012).

"Like many socio-technical constructs, social translucence is not something that can be simply added after a system is built; it should be at the core of system design" (McDonald et. al., 2012, p. 637). Re:Flex is a system developed by McDonald et. al. to examine how social translucency can be architected and presented by building on top of existing social infrastructure. "Social translucence is a stance toward the design of systems that allows users to better understand collaborative system participation through awareness of contributions and interactions." (McDonald et. al., 2012, p. 637).

2.4.3 Awareness - Backchannels and Notification

A common technique of communication that by its nature does not aim to provide complete awareness is the concept of *backchannels*, that is communication that occurs during, but is not part of the primary conversation. Backchannels can be used for a variety of different reasons, with both advantages and disadvantages (Yankelovich, Walker, Roberts, Wessler, Kaplan, & Provino, 2004), however in web design these channels are often process oriented, and used by designers to gather knowledge efficiently by directly contacting either specific client liaisons or designers. While backchannels can have negative consequences [such as in the case of Danah boyd's Web 2.0 presentation (Bry, Gehlen-Baum & Pohl, 2011)], they have a high degree of appropriateness in work settings (Kellogg, Erickson, Wolf, Levy, Christensen, Sussman, & Bennett, 2006). This use of backchannels is important in the web design process, however the disconnect to the primary conversation means

that it is often lost in the ether. Kellogg et. al. (2006) demonstrate ways in which backchannels can be made more transparent, in a way which augments the primary conversation without distracting the users.

The design of awareness in communication and social systems must be considered carefully to avoid misunderstanding by the users. For example, notification systems may provide a sense of awareness between participants; however, as explored by Birnholtz & Fussell (2012), this differs from face-to-face communication, as the person presenting the awareness has no knowledge of who observes their notifications. Some social software services have dual-notifications in place, such as LinkedIn. In LinkedIn, the act of viewing someone's profile lets the user know that they have been viewed. As mentioned by Birnholtz & Fussell (2012) this can cause the side effect of users being wary to check others profiles because of how the action may be perceived. In the web design context, such a system may give the false impression that the client is constantly checking on the designer's progress. These types of notification and awareness systems need to be designed in such a way that it limits these side effects and does not constrain collaboration through awareness.

It is important to note that the presence of awareness mechanisms may have unintended consequences, and possibly introduce issues to group communication. Teevan and Hehmeyer (2013) present a study which investigated an awareness telephone system where by callers had an awareness of the receivers current activity. When users were aware that their status was being shown to other users as busy, they were more likely to answer any incoming synchronous communication (as opposed to being available), anticipating that the communication would be important.

The study of communication and social networking technologies is a difficult task, as self-reporting methods have limitations, while tracking usage has privacy issues (Poller, Ileyes, Kramm, & Kocksch, 2014). One opportunity of studying and analysing implicit communication, collaboration and coordination is to integrate with

everyday tools which designers and clients use that aren't used directly for communication. Blincoe, Valetto & Goggins (2012) describe a study in which they captured interactions with developers IDEs (the application which developers use to write code) to better understand hidden collaboration between developers, with the opportunity to provide implicit awareness to others. The authors state that a large benefit of systems such as these is that the software can provide awareness to other group members without requiring explicit action by the user. This integration into existing work practices differs from common forms of awareness that provide explicit communication methods between group members.

2.4.4 Privacy

Privacy is a major consideration when considering the impact of awareness and its use to engage with clients. The monitoring of communication channels in a way in which information is visible to others may impact how such technologies may be adopted (Munson, Kervin, & Robert Jr, 2014), and awareness must be considered in the context of its use (Abowd, Dey, Brown, Davies, Smith, & Steggles, 1999).   Providing feedback from automated sharing is important, and should also provide the ability for users to control the sharing in the meantime, to reduce anxiety related to over-sharing information (Patil, Schlegel, Kapadia, & Lee, 2014).

A major consideration when examining privacy concerns is the increased mix between private and professional lives present in communication channels (Skeels & Grudin, 2009). In a study conducted by Houben, Bardram, Vermeulen, Luyten & Coninx (2013) on the evaluation of a collaborative desktop environment, they found a number of privacy issues related to collaborative technologies in the workplace. "A number of privacy and confidentiality problems arose because of the automatic distribution of information of the active work context. Some of these problems were related to the technological implementation but further investigation exposed a more complex problem at the intersection of organizational policies and personal preferences" (Houben et. al., 2013, p. 2271). Additionally, the authors found that while communication technologies were used primarily for work, the same channels

were also used by workers for personal communication, which may inadvertently cause implicit awareness of communication actions to the wrong context.

Privacy options are a key method in the design of systems that provide awareness of existing communication channels, and should allow the users to experiment and adapt to the types of awareness that they provide. Kokkalis et. al. (2013) conducted a study in which they developed a system which summarised emails using crowd sourced workers to manually read and summarise email. Initially the authors conducted a survey, which found that a majority of information workers were unwilling to share their email to assistants for the purpose of summarising, due to privacy concerns. In their survey, they found that some participants "were only willing to share a few messages manually (35.4%) or share nothing at all (38.1%). Roughly one quarter (26.2%) were comfortable with an automatic solution via email rules; only a few (4.1%) were ready to share their entire inbox." (Kokkalis et. al., 2013, p. 1293). However the authors note that as participants used the service, their comfort with the decreased privacy improved. By providing multiple methods of awareness, from full transparency through to requiring users to manually share individual emails, users could start with full privacy options, and change the settings later on as their trust and understanding of the system increased.

The capture of information for the purposes of an app or service is not necessarily based on the subject of the content; rather, it may be based on the context, and the connection in which the user makes to understand how a service or system will use the provided information. Wang, Wisniewski, & Grossklags (2014) found that when studying privacy settings of an application within the Facebook ecosystem, users were happy to provide information when it appeared relevant to the context of use (in this case a birthday application with relevant shared information).

This context of use of private information can be seen in commercial Social Networking Services. Blippy[4] was a social network that takes inherently private information (credit card invoices) and publishes them to the users friends. While Blippy does not directly relate to business communication, it highlights the potential of presenting information that is generally considered private into a shared space. While there are a number of privacy concerns related to publishing private information, there are a number of unique advantages (such as implicit awareness) that can be provided that otherwise requires explicit actions on behalf of the user.

Privacy is a primary consideration when considering the design of tools to support communication, especially in a commercial context. However, rather than privacy being a major limiting factor in the functionality of these tools, it is instead a consideration for the design that can be negotiated with the user, as long as it is purposeful to the task at hand, and that the user is aware and in control of what information is shared. Establishing an understanding with users about what is to be shared, how it will affect them, and providing control to the users can help establish trust between the user and the tool is essential for trust and for functionality that may publicise information.

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[4] http://en.wikipedia.org/wiki/Blippy

2.5 - Web Design Context

Context can be understood in a number of ways, including the users that inhabit the space, the physical and technological environment and the social structure within the environment (Dourish, 2004). Understanding this context gives insight into the work that happens, and the people who inhabit the context.

2.5.1 Web Design

Web design (including services such as web development and web marketing) is a relatively new industry that focuses on the design and development of interactive media, web pages and web applications, which are published to the World Wide Web. Since the first web browser in 1990, the number of web pages has continued to increase exponentially, with Google publishing in 2008 that the Web is expanding by over one billion web pages daily (Alpert & Hajaj, 2008). With over 83% of Australian homes with Internet connectivity (Australian Bureau of Statistics, 2014), the Web has become a primary method for businesses to promote themselves and develop relationships with their customers.

The web design industry is diverse: ranging from individual freelance web designers and service oriented web design businesses through to web design divisions within larger corporations (Brickman, Yu, Marie, Meyer, Stevens & Zeldman, 2008). While larger corporations have the resources and skill to produce web sites and media internally, many smaller businesses (which represent 97% of all Australian private businesses) contract external web design businesses to create their presence on the Web. Historically, these businesses have relied on semi-qualified individuals to produce web pages with little interactivity for a small cost; however with the increasing ubiquity of the Web as a consumer research and sales tool, businesses are becoming more likely to engage web design professionals to more effectively market to consumers with interactive web sites.

This thesis (as discussed in 1.4: Research Scope) focuses on design firms who interact with external clients, rather than working internally within a business. A majority of web design firms with external clients, whether they be individuals, small business operators, or larger corporations. This thesis is focused on small to medium web design businesses that provide the creation of websites for other businesses. While each web design business has its own methods and processes for the design and building of websites (Hecker, 2004), there are a series of tasks that are required to be completed within the process (Newman & Landay, 2000). The process that web design businesses often follow is referred to as the design process (Lawson, 2005), which commonly follows a waterfall or iterative/agile methodology, or a combination of both (Bauer, 2005; Bowles, 2008).

While there has been research into the study of web design (Ames, 2001; Dorn & Guzdial, 2010; Duyne, Landay, & Hong, 2002; Lin, et. al., 2000), these studies have not focused on unpacking the communication or working processes within the context, rather they have focused on the technical practice of web design. Web design has traditionally been a cottage industry (that is an industry where many businesses are SMEs), and as such little attention has been given to the non-technical aspects of the industry, due to its diverse working environments. Due to this lack of prior work on investigating the context of web design firms, Chapter 3 and 4 conducts a number of studies to better understand the nature of web design.

2.5.2 Web Designers as Knowledge Workers

In addition to the lack of research on web design businesses, web design as an occupation are commonly considered as informally trained persons who are *ad hoc* in their behaviour: "our work adopts the perspective that web developers and other end-user programmers are often informal learners of computing who develop their understandings in a piecemeal fashion" (Dorn & Guzdial, 2010, p. 704). However, many designers within the industry have formal educations, and the *ad hoc* nature (based on observations and discussions with industry professionals) is more due to the nature of work, the quick evolution of technology and techniques and diverse clients rather than a lack of education.

To maintain clarity to this research, I use Zimmerman et. al.'s (2007) definition of designers, as "someone who has had training or extensive practical experience in a discipline such as architecture, product design, graphic design, or interaction design" (p. 2). Web designers work in a similar manner to other design fields such as graphic design, where knowledge is gained through as part of communities of practice (Marlow & Dabbish, 2014). These communities generally work within a shared domain, learn through interacting with other members of the community, and develop a shared collection of experiences and knowledge (Marlow & Dabbish, 2014).

Schultze (2000) defines knowledge workers as those that work in a particular manner:

- they produce and transfer knowledge,
- they abstract information through thought process,
- they perform creative and non-routine tasks to create knowledge, and
- they are formally educated in the methods and techniques required to perform tasks.

Web designers may be considered as knowledge workers, as they use thought process and creativity to understand the requirements of clients and then design and develop solutions based on their clients needs. Knowledge workers have a heavy reliance on communication technologies to collect and disseminate their knowledge, which is required to effectively perform their job. The collection of knowledge by web designers is done from many sources (such as researching competitors), however a lot of knowledge is gathered through communication. This communication is not only important between designers and clients, but also internally within the design firm (Schröter, Aranda, Damian, & Kwan, 2012; Wolf, Schroter, Damian, & Nyuyen, 2009). This communication allows the designer to gather a broad understanding of the field that they are designing for in a short amount of time.

Knowledge work is typically composed of both individual and highly collaborative work. This means that knowledge workers use personal computing devices to perform individual tasks and activities that are part of a larger collaborative working context (Houben et. al., 2013, p. 2263).

Another consideration of this context is the non-traditional aspects of the web design working environment. The digital nature of the work means that workers may be distributed, or even working at different times of the day. Additionally, they may change or adapt to roles based on the in-the-moment requirements of the project. Lee, Tang, Park & Chen (2012a) state that while there has been many studies conducted within workplaces, these studies are generally focused on stable work environments, which "may not be applicable to the highly dynamic team collaborations, such as in the medical setting" (p. 868). The authors describe the nature of dynamic settings, stating that they are highly collaborative between many different disciplines, and the collaboration is loosely formed based on the situation. While web design as a context is not as intense and *ad-hoc*, designers often engage with clients without having a clear and grounded knowledge of the clients background and technical understanding, and must cope with changing conditions external to their control. Additionally, web designers will often perform multiple roles (such as graphic design and content editing) on an *ad hoc* basis. Similarly, the medical field uses a combination of technologies in the moment, and due to the nature of these technologies can cause in-the-moment problems with awareness and miscommunication. The authors state that in fields where dynamic and loosely formed teams, communication technologies should focus on "designing for team-based communication, providing lightweight feedback, and supporting information transparency" (Lee, et. al., 2012a, p. 875).

2.6 - Communication in Web Design

2.6.1 Designer-Client Communication

Due to the multi-disciplinary nature of design (Bannon & Schmidt, 1991), web designers require continual and rich communication with clients and stakeholders (Diffily, 2008; Williams, 2008). Web designers must engage with clients throughout the design process to establish a common ground (Convertino, Mentis, Rosson, Carroll, Slavkovic & Ganoe, 2008), which is required to effectively design media that positively represents the client, their business and their product. Correspondingly, clients require the ability to audit, provide feedback and reflect on the design and development of the website throughout the design process (Ashauer, 2004).

Although face-to-face meetings are often the preferred way to facilitate this design process, time and resource constraints mean that the majority of correspondence is conducted digitally (Dekker, 2010). The common theme amongst web design work is that there is not a common and pre-determined method of communication between the designers and clients - rather the methods of communication are chosen at the start of the engagement (and throughout) (Follett, 2007).

A large focus on the collaborative process of design practice within CSCW and web design has focused on early stage design. This part of the process relies on low fidelity prototypes and sketches, which can be misinterpreted by clients and other stakeholders due to their quick nature. Because of this, there is a focus on how this part of the design process can be represented through remote collaboration (Li et. al., 2012, Mangano & van der Hoek, 2012).

The mix of communication and core web design work is often inter-mixed; task switching between these is continuous throughout the day. "Taken together, previous research reveals that collaborative knowledge work, as it occurs in the *wild*, is a complex and fragmented activity in which workers must negotiate multiple tasks simultaneously and where interruptions are not only inevitable but necessary for

work completion." (Chong and Silino, 2006, p. 29). However, despite the shift "from personal to interpersonal to group to social interaction", communication and collaboration tools are separated from the tasks that use them (Houben et. al., 2013, p. 2264).

> instead of trying to replace human expertise with inadequate automated solutions, a challenge this insight poses for the CSCW community is how to support people's expert strategies in managing interruptions. (Fischer et. al., 2013, p. 42).

Web designers may prefer face-to-face contact or phone for rich communication with clients, however Dimond, Fiesler, DiSalvo, Pelc & Bruckman (2012) suggests that methods of interview (and knowledge transfer) conducted over channels such as Email and Instant Messaging can be almost as effective as phone interviews for the transfer of ideas:

> ...phone interviews are significantly longer than IM or email. However, our coding of transcripts shows that phone interviews do not contain substantially more unique ideas than IM. (Dimond et. al., 2012, p. 280).

However the authors point out that this may be contextual based on their study, and that the subject matter and the depth of the conversation may impact the effectiveness of interview style communication over Email and Instant Messaging technologies.

Emergent collaboration is collaboration that is not predetermined, but rather is *ad hoc* by nature and determined by users as they collaborate. Janeiro, Lukosch & Brazier (2012) describe the concept of an elastic collaboration support system, where by the types of collaboration changed based on the users requirements. In addition, the system suggests methods of collaboration based on the analysis of the current collaborative activity. "Elastic collaboration support is promising because it customizes collaboration support to the specific needs of team constellations rather

than forcing a team to follow a specific collaboration type" (Janeiro et. al., 2012, p. 319). By acknowledging that the best channels for collaboration change throughout a project allows users to not be confined to using tools which may not be appropriate for the task at hand. "Social collaboration software requires certain level of customization as different people have different collaboration needs of preferences" (Chi, Liao, Pan, Zhao, Matthews, Moran, Zhou, Millen, Lin, & Guy, 2011, p. 159).

2.6.2 Common Ground

Establishing relationships between collaborators is important for establishing a common ground (Clark and Schaefer, 1989), a mutual understanding, which is important for knowledge transfer between designers and clients. Common ground is established through collaboration and communication, engaging and understanding between designers and clients over time.   "Collaboration is purposeful joint action that creates shared understanding leading to the development of shared goals and visions of a group's desired outcomes" (Brown, Lindgaard & Biddle, 2012, p. 1381).

The creation of this common ground between designers and clients can be considered a form of intersubjectivity, where both parties communicate through various means to achieve a common understanding of the problem context through to the design of the product. Fugelli, Lahn & Mørch (2013) investigate the theory of proleptic intersubjectivity - that is whereby current events are dictated by past events in establishing a common understanding. The authors focus on new and long-term contributors to the open source mod_perl software channel. While similar categorisation can be made to how designers and clients come together to achieve a common ground, there is a difference in that both designers and clients are qualified in their own domain, and the common ground that is required to be established is the combination of these domains, rather than experts and novices collaborating. This highlights the importance of the visibility of the communication narrative over time, especially for designers or clients coming into the project at a later stage.

2.6.3 Communication Issues

The emphasis of communication within web design, and the nature of working with multiple clients and designers simultaneously mean that web designers are in a state of "constant interruption" from a variety of clients (Rouncefield et. al., 1994). Due the external nature of designer-client communication, the lack of an organisational hierarchy which dictates defined methods of communication, and the nature of the collaboration within web design, communication tends to be more small-world communication rather than hierarchy communication structure (Cataldo & Ehrlich, 2012). In this context, communication is less likely to be formalised through key individuals, and instead knowledge is shared directly and in the moment. This can lead to the detriment to the overall project timeline (Cataldo & Ehrlich, 2012).

> The level of shared understanding among team members is likely to be impacted by such partially distributed setting, which may lead to lack of knowledge sharing activity between sub-team members and increased susceptibility of in-group dynamics (Lee, Paretti & Kleiner, 2013, p. 124).

Even in large organisations, where the method of communication can be enforced from an organisational perspective, software and web development have many issues related to internal communication (Grubb & Begel, 2012). The issues of internal communication within web design firms is not a primary focus of this research, as the internal communication cannot be assumed to be without its own issues due the nature of the design firm's organisation. "While some companies formally mandate specific information infrastructures, student team members and freelancers may not share any infrastructure beyond Web access." (Oehlberg, Jones, Agogino, & Hartmann 2012, p. 184). This is also true when collaborating with external clients, which have no pre-defined shared infrastructure (aside from coincidence).

As with other contexts which provide a high level of communication, conflict resolution is a major aspect in successful collaboration between designers and clients. Conflict resolution can be complex through computer mediated

communication (Kiesler, Siegel, & McGuire, 1984), with the most appropriate channel for communication depending on a variety of factors, including the participants, their goals, and the shared goals of the collective. While more sophisticated technologies may provide more affordances for conflict resolution; they may also introduce complexities that increase the chance for conflict.

> As designers, we are often thought of—and think of ourselves—as vendors, offering design services. Sometimes an adversarial relationship develops, with clients giving orders and designers taking them (cursing all the while). Including clients in the design process can change this relationship, facilitating knowledge transfer, building trust, and fostering a sense of partnership. (Nelson, 2007, para. 1)

Dong and Fu (2012) presents a study that may assist in supporting conflict resolution through remote communication. However, while they demonstrate that video conferencing allows for faster and more effective conflict resolution when scheduling appointments, these processes are complex, and are dependent on many factors.

Lee (Lee et. al., 2013) uses the term *Knowledge transferability* to refer to the amount of effort required to transfer different types of knowledge in design. A large impact factor to strong transferability within remote collaboration is the technology that facilitates that communication. When designers discuss design decisions with clients, the clients are treated as the experts in their industry, and are used for sense making. However designers will often take this information as accurate, without questioning the expertise of the client. This "teammate inaccuracy blindness" (Kang, Kane, & Kiesler, 2014) is present within the web design collaboration, and designers need to spend time verifying information during the early stages of the design process. Similarly, designers should be concerned with the "Shared information bias" (Baker, 2010), where the designer is reliant on knowledge from the client regarding their perspective on their target users. Miscommunication can also commonly occur during the conceptual design phase, when knowledge is more difficult to transfer through digital communication tools (Lee, et. al., 2012b).

2.6.4 Role Shifting

Brown et. al. (2012) discuss the notion of "interactional identity", based on activity theory, that is the portrayal of collaborators in software projects and how they engage in the collaboration. These identities contain a number of attributes, in particular the collaborators personal goals, their shared objectives (that is how their personal goals fit with others goals), their shared artefacts (how their artefacts are interacted with by the teams), and their tensions (issues that they anticipate will commonly arise). Rather than focusing on the official role of the collaborator in the software team, the authors analyse how the collaborator imagines themselves as a member of the team itself, and what team qualities they offer to the team. The authors develop a number of handles, which express the collaborators various identities as they see it within the team. This is described as the glue that binds the collaboration together. In the context of web design, and due to its casual nature of roles within the collective, web designers will often shift roles not only due to the work that is required, but also to help glue aspects of the collaboration that arise throughout the project. The authors suggest that by acknowledging interactional identities, tools can be designed to better support collaboration by supporting the roles that these identities play within the collaborative process.

Similarly to interactional identities, Howard & Melles (2011) conducted an interview study on a consulting firm and discover that there are many roles within design that are not based on merely the practice of the field, but their roles as members of the larger collaboration. "*The* expanding role of the designer takes into consideration creating meaningful interactions between participants in order to design an outcome appropriate to the culture and context of the environment" (Howard & Melles, 2011, p. 155). These adaptive roles that web designers play, as well as the changing background and nature of clients, makes the web design context a very "dynamic construct" (Greenberg, 2001).

Communication is a core part of working within the web design industry. Clients do not only provide the initial requirements and the problem space, rather they are an

active participant throughout the design process. Because of this, it is important for designers to establish common ground with their clients and their domain. A major problem that can occur in the web design process is miscommunication between the client and designer, in part due to the tools that are used to communicate (as discussed in Chapter 3 and 4). More tailored tools can assist in lessening these issues. An additional complexity in designer-client communication is the role shifting which occurs in the moment, which is important to acknowledge when creation tools to support the designer-client context.

2.7 - Research Methodology

The research question that this thesis seeks to answer is *how can communication technologies be designed to effectively support designer-client communication within web design businesses?* This research follows an Interaction Design and Iterative Design approach, where the context is first investigated, and based on that investigation prototypes are designed, developed, evaluated and then iterated upon. As web design firms have a number of aspects unique to their context (due to small interdisciplinary teams, working with a variety of industries through *ad hoc* processes), the methods that are used in this approach are heavily qualitative. In this, the study relies on the collaboration with experts in the area, to establish a grounded understanding of the day-to-day operations and practices of these businesses.

2.7.1 - Step One - Understanding designer-client communication

While there is some literature that examines the processes that investigate the web design context, the literature focuses either on early stage (and face to face) design practices such as brainstorming, or is focused on the technical practice of web design (with little focus on digital communication). Due to this lack of literature, the study first uses a combination of reading and discussions with industry experts, as well as my prior understanding of the context (having run a web design business in the industry). This initial works helps in establishing the industry norms and roles within the industry, based on the immediately available knowledge. This is followed by a study to better understand the relationship between designers, clients and stakeholders within the web design process. Longitudinal ethnographic studies were not used to study the context, due to the time scale of the study and the lack of visibility in observing digital communication within the workplace. Instead, this understanding was gained through two studies - one participant observation study (Chapter 3.5) and another observational study (Chapter 3.6). The aim of these studies is to examine the web design process *in situ*, to gain an understanding of the

day to day interactions between designers and clients, focusing specifically on digital communication and face to face meetings.

2.7.2 - Step Two - Understanding the current tools which underpin designer-client communication

This research is focused on the technologies and methods to support designer-client communication. Semi-structured interviews are conducted with web designers across a wide variety of businesses and contexts. These interviews focused on three aspects: to refine the current understanding of the observational studies, to understand the tools which various businesses use to support designer-client communication, and to ascertain why certain communication practices were adopted.

Following these interviews, a follow-up podcast study is conducted to understand the similarities and differences web designers experienced when communicating with clients through technology. In this method (which for the most part is an adaptation of the focus group method), designers met and recorded audio discussions on certain topics. This method was used to understand the differences between web design firms, and have the designers explain to each other the differences in their communication practice.

To gain an understanding of the full breadth of communication tools that are available and suitable to support designer-client communication, a quantitative survey was conducted reviewing communication tools relevant to the context.   The reviewing system follows the Penichet et. al. (2007) method of categorisation, which is an extension of Johansen (1988)'s time/space matrix classification. In the categorisation, tools are examined in whether they actively support communication, collaboration and/or coordination, and also whether they support same/different time and space.

2.7.3 - Step Three - Analyse the challenges which designers face in developing communication tools to support designer-client communication

From Step 1 and Step 2, a number of challenges emerged - either challenges in which designers currently face when communicating with clients, or challenges that current tools have in supporting this work. Overall seven challenges are identified, in a similar method to Grudin's (1994) Eight Challenges of Groupware. Out of these challenges, the issues of successful adoption (which is also a major issue found in groupware literature) are identified as the major challenge within this context, as it limits new tools being successfully used within the context.

2.7.4 - Step Four - Design and develop a platform to assist integrative communication tools

Based on the findings from Step 3, this method focuses on the design of a platform, enSense (Chapter 6), which aims at providing building blocks for communication tool designers to build on top of. This process follows the conceptual design and prototype phases of Interaction Design, following a similar structure to Groupkit (Roseman and Greenberg, 1996). The aim of this platform is to provide tool designers with a way to easily develop prototypes and products that integrate with existing methods of communication.

This Step also conducts a number of investigations around the aspects of designing communication tools, in particular the design of APIs and modelling communication messages. A method was devised where a design competition was advertised to active web designers in the community. This competition was designed similar to other "hack" competitions, where members from the IT industry build new software on top of existing data or infrastructure resources, and are a popular past time for web designers. From the competition registration, a number of applications were proposed, and three were focused on as case studies.

2.7.5 - Step Five - Development of a tool to assist creators of designer-client communication tools

From the evaluation of the enSense platform, and the understanding that had been gained, a paper-based tool was developed which acted as a guide for creators of communication tools that focused on the designer-client context. The tool is similar in its relationship to enSense as the Design Framework for mobile systems is (Dix, Rodden, Davies, Trevor, Friday & Palfreyman, 2000).

The tool was developed as an adaption of the Business Model Canvas (Osterwalder & Pigneur, 2010), and is a paper-based guide that helps designers in understanding and evaluating the context that they are designing for. This tool is then evaluated through a participatory design informed workshop with industry web designers, to gather results from a wide variety of design firms. The workshop focused on designers working through a problem statement that they had developed based on their previous client experience.

2.8 - Foundation: Conclusions

This chapter has presented the body of literature that is relevant to the design of existing and new tools to support designer-client communication within web design. The research foundations are core to Interaction Design, and the research methods that are discussed are used throughout the rest of the thesis. Chapter 3 and Chapter 4 aim to examine the context of communication within web design, and the tools that support it. Chapter 3 describes two field studies: an observational study and a participant observation study to understand the web design process in practice. Chapter 4 uses semi-structured interviews (Myers & Newman, 2007; Saffer, 2006), and also presents a new method (the podcast study), which is a group interview contextualised to an environment familiar to web designers.

Chapter 5 highlights a number of challenges that have been identified from these previous chapters. Awareness and privacy are major considerations when developing communication tools, and these factors are further examined in Chapter 5, and also in Chapter 6 - where the designed platform is heavily focused on facilitating awareness. Although there is a strong history within CSCW of designing new communication technologies with a focus on context, little study has been done on the adoption of these tools into the workplace.

Studies that look at workplaces are primarily focused on a consistent context, rather than the context of web design where the context is continually changing based on every new clients background. While many Groupware tools have been developed and evaluated based on how well they suit the task at hand, little consideration is given as to how these tools exist within a larger ecosystem of pre-existing and in use tools, with little attention to the adoption of new tools to replace existing tools.

Chapter 3 – Context: Designer-Client Communication

3.1 - Introduction

This thesis is situated within the web design context - a rich, unique yet diverse context, consisting of short-term and complex engagements between design firms and their various clients from a wide range of industries.

This chapter investigates the context of web design to better understand how designer-client tools are used and how they drive the process. The chapter is focused on understanding both the web design industry and the web design process that is carried out by a number of roles from both the client and designer perspectives, each of which has its own past experiences and requirements for communication. This information is an abstraction of the investigations that were conducted throughout this thesis. In particular, the descriptions draw upon knowledge uncovered in the following case studies (Section 3.5 and 3.6), as well as the Interviews and Podcast studies in Chapter 4.

To further examine the web design context, two case studies are presented: one from the perspective of the design team and the other from the perspective of a client. These case studies specifically look at how communication technologies are used throughout the process, and how the tools and methods of communication change throughout the design process, in order to better understand why tools are adopted or abandoned in use.

3.2 - The Web Design Process

The web design process is the process that web designers employ to create and build a web site (or similar digital interactive media). The web design process has been adapted from the traditional engineering design process. There are two aspects to the web design process:

- The process of the work itself, which includes the design, implementation and deployment of the product;
- The web design collaborative process - which outlines the entire designer-client relationship, which includes the initial contact as well as the handover and support process

Rather than taking an abstract and organisational outlook of web design as a structured engineering process, this thesis examines web design from a grounded perspective through qualitative methods to better understand the real-world complexities surrounding the web design process. The description of this process is a synthesis of personal experience in web design, interviews with web designers (Section 4.2) and observations of web design practitioners.

The method in which web design firms engage with clients differs widely; however, there is a generalised practice that can be abstracted. While some aspects of this process may differ between companies, each of these steps may be considered a standard operating workflow for designer-client collaboration within web design. Agile development, which is a recent trend in software development, has not become as prominent of an approach in web design as it has in other fields, due to limited budgets, smaller scope of projects and technical literacy of clients.

1. Client's need for a website - prior to the involvement of the web design firm, there is a need or requirement of a business or individual for a website or other product.

The needs for these products are diverse, but they commonly are a need created for a few reasons:

- A new advertising / marketing medium,
- Branding the business,
- Supporting functional requirements,
- Entering a new digital market (such as a mobile application) and/or,
- Enabling new ways for a business to interact with its customer base (such as an online store).

Most commonly the business or individual will identify these needs internally. On some occasions the need may be made obvious through a web design firm contacting the business/individual (through marketing or advertising), or through third parties such as customers or stakeholders of the business.

2. Client searches for a web designer - the client will often contact a number of firms with a request for a proposal to accomplish the work. This often begins with either a phone call or communication (such as email).

3. Initial contact - Before the proposal is created, the design firm will often meet in person (or online) with the client to better understand the needs of the client and the scope of the project. The information that is gathered from the client is then analysed by the design firm to produce a proposal. The purpose of the proposal is to document what has been discussed with the client during the initial meeting and to document a solution for the clients needs. This proposal will broadly cover the design of the web site, the costs involved with the development of the product and a structured plan of how the design and development would proceed. A proposal will also address any legal requirements, as well as conditions for situations that come up during the web design process.

4. Client selects proposal - From the received proposals, the clients will choose one firm to complete the work. The firm may be chosen based on a number of reasons

including cost, perceived understanding of the need, location, or another perceived benefit. The client will then contact the design firm and negotiate the terms of the work (based on the terms listed within the proposal) and agree for the work to be started through a formal contract.

5. Web design process - Once the agreement is in place, the web design firm will then work on the project until the project is completed and the work is delivered to the client and handed over. On occasions that issues arise, the terms agreed upon in the contract will be enacted. The following sections highlight the primary types of work required during a web design firm's process:

5a. Project Planning - The initial phase of the design process is to establish an organisational working agreement between the design firm and the client. This establishes the relationship between the businesses to better understand how the work will be conducted, how often contact will be required between participants and to discuss requirements for the deadlines. During this phase, initial project roles will be established (who will be responsible for which aspects of the website), and how communication will occur between the designers and clients.

5b. Requirements gathering - This phase of the design process is to understand the needs that the design is required to fulfil, whether the client, another stakeholder or an external body initiates them. Requirements gathering is a fundamental aspect of the web design process. Not only must the designer understand the needs of the client, they also must understand the requirements of the end users of the web site, as well as other stakeholders. In addition, there may be governmental or industry regulations which must be considered when designing the site. Requirements gathering is often done through an ongoing process, as many of the requirements are not immediately obvious (such as the legal requirements of a specific type of content). This requirements gathering process is commonly conducted between the designer and the client, where knowledge is often shared, through digital communication. This requirements gathering is also where

the designer begins to collect assets such as logos that are owned by the client (or licensed through a third party).

5c. Conceptual design - The conceptual design is the overall design of the web site, what it needs to provide to the users, how users interact with it, what information is needed and how the information is structured on the website. Clients will often provide a list of websites to be used as inspiration - that is websites that they like aspects of and from this the web designers begin to construct the overall design of the website. The web designers will often peruse other designs, to understand what the current state of the targeted industry is, as well as draw on their prior knowledge of websites. Once the overall design concept is understood, the designer will then discuss their thoughts with the client, including the kinds of features and content that is needed within the design. This forms the basis for the overall navigation and interactivity within the website. The designer then chooses the most appropriate kinds of navigation patterns and interactive elements, and the conceptual design is adapted to fit these patterns. The conceptual design is commonly represented either as sketches or through paper prototypes. This conceptual design may involve a number of stages of iteration based on client feedback.

5d. Graphic design - Once the overall conceptual design is completed, the designer will then begin on the graphic design. The aim for this phase is to create what is known as "pixel perfect mock-ups" - visualisations of what the final website will look like. The designer will use a graphic design tool such as Adobe Photoshop to create their vision of the concept from the conceptual design and include assets the client has given. Many variations of these may be created and sent to the client (and other stakeholders) for feedback. Colours, fonts and design composition are all considered within this process. Graphic design mock-ups are created for each area of the website which has a unique layout, to facilitate a quick development process. The emphasis on pixel perfect design is to ensure that the development of the website is not distracted by developing an ambiguous design. As with other stages of the web design process, the graphic design may involve a number of iterations based on client feedback.

5e. Development - The development of the website can be considered a job for both web developers and web designers. Often, web designers will work with development tools to prototype or create the web sites. Many of the technologies that are required for the creation of web sites are tailored for designers rather than traditional software developers. In particular, HTML (Hypertext Markup Language) and CSS (Cascading Style Sheets) are tools which can be effectively used by web designers without the need for a formal computer science education, whereas web developers are often focused on the dynamic and functional nature of the website. Similarly, other forms of application development such as mobile development have a strong focus on designer-centric tools (such as the Xcode Interface Builder) for creating the user interface elements of mobile apps. To this end, the development of a website requires a strong level of collaboration between the web designers and programmers.

5f. Content generation (Copy Writing) - This is the stage where content required for the website is created by both the clients and also, at times, the designers. This may be created entirely for the website or be a modification from existing material. The creation of effective content for the web requires a detailed understanding by the designer and the client, as it is domain specific. The generation of content requires a well established understanding of the target audience, as well as an understanding of how text reads on a webpage, not only by humans but also search engines and other indexers.

5g. Evaluation and testing - An important aspect of the web design process is the evaluation and testing stage of the design process. During this phase, testers (including the clients) are engaged to provide feedback on the design and functionality of the website. As agile development becomes more common within web design practice, this aspect of the design process becomes more integrated into earlier stages of the website design and development. The evaluation and testing of the website introduces complex conversations between the stakeholders of the project, and will often inform late changes to the design.

5h. Deployment - Once the design and development of the website is complete, the website must be then set up in a production environment. Often this process requires interaction with a number of third party businesses and individuals to organise hosting, domain and other services that are required. This stage requires a continual conversation between the design firm and the client, as the client may be required to take action on behalf of the designer (as the client will be the official client of the services). This stage can commonly cause concern or miscommunication within the process, due to the terminology used within the industry as well as the turn-around-time for transactions such as purchasing domains and hosting.

5i. Hand-over - As the deployment of the website is complete and the website goes "live", the design firm will prepare for the "hand-over" of the website. This stage requires documentation to be written for the client, and the contract with the client will be officially completed. The documentation will contain a number of aspects, in particular how to manage and maintain the website, as well as terminology and information that the client may need in the future (such as domain name and hosting information).

6. Support and ongoing relationship - After the work is complete, the client and the designer will then agree on an ongoing relationship which provides support for the product for a predefined period of time. The type of support and maintenance which is covered by this relationship is stated in the original (or an amended) contract, where some minor work may be offered for free, while more major modifications or support may incur additional costs.

This generalised practice has been gathered from a multiple of sources: personal experience, discussions with web design participants from Section 4.2 and 4.3, and through analysis of online articles and forums by web designers discussing best practices and their experiences.

3.3 - Communication Roles and Complexity

3.3.1 Roles within web design process

There are a number of roles that are commonly found within the web design process. The roles that are highlighted in this section are typical of a web design business and have been discovered through my own personal experience as well as through discussion with participants throughout the studies included in this thesis. The web design process that this thesis focuses on two distinct groups - the client's who require work to be done, and the designer's who accomplish the work. At the highest level, the roles can be imagined as in Figure 8.
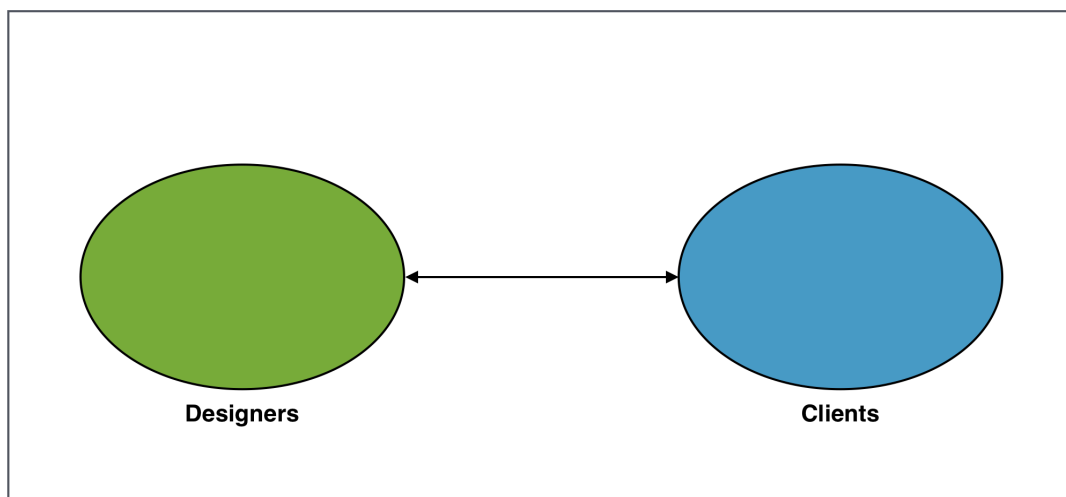
Figure 8: Designer-client communication in summary

Upon further examination of these groups, a number of commonly named roles are used to identify the subset of individuals who are involved in the client and designer groups. From the group known as designers, there are a number of traditional subset roles: developers, designers and project managers. From the client's perspective, there are also an additional number of subset roles: liaisons, users (clients which will use the website) and stakeholders (those with some other vested interest such as the business owner), as seen in Figure 9 (red arrows to show cross-boundary communication). In this, the two roles that mediate the communication are

primarily the project manager and the liaison. However, one person may take on multiple roles, such as a single owner/operator business or a design/developer.
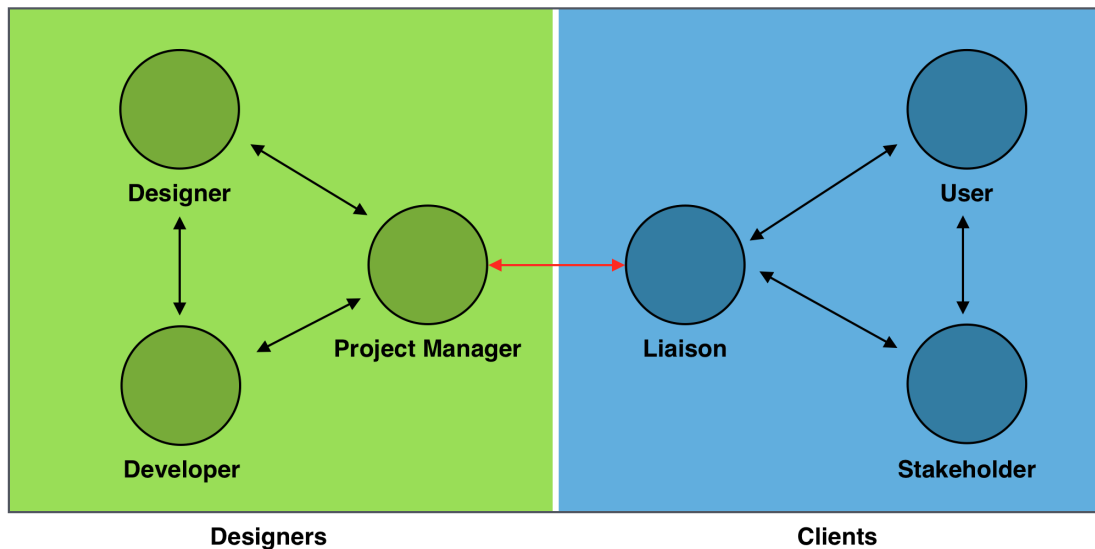
Figure 9: Designer-client communication roles

This figure also shows that the communication not only exists between the design and client groups, but also internally within those groups. Communication that occurs between the project manager and the client liaison is passed on internally within the groups. Likewise, messages from within the group are then summarised and sent to the other group. The role of the project manager and the liaison is to establish and streamline communication between designers and clients.

In addition to the project manager, many design firms have specialised managerial roles to serve needs that they have encountered. Although project managers are commonplace, some firms use other types of jobs such as the AM (accounts manager), who is concerned with direct client relations rather than the overall project, and the DP (digital producer), who manages the internal design and development of the project.

The roles presented in Figure 9 can still be considered broad, and often can be broken up into smaller roles (which one or more people may adopt). Within each of these roles, a number of specific roles may appear. There may be a number of

specific responsibilities within the over-arching design role: graphic designer, front-end designer, user experience designer, interaction design, art director, and usability designer. These may be considered different areas of expertise that could be present within the web design process. Similarly, developers may be further segmented: front-end developer, back-end developer, database engineer, systems architect, IT technician, and search engine optimisation (SEO) specialist. In addition, the project manager role can be broken down into a number of roles: client liaison, product manager, customer service representative and/or content manager. From the client group, a number of roles may also exist, and the extent of these roles is a lot more diverse as the client industry changes. For example, a veterinary company's website may involve a nurse who updates a members' area that lists the pets who are in care (for current customers), while the receptionist may be involved in updating currently available products. In contrast, an accounting website may involve the accountants who respond to an online quote request from a customer, while the marketing manager is focused on advertising for new customers. Figure 10 outlines an example of a web design project with specified roles.
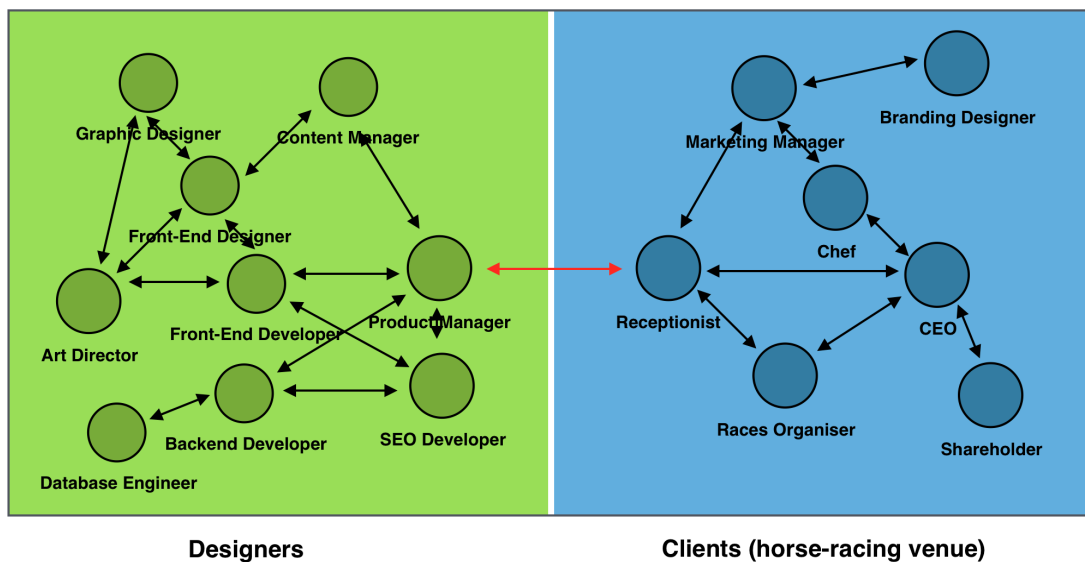
Figure 10: Designer-client communication roles in detail

In this example, the design group consists of a small to medium web design firm, and the client group is a horseracing and events venue. This figure, however, ignores two other groups of stakeholders in the project that are involved in the

communication process. These other two groups are the support group and the end users. Both of these groups are involved in almost all types of web design and in some aspects of the communication. Figure 11 shows these groups and their interaction.

The support group consists of expertise not readily available within the design group, but is required in the web design process. Commonly, this expertise includes web hosting and domain name registration, which is most commonly sought externally by design firms. Additionally, services such as email mailing list providers, customer support services, mobile application developers and SEO developers are also commonly outsourced. These support roles may also include those that are listed within the design group through outsourcing. Communication between these groups and the design and client groups can also be considered as external communication, as there is no pre-determined communication method with these groups.
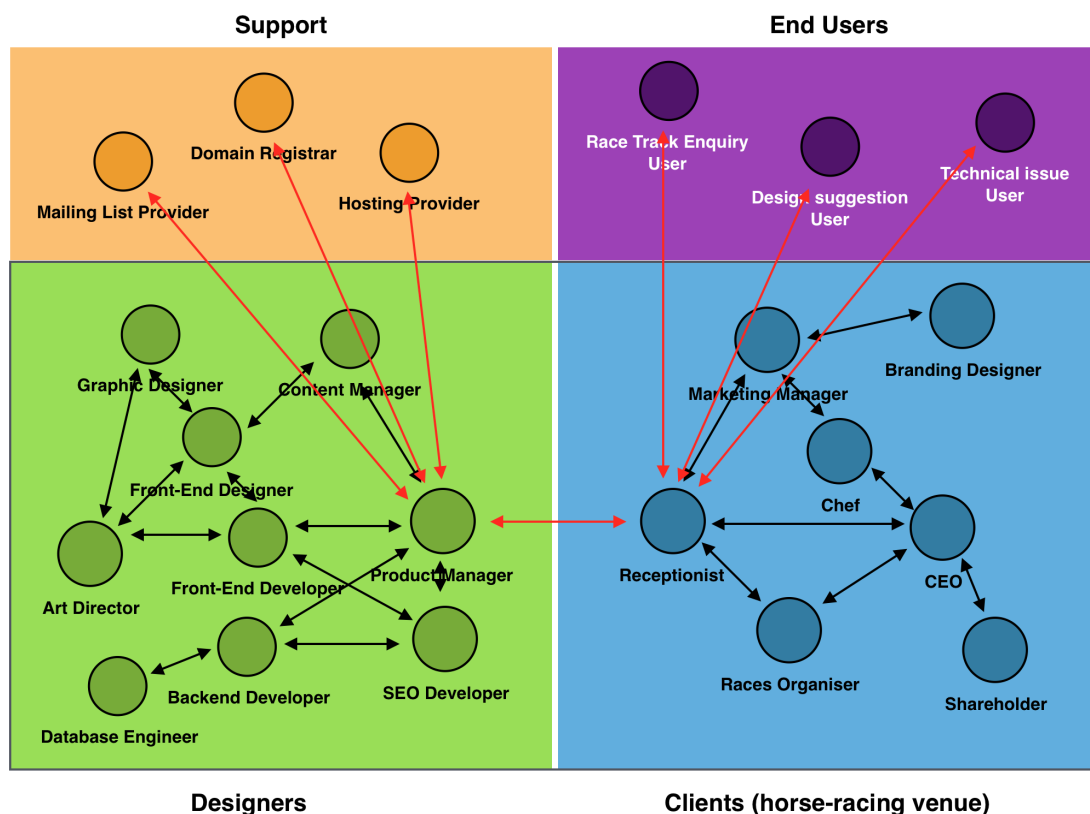
Figure 11: Designer-client communication roles in detail with additional groups

3.3.2 Complexity within roles

In the previous examples, the client, designer, support and end user group communication was mediated through the project manager and the receptionist. However, in practice, this mediation will often break down over time in order to create efficiency within the project due to a number of emerging issues, which in turn creates backchannels in the communication organisation. These issues may include changing of roles, misunderstanding of organisational structure or not having an adequate understanding of the web design process.

Liaison (Receptionist): The liaison in this example has the web design project as only one task of their day to day work. This may cause a breakdown, as the speed in which the receptionist may be able to mediate communication is dependent on their workload at the time. This may lead to other employees of the client contacting the design group directly or assigned tasks being delayed. In addition, the liaison may not be the person who best understands the needs of the client that they represent, but is the person involved because they are perceived to have the most time available (from the clients perspective).

Project Manager (Product Manager): A primary aspect of this roles job is to mediate communication. However, in practice a majority of the communication may require detailed communication between a specific design and client role. For example, the marketing manager may require continual back and forth communication with the art director of the design firm. Some roles in the design side, such as the front-end designer and content manager, have structured processes that require continual communication with certain client roles throughout the process (open dialogue, rather than communication that can be mediated).

Figure 12 shows some of the potential backchannels that may be created during the web design process. These backchannels are often not formally established, but form naturally to increase practical efficiency.
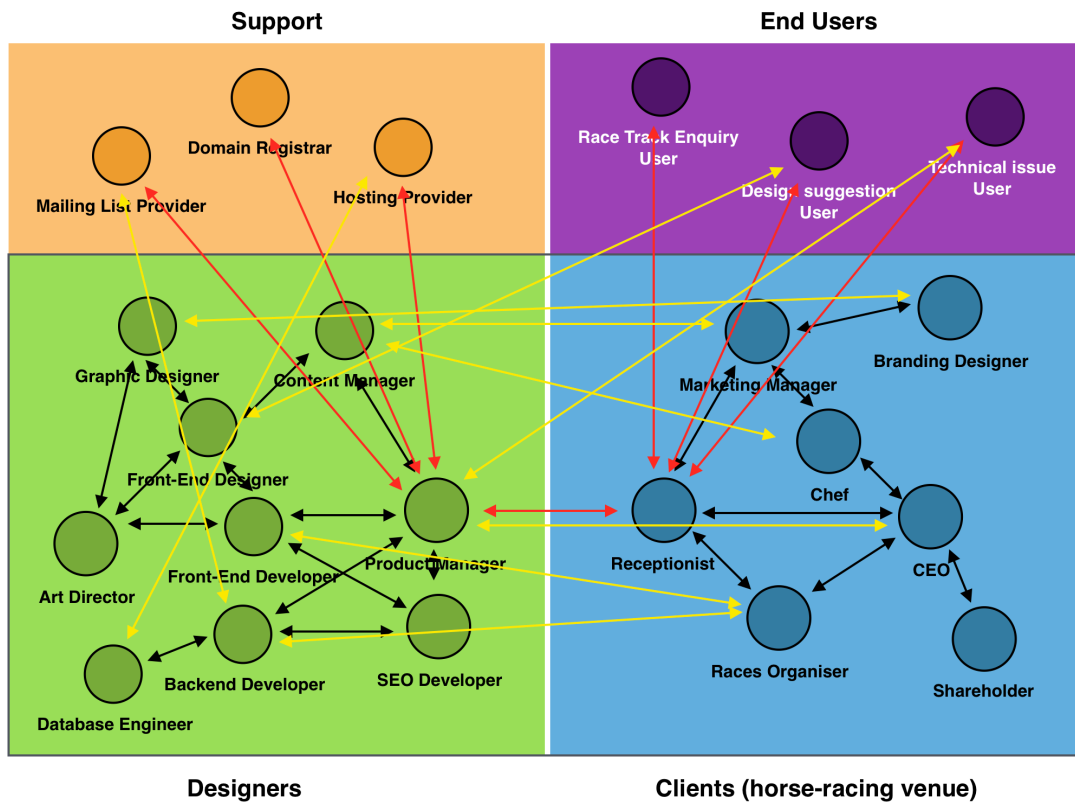
Figure 12: Designer-client communication roles with backchannels

In addition to these complexities, the nature and length of web design projects result in certain clients becoming more or less involved in the project over time due to their other jobs commitments. New client members may be introduced into the process on a needs basis, and during these situations additional backchannels are dynamically created to allow the collective to bring new clients up to speed. This complexity was verified with three web designers who are active in the web design industry, through discussions of examples of their communication within particular projects. In these discussions, the designers would sketch on a white-board to explain their communication process, discussing the project in a chronological order (Figure 13).

Figure 13: Designer mind-mapping the communication process in the design of a website

3.3.3 Forms of digital communication

Although there is an array of technologies used within web design projects, they can be categorised in terms of how many people are involved in the communication (the form of communication). These communication forms are not isolated, and will often transform to another form based on how the conversation progresses. Some technologies may be appropriate for many types of these forms:

Person to Person:

This form of digital communication occurs when two people are in a directed conversation, which has a number of back and forth message passing. The nature of this form is that the two people are trying to reach a conclusion to help progress the project. Examples of this may include solving a particular technical or design issue, back-channel discussion to decide on a specific design or to transfer knowledge directly from one person to another.

Chain:

The chain is a unique form of digital communication, in that it involves many people who do not have direct communication with each other. In this instance, a message flows from one person to another to create a chain communication with an intermediary. An example of this is the web graphic designer requesting for a logo from the project manager. The project manager forwards this request to the client liaison, who then forwards it on to the clients branding manager. The branding manager replies with the logo, which is then passed through the client liaison, to the project manager and back to the graphic designer.

Person to Group:

This form is when a member of the collective messages a specific group within the collective, either to provide them updated information or to request information without knowing the best person to message directly. This form of communication is often used to gauge a groups' opinion of a design or to gather a specific piece of knowledge, for example "what information is required on the contact page".

Breakout Group:

This form of communication is a conversation conducted in isolation to the rest of the collective to discuss a certain aspect of the project. The results of this conversation will then be disseminated back into the collective stream. This is a common form of backchannel within web design projects, both from the designer and the client sides. An example of this is a designer and developer discussing the technical feasibility of a specific design concept.

Person to Collective (Broadcast):

The broadcast form is when a person messages every person within the collective and is most commonly used to disseminate information about the project status. Broadcast messages which are sent to both clients and designers are more formal, and about delivering knowledge. For example, the project manager may send a broadcast message when a milestone is reached during the project.

Passive Communication:

Passive communication is when others observe a task within the collective. Although no explicit communication occurs, the action of the person is observed and acknowledge by other members. As an example, a web designer may update the background colour of the website, which is seen and observed by other members. This may or may not be followed up by a broadcast message.

3.4 - Challenges in Designer-Client Communication

Chapter 3.3 outlines the various roles that are common within web design projects and how communication between these roles is organised (including backchannels that emerge through practice). This section discusses the challenges that these roles can introduce throughout the web design process.

As discussed in Chapter 2.5, current literature has focused on the technical practice of web design, rather than on unpacking the communication processes within the web design process and understanding the relationship between designers and clients.

Figure 14 presents the communication practice for a large web design project. However, this figure is simplified, as the channels of communication are not specified. The communication practice is often rather more complex and fluid, as a variety of communication channels are used - both physically and digitally. The channels of communication are also not fixed, and instead are shifted amongst by users, even throughout a single conversation. Additionally, many of these communications, due to their nature of either the message or the technology, are not shared with the larger collective. These complexities, combined with the *ad hoc* nature of community, lead to a communication environment that is dynamic, inconsistent and without organisational control, which may result in miscommunication.
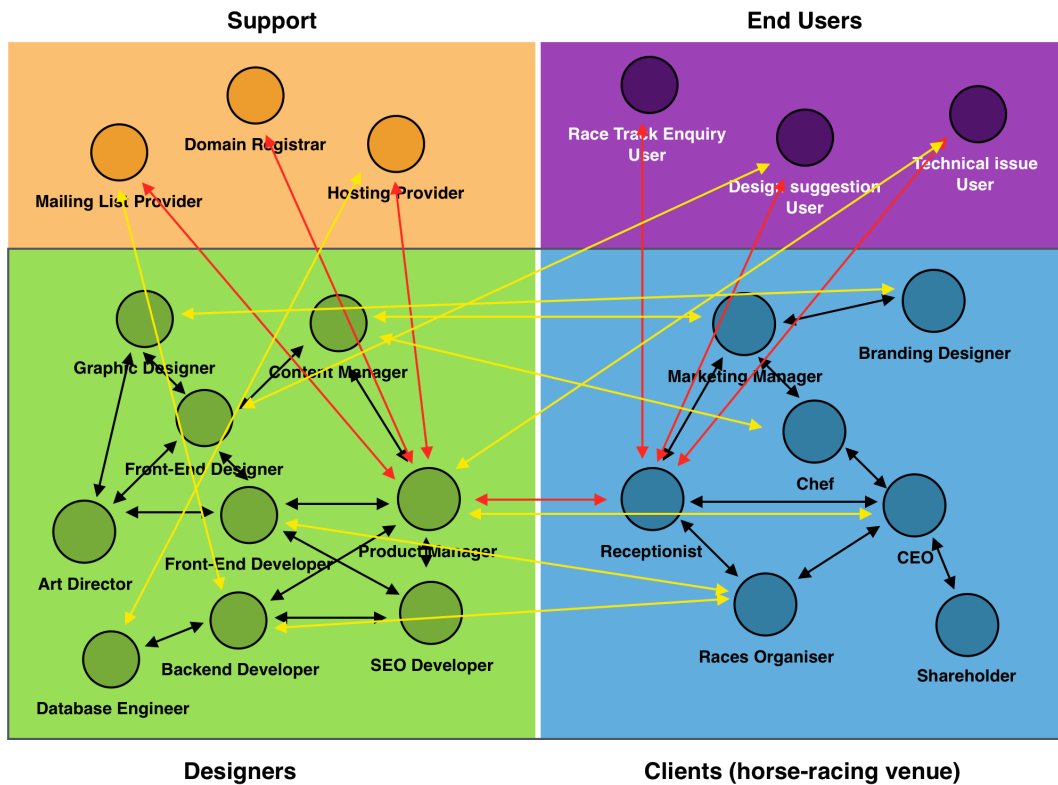
Figure 14: Designer-client communication roles with backchannels

From this overview of the web design process, there are a number of challenges apparent with regards to designer-client communication. These are challenges that designers currently face when communicating with clients.

Transfer of knowledge

A web design firm will primarily work on a diverse range of projects, each with their own unique target audiences. The need for direct involvement by the client in the design process is due to the client's understanding of and expertise in the users who will use the product. The designer must engage with the client to gain knowledge related to the target audience. The difficulty is that although the client may possess this knowledge, they are not trained in understanding the needs of the user in relation to a web page or application. Because of this, the designer needs to engage with the client in a way that they can tease out this information. The practicalities of time commitments and potential conflict due to bypassing the client mean that the majority of the time the client becomes a representative of the users.

Designers use an array of techniques to gain knowledge from the client, including interviewing the client, observing their work, gathering information related to how information is currently presented to users through other forms of media, or by asking the client questions related to their users. Although much of this information gathering can be conducted through face-to-face discussions, the iterative and reflective nature of design means the transfer of knowledge has to be conducted throughout the design process. This continual transfer of knowledge can be a challenge, especially due to the nature of synchronous communication where the client must recall knowledge in the moment.

Capturing of information

Throughout the web design process, specific information related to the project needs to be gathered from the clients. This is not necessarily knowledge about the target audience, but rather specific information such as website content, account details or contact information. This information is primarily sent through digital communication, and then needs to be stored in a location accessible to the organisation. This information also requires categorisation and occasionally an editorial process. Primarily, this information is essential to one or more specific tasks within the design process and is referred to continuously. Storing this communication information for quick retrieval is essential to streamline the creation process.

Awareness of work

An important aspect of the web designer's process is managing and assuring the client. The client should be aware of how the work is progressing and have an understanding of the design process. When clients lose this awareness, they may begin distracting the designers by asking the status of the work, detracting from the current activity. Keeping clients aware of the design process is crucial for the designer, as the transfer of knowledge requires strong communication with the client. Additionally, designers will at times require information or knowledge directly from the client, which can delay the progress due to content being unavailable at the time. Awareness of the client's progress in sending the information can alleviate these issues of time management and planning.

Documenting the process

A fundamental aspect of the design process is reflecting on the process for future projects. Documentation of the communication process is crucial to understanding issues that have occurred and how they can be mitigated in the future. Communication, in particular digital communication, needs to be documented in a way that it can be understood in perspective of the entire design process. This can help contextualise issues or understand correct processes. In addition, this knowledge needs to be transferred to other designers within the firm to ensure and increase organisational knowledge. Although designers understand the importance of this documentation in principle, in-the-moment documentation can be difficult for designers and distract them from the task at hand.

Collaboration around artefacts

Throughout the design process, there is a need to receive feedback and collaborate around the work. Web design lends itself to this, as artefacts can be put online so that clients and other stakeholders can directly see artefacts. However, the methods through which clients can provide feedback using these technologies are limited. While some online viewing technologies allow for annotations and other forms of feedback, clients will more commonly resort to the methods of communication that they are familiar with - such as email or phone calls. This disconnect between artefact and feedback means that designers are forced to make these connections and document the feedback. This challenge is common throughout the design process, from initial mock-ups and wireframes to issues clients wish to highlight once the product is completed.

Controlling communication channels

An important aspect of communication within web design is to keep the communication process as simple and straight forward as possible, to eliminate possible miscommunication. An effective method is to have a single liaison (often the project manager) creating a black box effect where all communication with the client is conducted through the liaison. This means that the liaison has to have a

good understanding of the project and act as a message hub between the team of designers and the clients. This is an effective method of negating a number of communication problems; however, it requires an individual designer to dedicate a majority of time dealing with communication and enforcing strict communication processes. The liaison also requires an in-depth knowledge of all aspects of the project (including design and development) to be able to effectively communicate with the other designers and the client. Although larger firms have the resources to dedicate to creating this black box of communication (the project manager), smaller design firms rely on a coordinated effort by the team.

Simultaneous Projects

Although it may be convenient to examine the web design process with an individual client, it is important to acknowledge that a designer will often be working on multiple projects simultaneously - as well as supporting projects that have concluded. Each of these projects requires some demands on time, and projects may be prioritised based on a variety of factors. For example, a client may be working on developing a project for client A when client B contacts the firm with an urgent technical issue. The designer needs to be able to understand the issue and have the information from the project at hand to solve the problem in a manner which does not significantly delay the work for client A.

Priority Management

Another challenge with designer-client communication is miscommunication around priorities and which aspects of the design are important based on the context. At times, designers and clients may have differing opinions as to whether certain aspects of a design or focus are important to the target audience. It is important that these concerns can be addressed clearly, effectively and without unnecessary delays to avoid distraction and possible arguments. An example of this may be regarding contact information on a website. The designer may suggest putting a phone number on the website, but the client does not wish to advertise their phone number online.

3.5 - Case Study: Communication in UQMarkup

This section outlines a participant observational study that was conducted during a long-term iterative design project in which there was a high level of digital communication between the designers and clients. This study is based on the discussion presented in Dekker, Worthy, Viller, Zimbardi & Robinson (2014); however, more detail is provided to illustrate the range of communication tools and how they are used in the practice of designer-client communication.

The project, UQMarkup, was a web and application development and design process done in collaboration with the School of Biomedical Science at The University of Queensland and a local design firm. In this project, I participated as one of the designers within the design firm, and also acted as an independent researcher who conducted an ongoing analysis of the communication process throughout the design and development of the project. This section brings to light some of the communication problems that I observed, specifically the messiness that is often found within real-world design projects.

The concept for UQMarkup was to develop a web and mobile-based platform that aims to support the marking of assignments by providing students feedback through the use of in-situ audio feedback. Prior to the involvement of the design firm, the clients established a project team to develop the concept based on their prior knowledge and experience within the teaching and learning area. The initial project team consisted of 7 academics who worked as client liaisons and a project manager who was there to facilitate the organisation of the project.
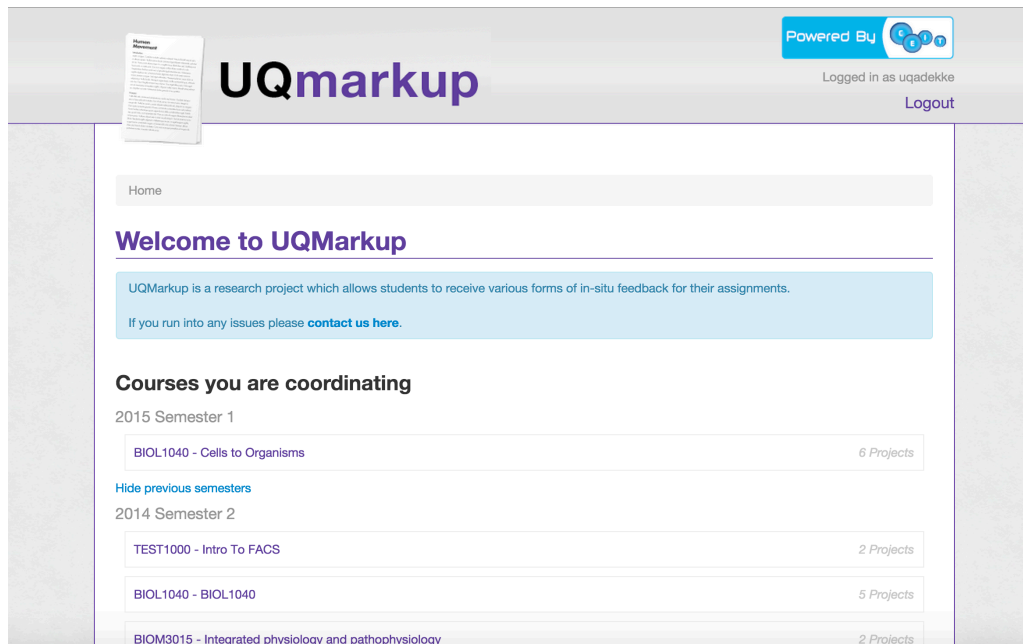
Figure 15: UQMarkup Application

The focus of the design was to create a web and mobile-based system that was deployed within a university environment, could integrate with existing university systems, and would allow academics and administrative staff to mark student assignments. The system provided a mechanism for submitted student assignments to be delivered to a marker's tablet device. The marker would provide in-situ feedback onto the submission (markers could leave pen, highlight, textual and audio feedback), and would assign the student a grade. The annotated submission would then be presented to the student through an interactive website. The student could interact with the feedback, and all interaction by the student was captured for analytical purposes.

From these high level requirements, the project team then engaged with a design team that included two designer/developers (one being myself). This engagement was done external to the institution, with the design team operating through an external web design company. The original scope of the project was over the course of 6 months, which was then extended for continuing iterations for the subsequent 3 semesters of university courses (18 months). The software was deployed and evaluated in-situ in a number of classroom and teaching settings, across a number

of disciplines. Over the project lifecycle, a large number of people were involved, either acting as clients, users or designers:

Table 1: UQMarkup stakeholders

STAKEHOLDER	ROLE	NUMBER
Academic	Client	8
Designer	Designer	2
Graphic Designer	Designer	1
Tutor	End User	108
Student	End User	3682
Administration	End User	4
Project Manager	Support	1
Server Support	Support	4
TOTAL NUMBER OF STAKEHOLDERS		3810

Table 1 shows the total number of participants within the project overall (25 primary participants). Throughout each iteration of the design process, the number of participants changed (within all of the roles) due to a number of factors such as holidays and change of job. As a consequence, some roles changed, as clients and project coordinators joined, left or replaced others in the project team (Table 2).

Table 2: UQMarkup project stakeholders' timeline

Project Stakeholders Timeline

	2011-2	2012-1	2012-2	2013-1	2013-2
Client	5	6	8	7	5
Designer	2	2	2	1	1
End User	1000	1400	1600	1800	2000
Support	1	2	4	3	4
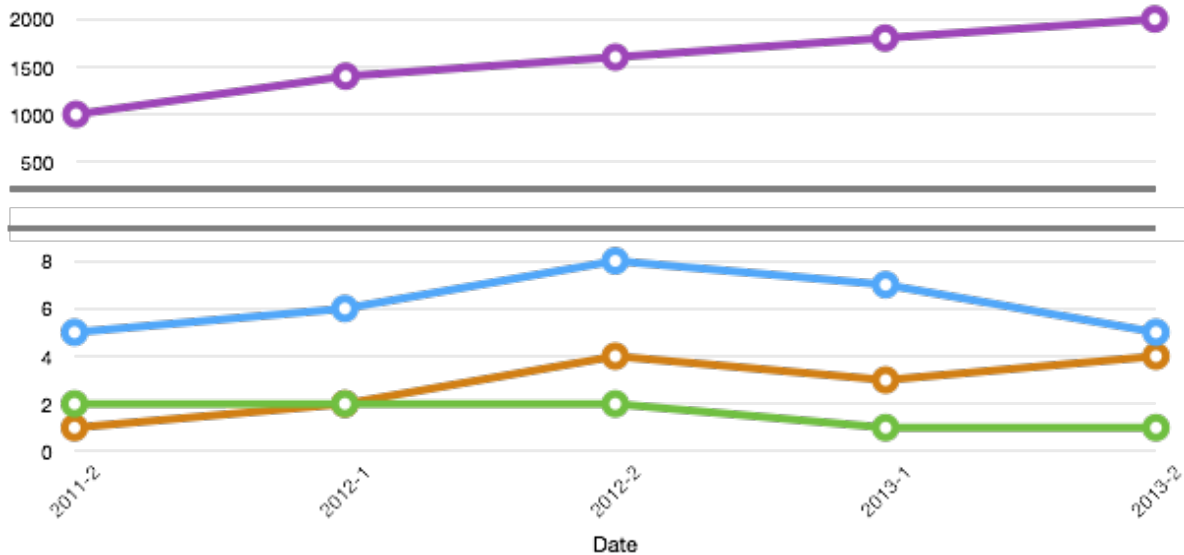
3.5.1 Tools Employed to support Designer-Client Communication

A number of communication tools were chosen to support the design project's communication and coordination.   Some of these tools were formally introduced to pre-empt requirements for specific forms of communication by the project team while others were introduced *ad hoc* as the project progressed.

Email

The initial contact between the designers and clients was primarily conducted through email. Email was the primary form of digital communication and was used consistently throughout the project for both organisation and file sharing.   Generally, emails were sent to all members of the project team. Discussion threads within email were most common, with the majority of emails containing at least 3 replies. While email was a formal method of communication used by the project team, it also became the primary method to perform other tasks such as transferring files or providing support.

119

Basecamp

Basecamp is a project management tool that provides the project team with a collaborative space to write notes and task lists.   Basecamp integrates with email to provide notifications as tasks or notes are added to the system. The project team decided to use Basecamp as the primary communication method for project organisation after initial issues of organisation through email and face-to-face discussion.   Basecamp was used heavily for task lists between the designers and clients; however, as the project progressed Basecamp was used less frequently, with project team members instead using Email or Dropbox. During the project implementation, Basecamp was used heavily to keep track of user details (in particular markers using the system); however, email threads replaced this during later iterations of the project due to the project team's existing email habits.

Blog

The design team decided that it was important to provide a web presence that could be used throughout the project to disseminate information to the users of the system. Additionally the blog would allow users to comment back to the project team around issues that they had. A number of categories were created on the blog for specific kinds of posts: "Design and UX", "Development", "Project" and "User Blog". While initially the blog was used continuously to update users and stakeholders on the progress of the project (as well as issues), it was rarely used during the implementation and support phases of the project. The project team found that while users were asked to look on the blog on occasion, there was rarely any activity. The blog platform was primarily used to put up documentation easily (such as user guides), which could be referred to later.

Face-to-Face Meetings

Face to face (F2F) meetings were used throughout the project for coordination and collaboration. Both scheduled and *ad hoc* F2F meetings were common between a variety of stakeholders. Often *ad hoc* F2F meetings were used when digital communication became a burden due to miscommunication. Additionally, F2F

meetings were preferred when discussing or troubleshooting the user interface due to the quick turn taking in the discussion. Formal meetings were run to provide awareness to the project team on the status of the project and to discuss future design directions for the project. In each of the formal F2F meetings, the project manager took notes of the discussion for documentation that could be referred to later.

Skype

Skype is a desktop and mobile application for video conferencing between two or more users. Skype was used during out-of-hours by the project team to conduct synchronous communication as well as to provide awareness for those that were unable to attend F2F meetings (Figure 16).
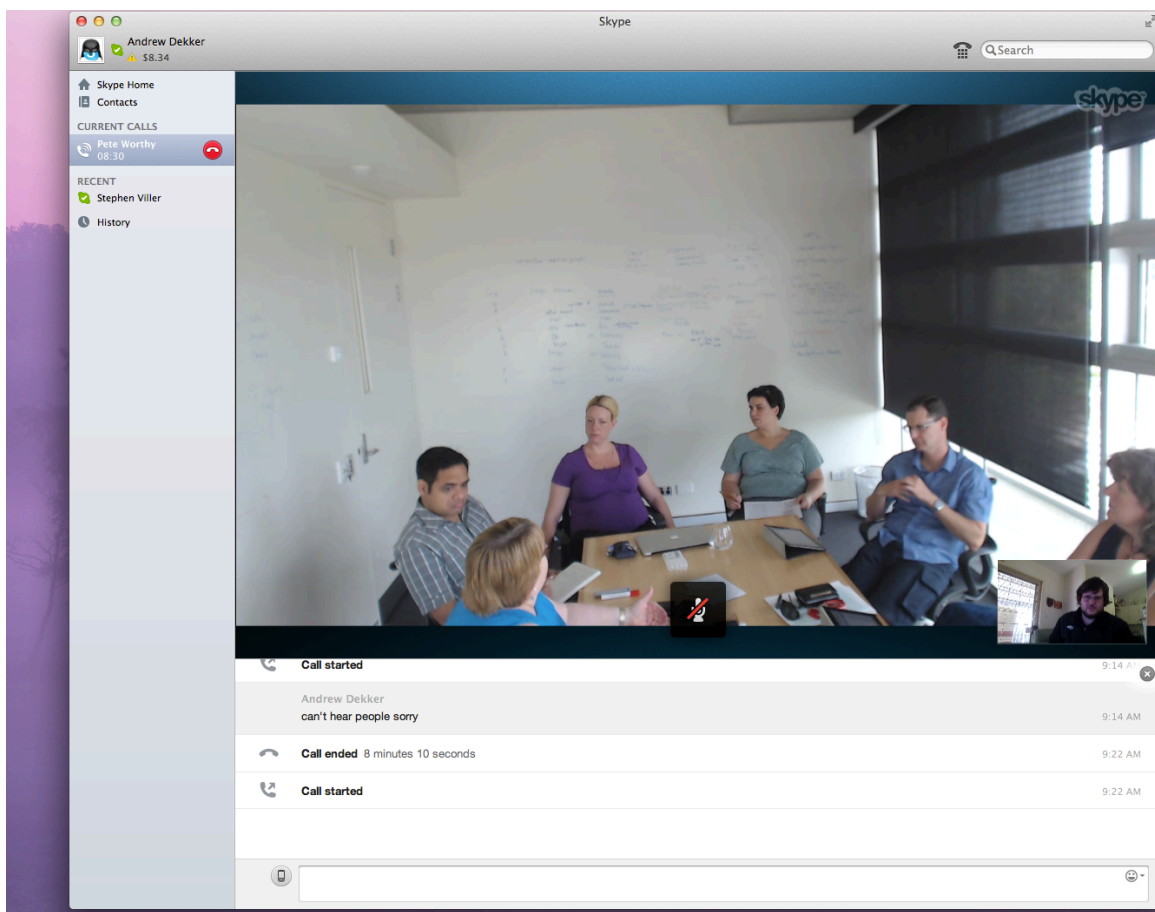
Figure 16: UQMarkup F2F and Skype communication

Evernote

Evernote is a service provided on web, desktop and mobile platform to create, manage and share notes. The project team did not formally use Evernote; however, the project manager used this to record notes of F2F meetings and administrative lists relevant to the project. Evernote allowed this to become a backchannel over time due to its synchronous sharing functionality. As other stakeholders required the information stored within Evernote, the project manager shared these documents; however, this sharing was only done on demand, and broadcast dissemination was conducted through email.

Dropbox

Dropbox is a cloud storage service that allows users to sync their local files to cloud and share it with other users. Initially the project team did not use Dropbox, instead using Basecamp to share and collaborate around files. However as use of Basecamp by the team reduced, and email became the de facto solution for sharing files, Dropbox was introduced to share files that were frequently updated by team members. Dropbox became the easiest way for the designers and project manager to share documentation with the clients; however, clients still preferred sending attachments in email.

Doodle

Doodle is an online scheduling tool that provides an easy system for finding out the best time for meeting among several users. It calculates the "best time" by aggregating each participant's self-selected preferred options. As email became the de facto method of communication for organisation, large discussion threads were created to organise meetings. The Doodle service was introduced into the project to help streamline this organisational process. While the Doodle was used occasionally for this purpose, its use was always initiated by email and resulted in email to confirm the meeting time (as well as for follow-ups for project team members who did not use the service).

Bitbucket

Bitbucket is a Git based source code management tool that offers a service for forms of implicit communication such as attaching comments to changes to code. Bitbucket was used during the early stages of the project to communicate around design and implementation ideas in context of the programming. This implicit communication allowed the designers to have an awareness of what the other designer was working on, and at the same time offering the ability to explicitly comment where necessary. Whilst explicit commenting was used thoroughly in the beginning, for the majority of the project only the implicit aspects of Git (such as knowing when a designer was working on a specific piece of functionality) were used.

Feedback System

Within the UQMarkup system the designers put a small form within the web-based interface to allow users to provide feedback directly to the designers. The original purpose of this form was for users to be able to quickly identify technical issues. Throughout the duration of the project this feedback form was used continuously by users of system, not only for technical issues but also to provide design feedback.

F2F Training

When the implementation of the project was complete, training sessions were organised for the first users of the system. As the system was being used by a user group with a wide variety of technical skills, and was within a controlled environment (members of the University community), training sessions were done with between 5 and 20 tutors at a time. These sessions were run by both the designers and the project manager, and lasted up to two hours. In these sessions, the system was introduced, and the users asked a wide variety of questions.

3.5.2 Communication Tool Use in Practice

As *ad hoc* communication methods were introduced into the project, other methods of communication became less used or abandoned altogether. A number of

interesting situations occurred throughout the project in terms of tool use amongst the project team:

Adoption of Dropbox

Initially, Dropbox was used as a repository for the storage of static information such as key documents and resources. Over time, the team began using Dropbox as a method of sharing dynamic information, avoiding the risk of members accessing out-of-date information that may occur when using email. It was also used as a method to support collaboration around the creation of a document, sharing versions as they were created. However, the frequency of use of Dropbox for these different purposes varied considerably with only a small number of members accessing Dropbox regularly. Because of this, documents that involved all participants were more commonly shared through email.

The use of Doodles

Doodle was used to schedule meetings involving only team members, and meetings involving team members and stakeholders external to the team. However, it was only used in a small number of instances. Largely it was used to schedule meetings where difficulty was experienced in easily finding suitable meeting times at F2F meetings or via email.

The abandonment of blogs and Basecamp

At the commencement of the project, the team specifically elected to use both Basecamp and a blog for different aspects of communication.

Basecamp was chosen due to its functionality of combining communication with organisation, collaboration, and information sharing and storage. The team felt that it would deliver the functions of a number of other systems. However, over time, the team felt that the need to open and use Basecamp on top of email was an additional burden.

The designer's intention for the blog was to provide the project with a web presence, specifically targeting users. The team discovered that users were not referring to information provided on the blog. Rather, users obtained information from other people, such as peers or supervisors, even though the information on the blog was more likely to be accurate. As a result the blog was abandoned, and instead email was used to disseminate new information.

The evolution of face-to-face meetings

From the commencement of the project, the project team agreed on a weekly F2F meeting. Those meetings were used to provide progress updates, discuss and agree on deployment details, review outcomes and explore future possibilities. Initially the entire team regularly attended these meetings. For most, these meetings were the most efficient method for keeping informed of project developments. Having a committed time in a physical location away from team members normal place of work allowed team members to focus exclusively on the project. Further, a F2F discussion was perceived by some team members as being a more efficient method for communication around the project.

Over the life of the project, the focus of these meetings changed from design, development and emergent possibilities, to "routine" issues of deployment. Attendance at the meetings then reduced and was limited to those who were directly involved in that deployment. Over time, the meetings ceased and were replaced by email supplemented by ad hoc meetings as required.

The effectiveness of email

Email was heavily used during the initial stages of the project for coordination. During that period email was formal and primarily for broadcasting information to the team for reference. However, as usage of other communication technologies reduced, the additional communication moved to email. During the later iterations email became the primary method of communication, and included many splintered discussions on design and support. For some team members, email was the primary method of digital (non face-to-face) communication throughout the project.

3.5.3 Emergent Findings

Throughout the project, a number of themes were discovered in the communication process. As the iterative process was conducted multiple times with different stakeholders, these themes were repeatedly seen. These themes are findings that should be considered when designing for these complex contexts of designer-client communication.

Evolving Roles

During the project a number of roles emerged, in both the project team structure but also in the communication structure. These communication roles were not formally assigned, however certain client liaisons and also designers were informally given certain responsibilities amongst the team. These roles also shifted throughout the project to different members of the project team as responsibilities changed. These evolving roles are important to track to keep the right people in the conversation.

Support and evolution of communication

A large amount of communication that was done through the project was around the support and running of the project. Often these issues would repeat throughout the process. Initially, the support would take a lot of negotiation between the designer and the client to understand the problem or situation. As the problem was encountered again, the project team was able to solve this issue in a more efficient manner. These communications evolved to the point where a single email was able to resolve the problem. However, when another stakeholder ran into the same problem, the knowledge had not been transferred, requiring more work.

Opaque Communication (awareness)

An interesting aspect of the communication process occurred when communication threads were not shared across the entire project team. There were a number of reasons for this - on occasion due to the limitations of email (including accidentally missing people on the project team), but also often done purposefully to streamline the communication around the discussion process. Email in particular was used in

this regard, as other tools were broadcast and would automatically provide awareness to all of the project team.

Ready to Hand Communication

One pattern that became apparent with so many communication tools in use was that project team members (especially those that were not involved in choosing the communication tools) used the tool with which they were more familiar. Instead of adding a task or issue to Basecamp, email was used, as it was the most obvious form of communication to use (as perceived by the project team). Additionally, files that were relevant would be sent through email rather than included in the Dropbox folder. Often other team members would then have to manually keep the formal communication channels up to date.

Digital/Physical Crossover

Throughout the project communication, there were a number of situations where physical artefacts (such as notes, and the software itself) were referred. Most commonly, these artefacts were referred to using descriptive text, explaining the situation or process that was done with the artefact. On occasion, where possible, screenshots were attached. This not only was the case for the clients, but also for the designers as well.

Understanding

One recurring theme throughout the project was that of understanding between the project stakeholders. As each iteration progressed, the team became more aware of each other's communication tool use. For example, sharing a file evolved from "I have shared this file on Dropbox under the UQMarkup folder, the Project folder, the Course folder, the Class List folder" to "the class list is shared now". However, when other members of the project team were asked to collaborate on a file, explicit instructions had to be given on where the file was stored. Although all project team members had the equivalent information (all project team members were cc'd in emails regarding Dropbox use), only those who were required to use it understood what was being said in other forms of communication.

3.6 - Communication in NewsCube

The data that was collected during this study was done with the permission of Skye Doherty (the client involved), and was conducted using the ethical clearance that she obtained through her research on the NewsCube (Doherty, 2015).

This section documents a design project where a client engaged with a team of designers to create a web and mobile-based system. The client in this study was a researcher at the University of Queensland who was looking for a design firm to assist in the creation of a research prototype. The project was focused on developing new methods of interaction for journalists to research and navigate source material, through the development of a mobile application (iOS). The client was a researcher within the Journalism school who had a background in journalism and an interest in social media and interaction design. With the help of the researcher (the client), I was able to study the design process that they undertook, collect communication data and interview both the client and the designers. The focus of this study was to observe the methods in which the designers and clients communicated throughout the design process. This was conducted with interviews throughout the process to understand the perceptions of both the client and designers in relation to the communication methods employed.

As the client (the researcher) had a concept in place prior to the design firms involvement, the initial stage of the project was for the client to explain to the designers the concept they had in mind. To do this, they used a number of prototypes, including a wood square (the concept was to have a three dimensional rotating cube which could be navigated). After discussion, the client (under the guidance of the designers) decided that the best way to demonstrate the concept was to create some mock-ups (that is quick examples of the concept) that the designers could refer to. These artefacts allowed for communication around specific aspects of the concept, to avoid misinterpretation. The designers then began the design and implementation process, in an iterative manner. The initial prototype was simply a 3D rendered cube, which the client could interact with. As the client

provided feedback, the implementation was refined. Once the implementation was complete, the product was handed over to the client, and some additional support was given to the client for any technical issues that arose.

3.6.1 Tools Employed to support Designer-Client Communication

Throughout the design project a number of technologies were used to perform communication, collaboration and coordination between the designers and the client.

I observed the initial face-to-face (F2F) meeting between the designer and client. Towards the conclusion of the meeting, the conversation began to discuss the communication tool strategy that the team would employ to continue the collaboration. A number of tools were suggested, including Basecamp, Evernote and Dropbox. While these tools were discussed at length during the initial meeting, during the design process they were not used. When reflecting on the initial meeting with the designer and client, the participants stated that they ended up using the tools that were already established in the relationship. The primary methods of communication that were used throughout the design process were Skype/Phone, Email, and face to face meetings, as well as some specialised prototype tools for knowledge transfer around the concept.

For a detailed view of one of the designer-client meetings see Appendix 3: Designer-Client Meeting.

Phone and Skype

Phone was a primary method of communication for both organisational purposes and also for *ad hoc* queries by the designers and suggestions from the clients. Skype was commonly used towards the later part of the project; however, it was used primarily as a replacement for phone calls rather than for its feature-set. Skype was mostly used as for real-time collaboration and updates, which were followed up with emails containing information requested during the call. The client would most often initiate phone calls: either to receive technical help or to request feedback on an idea and determine whether it could be incorporated into the design.

Email

Email was initially used for coordination of face-to-face meetings and discovery (asking for new knowledge), as well as a mechanism to transfer files and information. While email was never preferred to phone or face to face for collaborating, it was used during periods where the other methods of communication were inappropriate. The client felt that a significant benefit of email was that it provided a record of what had been communicated, which the client could use to recall where the process was up to. A common usage of email for the client was to check whether the designer was waiting on anything from them. The client reflected that "Email is the key communication tool; we used it all the time." Although phone and face-to-face meetings were not officially documented, email often references discussions that occurred within these interactions. Over the course of the project there were 151 emails (over a four month time period), from the initial introduction, to final handover, and follow-up support (Table 3).

Table 3: NewsCube emails categorised

Category	Quantity
Arranging meetings (either F2F or Skype)	40
Transfer of knowledge	34
Discussing design decisions	12
Updates about the design (awareness)	16
Supporting technical issues	25
Administration (billing and contracts)	21
Discussing future work	3

Face to face meetings

F2F meetings were the primary method of knowledge transfer, where the designers would meet with the client at the client's location. The benefits of the face-to-face meetings were that an open dialogue could occur and collaboration could occur around design artefacts. In particular, the white board was often used by the designer and client to sketch out ideas and to provide feedback to each other. The

client generated physical prototypes to demonstrate the initial concept (Figure 17), which could be physically manipulated by the designer to investigate the interaction. The designers would take notes throughout the meeting for documentation purposes. These notes would be stored within Asana (a collaborative project management tool), but were only used internally for administration purposes and not used with the client.

Figure 17: NewsCube physical prototype

Prototype tools – FluidUI, Vuvox and Testflight

In addition to the standard communication tools, a number of design tools were used by both the design firm and the clients to share and collaborate around conceptual designs. These tools (Fluid UI and Vuvox) enabled the client to create sketches to explain their thoughts, and then share these visual concepts with the designers. The designers could then interact and refine these concepts and explain potential technical and design issues that might arise. Both the designer and client highlighted these tools as an excellent method for sharing their ideas. During the later implementation stages of the process, the designers to be able to share the current state of the product with the client through Testflight. Testflight is not a communication platform, but it does provide awareness to stakeholders about the state of the product and allows the designers to see technical issues (crashes) with

the product, as well as see how users interact with the product. In this sense,

Testflight provided the designers with an awareness of how the client was interacting

with the product. Figure 18 shows a prototype of the application as it was developed.
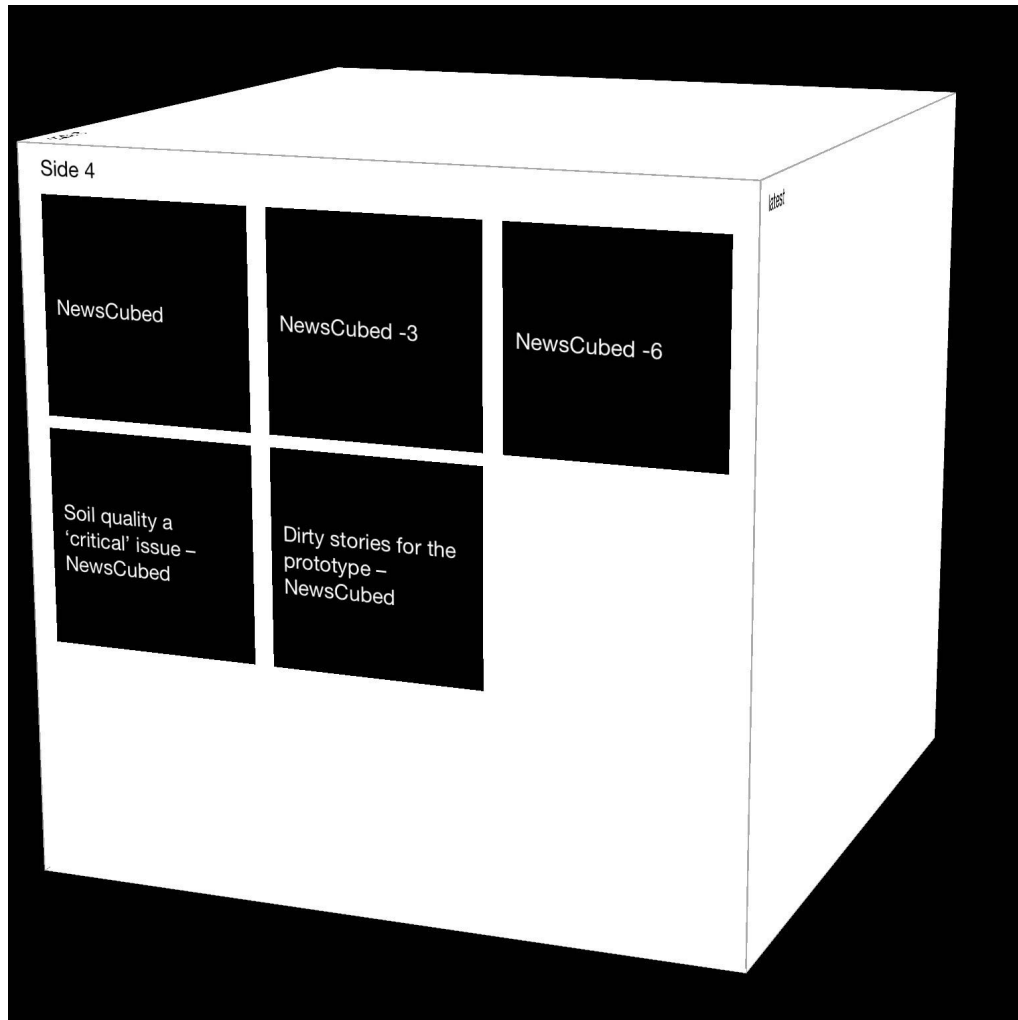
Figure 18: NewsCube interactive prototype

3.6.2 Communication Tool Use in Practice

Screenflow and transfer of knowledge

An interesting method of communication arose due to a situation in which the

designer was required to describe a specific technical process to the client,

specifically around deploying the mobile application to new users. Initially the

designer attempted to talk the client through the instructions, and then afterwards

wrote an email describing the process. However, as technical issues were

encountered by the client (which resulted in additional phone calls or emails), the designer used screen-recording technology to video their own process, which was then uploaded and sent to the client. The client mentioned how important this video had become in their own process, and that they could follow the video along when attempting to perform the technical process. While not always successful, the video allowed the client to better understand the technique.

Sharing accounts

A pattern that was discovered during this study (which also on reflection was prominent within the UQMarkup study) was the problems associated with third party accounts. During this design process, there were some situations in which accounts to online services needed to be shared between the designers and the client. The services that needed to be shared are:

FluidUI – to provide the designers access to mock-ups that the client had designed to demonstrate the concept. In this instance, the client had previously purchased an account and sent the credentials of the account to the designer in an email.

Testflight – to provide the designers with the ability to upload the application in a way in which the client had control of the account once the handover was complete. In this situation, the designers met face to face with the client and assisted the client in setting up the account. This was done to ensure that the client was the person who dealt with the terms and agreements of the service. Once the account was created, the client emailed the credentials to the designer.

Apple – as this project involved the development of an iOS application, the client was required to purchase a developer account with Apple. Similar to the Testflight service, the designer sat with the client and went through the process. The credentials were then emailed to the client. This was a larger concern to both the client and the designer as the Apple account gives access to all aspects of their Apple account.

During an interview with one of the designers, the designer mentioned that dealing with account sharing was a major hassle with client work. "We ensure that the clients are the ones that set up the accounts, so they know what they are signing up for. Personal details are best entered by them. But we still need the details so we can login and use the service. It's a complete pain. Passwords are a huge issue. No real solution at the moment, everything is sent through email." These services, in addition, assume that the user registering has a strong technical understanding, which requires the designers to walk through the process with the client. Communication tools should detect this kind of sharing of account details, and both provide a way to secure this content, as well as making it easily accessible to the user.

3.6.3 Emergent Findings in Study

A number of themes were identified in this study, in particular around information sharing and rich remote communication. These themes introduce a number of findings related to designer-client communication, in particular from the perspective of the client:

Time and focus

During interviews, both the client and designer mentioned that although this project was a priority, other work often got in the way of dedicating complete time to the project. The client stated when asked what they would have changed in the communication process, "I probably would have tried to make things happen quicker, but that's from both of us. Reduce the time between contact, [but I] don't think that would have affected the product." The client stated that this was the fault of both parties, that both of them had plenty of other things on that limited their ability to conduct face-to-face meetings. The client mentioned that not being collocated was a major limitation, with the client's previous experience commonly involving working with others situated within the same company. "Much more organisation was needed cause not being in [the same] physical space."

The client's perception of design

An interesting discovery of interviews with the client was their perception of the designers and their work. "From my understanding of how designers work, give them space, it involves people with lives, and money, focus on keeping the designers happy, making sure that the team functions well and there is no animosity. Making sure there is enough good will to last."

The client assumed that there would be a high level of collaboration with the designers around the concept; however, the client found that the designers were more focused on delivering the product than exploring the concept.

The forgotten ideas

Both the designers and clients stated that throughout the design process, many ideas and features were discussed but not carried through. Many informal stages of brainstorming took place, discussing potential ideas, however these ideas rarely were bought up again unless either the designer or client thought of them being important enough. One issue with this was the lack of documentation about these ideas, as the ideas were quickly forgotten or put to the side as more important aspects of the project were focused on. While neither the client nor designer was unhappy with the loss of ideas, they were both interested in what could have become if they had focused more on them.

Tools to improve the design process

When asking the designer about any tools that they know of that could have assisted in the design process, the designer described a tool that could help by "being able to show stuff on device or screen, without effort, would be really useful. It would have been good to iterate more quickly, being in the same room just being able to get in-the-moment feedback." When asked about the current tools that do provide this functionality, the designer commented, "current tools are more trouble than they are worth, too much setup time and explaining things to the client." Tracking of the current state of the project was not a major concern for the client; however, "it was

on the mind but didn't want to rush the designer. At one point thinking I was thinking this just needs to be finished, what needs to be done."

Highlighting important information

An important finding of this study was that much of the frustration of current communication tools is around specific kinds of information not being treated contextually. In this study, account information is not treated differently from other information, making it difficult to find, document and secure. Systems have begun to be smarter at this (e.g. by highlighting Calendar events); however, other types of content can be contextually enhanced by communication tools.

Overall the designer and client were both happy with the outcome. When asked about improvements to the process, the designer said that the only point for improvement was the slow start to the design process regarding defining the project, "problems with defining the project at the start, running into walls about not having enough detail, ambiguity mainly."

The two main observations from this study were the need for effective knowledge transfer from the client to the designer and that tools should provide more awareness of the project as a whole, being more transparent for the client. Although the tools that were used (Phone, Email, F2F) were effective in providing this knowledge, the lack of documentation was problematic, and only email was beneficial in the *ad hoc* nature of the interaction.

3.7 – Context: Conclusions

This chapter has examined the details of designer-client communication within the context of web design. The web design process is complex, with a diverse and specific range of users and design firms that changes throughout the process and relies heavily on continual communication between the designers and clients. While each web design firm and client is unique, there are a number of roles that can be identified. Each of these roles represents how they act within the larger design process. In addition to the design firm and the clients, other businesses may be involved throughout the web design process. To facilitate the communication that is required, designers and clients employ a series of digital communication channels as well as face-to-face meetings. It is noted through observation and participation in the web design process that the current tools to support this communication are not suited to the work; rather, they are general communication tools that have been adopted due to their ubiquity.

The complexity of a web design project is more complex than a single designer-client relationship, and it involves a large number of stakeholders for all but the simplest of projects. In particular, an understanding of the scope of stakeholders is important when considering the best methods of communication. In addition, the roles that stakeholders play within web design projects changes over time, so the transfer and awareness of knowledge and prior communication is vital for smooth transitions between stakeholders. It is also important to note that there are also third party stakeholders such as service providers and contractors who may not be involved in the entire process but are required to be involved for certain aspects of the project.

The tools that are currently used to support designer-client communication are a collection of general-purpose communication channels, which all stakeholders in the process are familiar with, and the process in which they are used is often *ad hoc*. In particular, tools are used in the moment and are dependent on the specific person's prior knowledge of the technology, as well as the evolving understanding of how

other stakeholders use the technology. As an example, in the UQMarkup case study, it was found that certain tools (in this case Dropbox) were popular for some stakeholders but rarely used by others. This understanding made stakeholders choose alternative channels when communicating with those stakeholders.

The diverse nature of tool use leads to a disconnected narrative describing the project, and information is commonly misplaced or forgotten within the larger conversation. Noticeably stakeholders who are from the same enterprise (such as a design firm) will often use tools for internal communication that are different from the tools that are used for communicating with clients. This is seen in the NewsCube example of the designers using Asana; however without the client's having any interaction with the system. When discussing the use of Asana, the designer mentioned that they used it for each project but never gave clients access to the system. While Asana supports this functionality, the designer was concerned how the client would interact with the system, and whether anything within the system may offend them (as it was being used internally). Instead, these internal tools are most often used as a backchannel between stakeholders simultaneously with public channels.

The planning of communication channels use is a common task during the initiation of a project; however, the perceived use of these methods of communication change based on the nature of the project and stakeholders. This is not a misunderstanding of the technologies by stakeholders, but rather the lack of understanding of how the use of these technologies will be used by the project team (both individually and as a group), how that use changes over time, and how different channels can adapt and accommodate these changes. In some situations, the breakdown of communication is caused by the functionality that tools provide – such as real-time communication methods like Skype, which are not recorded and disseminated to other stakeholders.

From this understanding of the web design process and its complexity, Chapter 4 studies in greater detail the types of communication technologies that are currently available to support the web design process, how these tools are being used in

practice and the problems that these tools present in the context of designer-client communication. In particular, Chapter 4 is concerned with understanding the technical, practical and usability limitations of current tools, and how designers adopt them to support their work with clients.

Chapter 4 – Tools: Current Support for Designer-Client Communication

4.1 - Introduction

A majority of communication and coordination used within the web design process is done through Computer Mediated Communication (CMC) technologies. This chapter explores CMC within web design; in particular how current tools are used in practice to support designer-client communication. A series of interviews were conducted to understand how web designers perceive the use of CMC within their practice, as well as identify their issues with current tools. Clients were not interviewed during this study due to the diverse nature of the web design clientele; in particular as they have very specific requirements and at the same time are part of a general user group. A quantitative evaluation of collaborative and communication tools which are available to support designer-client communication is detailed to understand the methods of communication that are currently available to designers, and the problems which they aim to solve. From this analysis, as well as the studies from the previous chapter (Chapter 3), I then analyse the technologies and tools that are currently being used to support designer-client communication, and identify a number of limitations with these current tools. These limitations are analysed to understand how they exist within the context, and how they affect current web design practice regarding communication.

4.2 - Interviews with Web Designers

A series of informal contextual interviews were conducted to better understand the current practices of designer-client communication and the problems with existing communication tools and processes within specific web design SMEs (Small to Medium Enterprises). Ten interviews were conducted with participants who are actively working within the web design industry. The experience of these workers ranged between less than a years' experience, to over 11 years in the industry. Participants either work as a designer, developer or director within their respective web design businesses.

In this study, interviews with clients were not conducted due to a number of reasons. Specifically, in the context of web design, the client is a diverse and generic user group, with a number of unique and specific goals. The client group may change from a multi-national childcare group, to a fish and chip shop owner, to an online clothes store, to a charity cycling event. Although there may be quantitative insights into the types of industries more subject to requiring web design services, this is outside the scope of this thesis. Additionally, any qualitative study of clients has the potential to bias results based on their individual requirements or biases.   Aspects such as technical competence are also varied and individual to the client. Instead, this study takes the approach of understanding client demographics through the eyes of the web designers that are interviewed.

Each participant was required to provide written consent prior to the interview process and was offered the chance to withdraw at any point. Interviews were structured to emphasise conversation, and focused on the discovery of stories and ideas, which detailed personal experiences with communication tools within the participants work. The interview process was based on semi-structured interviews (Preece et al., 2007) and directed storytelling (Saffer, 2006).

The structure of the interviews was to gain qualitative data around communication processes from the viewpoint of the participants. The interviews were semi-structured and conversational, focusing on five discussion topics:

- communication practices within the business,
- problems with communication tools,
- communication tools in general,
- adoption of Social Software into the business, and
- potential communication tools based on the idea of an enabling platform.

Interview times ranged between 34 and 72 minutes. The average amount of experience among participants was 4.5 years working within the web design industry. To protect anonymity, aliases are given to each participant (A001 etc.). Table 4 provides an overview of the each participant's job description and experience within the industry:

Table 4: Interview participants (web designers)

Person ID	Business ID	Role	Experience
A001	B01	Designer	1 year
A002	B02	Designer	6 years
A003	B03	Designer	7 years
A004	B04	Developer	3 years
A005	B05	Manager	11 years
A006	B06	Developer	5 years
A007	B07	Designer	3 years
A008	B04	Developer	1 year
A009	B08	Developer	2 years
A010	B09	Developer	6 years

The interview responses were coded based on the specific question that was asked by the interviewer, and the type of problem that was discussed by the participant.

These questions were then categorised by the coding. A number of findings emerged from this study. It was found that email was not only a common method of communication within these businesses but was also a preferred tool due to its ubiquity. A common problem with email was the lack of awareness, such as when emails were "lost" in the system, leading to communication breakdown:

> Ah we get that, cause it is me and **** who will get client's emails, or just one of us getting client emails. So you try to reply-all but occasionally forget someone so you forward something over and he's like, "What was that?" Because you're getting different waves [of email], you'll send a response to something both of you received, and they will only respond to you and not the other. So you get a lot of crossover, of I don't know if he knows about it or who is supposed to be dealing with this, or if someone has already dealt with this. (A004)

Some tools (most often Skype) were used as informal communication tools that were used as a backchannel between workers within the business. Participants regarded these backchannels as not officially work related, although admitted that a large amount of discussion around projects was conducted through these backchannels:

> No Skype conversations would ever be recorded into Salesforce. It was an unwritten rule. Management knew that we were using it, but never mentioned it. You never wanted to rock the boat by creating a scene around the way you were using Skype." "What stops those channels converging is the unsaid stuff.   Everybody knows what's going on, but nobody talks about it. And that's what really interesting. It's stupid, because they should definitely cross, because there is information there." "But, in terms of business information, yeah. So say if I was organising an event, I would talk to ***** over Skype. "I need this, can you get me this." So yes, I would definitely use those channels for that as well (A001).

A common situation that created communication breakdowns occurred when multiple communication tools were used in tandem. Information spread between multiple channels created a large overhead when collating the narrative, and can lead to misplaced knowledge within communication tools, emphasising the desire for communication to be posted to multiple channels:

> I'll post something on Basecamp. When the client goes in to see the work that I've done, there is an option for commenting, for some reason they don't comment there, but rather

through email, and that really disjoints my flow of back and forth with that client. I still put all my work up there. Say they sent a contract via email, I would go and put it on basecamp, but so far the emails that they have sent hasn't justified for me to put that information on Basecamp (A001).

There was little if any official documentation and archiving processes of conversations conducted through CMC. Searching communication logs was a common task, as well as having to forward on discussions to other workers to provide context:

Basecamp has a lot of problems with filtering. Clients will often reply to threads, rather than create new threads. So threads will have many different things not related to the original message. And it's all grouped by the title of the message. Also keeping track of the conversation in real-time is difficult due to the dashboard. It doesn't help you at all when the context changes in the discussion. They only thing you can do is use the search function, and hoping you'll have a good keyword to pull up those messages. Otherwise it's lost (A003).

Overall, participants regarded the existing methods of communication used within the business as satisfactory. While participants mentioned a variety of problems associated with these tools, they had informally developed strategies for negating these issues:

I tell people "unless you put this in an email it's not guaranteed that it's going to get done." You just can't control clients; they are just totally out of control. Not all of them, but specific personality types. We've done 700 odd projects, so you can pick the client that's going to be a problem, because they won't email (A005).

The thought of using communication tools that were inspired by Social Software within the business was met with mixed reactions. The primary concern with Social Software was how it would affect existing communication practices and tool usage:

For what we do, moving people off email would be undoable. It's what they know; it's what they use. It's ridiculously overused for what it's useful for though (A004).

Privacy was not seen as a primary concern, as long as workers had fine-grained control over what information was shared, and wasn't later accidentally shared by the system:

> *Client may email me asking for something and I'll then forward the email to my boss and say, "Look at this idiot," I wouldn't want that conversation going out to the client. I shouldn't have to flag that or anything; it should be taken for granted that that is not going to the client. [But within the business it's all fine.] (A002).*

Communicating around artefacts was a large problem with existing tools, which do not support this effectively, resulting in new tools being introduced into the communication, such as Yousendit and Dropbox:

> *[We use email] If it's small enough (exchange strikes again, 10MB limit on attachments). That kills people a lot of the time. The designers use yousendit to send files to people. I just use FTP to send files so people can just download it off the web (A004).*

Sharepoint was raised as a solution to these issues, but considered by participants as a bad communication tool due to lack of interoperability with other systems:

> *…we have tried different things like Sharepoint and a few other things, but it never ever takes off. I think it's mostly a usability problem, people get on and go "this is crap" and walk away, never looking at it again. Sharepoint is not really designed for what we wanted to do, and it was never really explained properly. IT came along and said, "This will work," and our response was "Work for what?" (A004).*

Participants were not able to effectively ideate new communication tools. They could easily identify problems with current communication practices, but were generally unable to identify new concepts that could overcome this without examples given by the interviewer:

> *It's that client relation/management sort of stuff, where you have all client details at your fingertips. So you can do that fundamental search of everything, "I remember something happened to do with somebody, when" and search everything for a particular thing. And if you had that level of access across a group, in that historical sense, especially if it was a*

mobile app, that could search all emails for contact information, that would be a very handy thing (A005).

Overall a number of findings emerged from this interview study. Most prominent was the understanding of how communication tools are used in the context of web design, and how critical they are to the web design process. Web designers do not use a single method of communication with clients; rather, they use a number of tools in combination. The management of these tools, but individually and across the organisation lead to a number of issues, in particular around archival and awareness mechanisms. Additionally, Email is a baseline technology that is essential to designer client communication, and should be integrated with any new method of communication to support this context.

4.3 - Podcast Study

Based on the interviews in Chapter 4.2, there were particular aspects of web design and client interaction that warranted additional investigation. To gain this additional understanding, a study was designed using the medium of a podcast to create a conversation between web designers around their experiences with clients and communication. The podcast method was designed by myself, based on the discovery that podcasts are a common medium for web designers to discuss their practice in a social forum. Web designers are not only familiar with this medium; they use it as a way to learn about new aspects of their work. However, existing web design podcasts are focused towards technical or business related factors, rather than on client communication. The method was designed as a way to engage with web designers on an area that they can claim expertise in a manner with which they are familiar.

The podcast evaluation method is well suited to the context of web designers as it is a medium that is commonly used within the industry to transfer knowledge between well-respected web designers and the rest of the industry. The purpose of podcasts is for members of the community discuss various facets of their job, and distribute them online for the rest of the community to listen to and comment on. The nature of the discussion is considered informal and conversational, however at the same time due to its public nature is thought of to be considered and accurate information by the presenters.

A series of four podcasts where recorded, selecting members of the web design industry who had a number of years experience with a wide variety of client encounters. There were three participants overall, two which participated in two podcasts each, and the other who participated in four. Participants were chosen from the interviews (Section 4.2) based on their range of experience and ability to discuss core web design issues. Each of the podcasts focused on a particular topic, to guide the conversation. While I led and moderated the discussion during each of

these podcasts, the focus was to get the web designers who were presenting to discuss their own experiences and discuss with each other similarities and differences with the situations that they have experienced. Each of the podcasts was designed to be 30 minutes long, with the overall discussion lasting for 42 minutes (before editing).

4.3.1 A day in the life of a web designer

The purpose of this podcast was to gain a more detailed understanding of the day-to-day activities of a web designer working within the web design industry.

- *What is your role within web design and whom do you work with?*
- *What is a typical day in the life of a web designer?*
- *How many projects do you work on in an average week?*
- *What is the range of projects that you have worked on?*
- *What is the lifecycle for a normal project?*

In the initial podcast, a lot of information discussed was the details of communication. P1 works as a designer/developer for a research institution, working on a number of web-based projects with a number of clients. Each of these projects is in different domains, and has a strong focus on user interfaces. P2 works as a developer for a commercial web system, and has previously worked in a number of web design firms over the last five years.

In discussing the designer's day, both designers discussed how Email was the first task of their day, and they would plan their work based on the Emails that had to be responded to:

> *Yes, in the morning, in the morning, Email. That's generally—to be honest, all day. All day it's emails. Then again, normally we get stuff in emails kind of from within the organisation and clients. (Participant 1)*

Generally, what will happen is that the morning is all taken up with communications. I start at eight o'clock in the morning. I might get half an hour of work working, meat-to-the-grindstone sort of work. Then there's an hour of dealing with communication, which is almost all Email and Skype exclusively. We experimented with a few other tools, but nothing sticks. We experimented with Slack, but it turned out to be very few of the benefits that Skype already had. (Participant 2)

Yes, it's nonstop, and it—a lot of Skype calls, at least one a week—at least one a week, as like a—this is a fixture every week. There will be this Skype call and then additional, depending on whichever project is coming up and what I need to talk about and different things, office politics, and lots of stuff. (Participant 1)

The average number of projects that the participants worked on simultaneously was highly variable, but could be from as little as two to over eight. Each of these projects were at varying stages, and was with different clients in different domains. Both designers worked on a wide variety of projects, ranging from simple static webpages, to highly dynamic and interactive systems.

Most of the time, it's stuff that's all interactive mainly because everything that I'm dealing with has huge amounts of data. When you're selecting like, "Pick the three genes that this thing affects," there's a lot of genes. Everything has to be interactive. They're going to be able to find the thing. There's different ways of typing in names of genes. There's like four standards. Everything has to cater for everyone everywhere because they're all international. (Participant 1)

In discussing the project lifecycle, the designers commented on how complex projects can become, and that often they would inherit projects from other designers in the organisation:

I've inherited a bunch of projects where I had no idea what anyone—I had inherited a project where I had no idea. I had to talk to that client, and they went through the list of stuff that they had been promised to have been delivered eight months prior to when I inherited this project. I had to get that from the clients. I didn't have any documentation from the person who had left. I had to go to them. That's a bad position to be in, to have—I couldn't—I only had what the client was telling me that they had said and they were promised would be delivered. (Participant 1)

149

I've inherited a project that was in its third year of maintenance after it had been released through poor communication between the people who are the primary client contacts. They had a group of what they call producers, which are essentially project managers, usually 25-year-old children. I'd get an email from this client who I'd never met before saying, "Two years ago, they promised us this thing." Then I'd go to the PM and they'd say, "We have to do this, but we don't want you to spend any time on it because there's no money coming from this client. (Participant 2)

4.3.2 Designing and communicating with clients

This podcast aimed to better understand how web designers saw the client's role within web design, and the collaboration that was required with clients to achieve successful outcomes.

- *How much do you collaborate with clients?*
- *What do you communicate about with clients?*
- *What kind of issues do you have when communicating with clients?*
- *How do you tackle issues that occur in client communication?*

Participants stated that they deal with their clients a lot, primarily in obtaining information from the clients. However, the participants stated that this could result in a lot of delays due to the clients schedule and priorities:

Yes. I mean, they've all got other jobs, but this is not—the people that I'm dealing with, this isn't their job. They've got money from somewhere else to get this thing done, and I'm doing it. They all go off and do the rest of their regular jobs. I'm generally the one driving a lot of the conversation. Unless they aborted and they're like, "Wow, I'm going to put in 50 requests," up and down on that one. (Participant 1)

There was this one—she works with them [the client] for one day a week doing their social media management campaign, but she drove all of the client response because the client themselves are nearly hands-off other than to get their product into the zone. What would happen was she'd have one day a week, so you'd be lining up—you'd be Email, Email, Email, communicate, all one way. Then in a rush, it would all come back, and then 25 requests would come back on top of that in one day. You'd get through that through the rest of the

week, then you'd Email, Email, Email, Email, then it all come back in a rush like in waves, basically. (Participant 2)

On asking the participants on how they manage these issues, the participants stated how important it was to understand how the clients operate, and plan your communication from there:

If you're lucky, you manage to keep your various projects happening that way, alternating. You're like, "Okay, I won't respond to these emails today. I'll wait until the day after so that it hits their next cycle of responses. Very detached. Not enough—nowhere near enough direct communication. (Participant 2)

A major aspect of the participant's job was to learn the client's domain while at the same time being able to explain technical aspects to the client without overwhelming them:

It takes a long time to learn the jargon, and then being able to communicate that back in a way for people who don't understand the jargon, keeping your feet in both user space and expert space. (Participant 2)

Yes, I agree. You got to have that kind of foot in both worlds because—especially with research. I talk bones, genes, disorders. I can tell you that disorder and disease are not the same thing. (Participant 1)

You hear it all the time where someone will say, "I don't think a clinician will know what a parent is. They normally think of the disorder's pedigree." I go, "Okay dokey." I go off and I have to ask people what do these words mean, or I Google them, which is what happens a lot. (Participant 2)

In addition, the change in the type of communication would affect the way in which client communication would occur:

Switching mediums. People switch modes. I'd have these meetings face to face with the exact same person I was emailing to, and they'd act like that Email chain had never happened. It was like you're speaking to a different person. (Participant 2)

When asking about the issues of collaboration, and how they solve communication issues, they stated that the main issue was miscommunication and a misunderstanding of *why*:

> *For me, I was going to say that doing a lot of the kind of iterative user story stuff, where they'll say what they want and, the most important thing, why, because generally the why is so much more important than anything else they say they want. They want to be out of print, and I'm like, "Oh, you want this. This is what you're actually asking me to do." The "why" really helps. Generally they say, I use kind of like the MoSCoW priority, so whether it's a must or a should or a could, they generally—I get them to say that, and then I come back with like an effort score, how much effort it's going to take for me, and then they decide, "Is it worth my time to do that?" (Participant 1)*

> *The "why" is definitely a huge part of any sort of understanding the scoping input. The question is a lead, is a thread to follow. The question is not something you answer. (Participant 2)*

When asking the participants how they get new clients to engage in this style of communication, they recognised that it takes some time to train the client, and the best way is to ask them questions constantly, and show how those questions influence the design and development of their product.

4.3.3 Better ways to collaborate with clients

This podcast was focused less on web design practice, and more on the communication tools that web designers utilised when collaborating with clients, and the problems with communication.

- *Which tools do you currently use to communicate with clients?*
- *What strategies do you employ with using communication tools?*
- *Which tools do you see becoming more useful for client communication?*
- *Which types of tools have you tried to use that didn't work?*
- *How do you imagine future tools could improve your client communication?*

When asked which communication tools the participant's use with clients, they had a strong emphasis on Email:

> Okay. What do I use? Email. Email, Email, Email. I probably should say it enough so that— you have this huge number of emails compared to the number of other things that I use. Email. GitHub. We use GitHub for client stuff. (Participant 1)

> We've used Asana internally. We've used Basecamp in the past to communicate with clients. Basecamp is sort of like a hit-and-miss thing for us. We ended up not using it because, yes, you can get something out to clients, but it's all really just bunching around the edge of it, like maybe they'll go once or twice and add some stuff, we'll find some stuff, but not really use it in such a way that it's usable of us while we put it up there for their sake. (Participant 3)

> Generally, what happens is they'll be on the GitHub repo as a collaborator? They don't, most of the time, even know how to get there. GitHub will send them emails and others reply to the emails. That will end up back at GitHub and then I'll reply there. It basically just passes through the Email for them. (Participant 1)

The other tools the participants mentioned were Skype (which they used a lot for in-depth conversations with clients), Screen sharing software, Google Docs and other tools to assist in knowledge sharing (with Email as the transfer method). When asking about future communication tools, and how they see their use, the participants highlighted that tools that help bridge the knowledge gap, and are easy to adopt would be most beneficial:

> For me it's about understanding what's going on in the style of the process. I like to talk a lot about shared knowledge now, and the clients are going to come in this whole set of knowledge that you won't even get the tip of the iceberg on, and you're going to have a whole set of knowledge that it's just going to glaze over at. The tools that will be really super interesting in the future for me would be stuff that at least makes it clear where the knowledge doesn't align. (Participant 3)

> Yes. Even just like different tasks with things that I know. I swear, radio buttons, no one knows what that is. I say a lot like, "Check box." Very good. Radio button, the circles that let you choose between options. Even these option buttons or anything, there's no name I can use to describe those for anyone who's never done anything with the computer. There was no

difference between those buttons. They've never thought about them before. They have no
idea. They just don't exist. (Participant 1)

The discussion led to whether social media would be an option for communicating with clients. When asked whether they use Facebook with clients (even when the original referral and contact came through Facebook):

No. No. I don't know anyone that does. I don't like the idea of those two things touching—
there's a gap—when it comes to my Facebook. (Participant 1)

Hell, no. Facebook isn't a very good tool for demonstrating anything other than three lines of
texts. The sooner we can get out of there the better. (Participant 3)

The final topic of the discussion was on tools which were unsuccessful when trialled with clients. There was a great many tools discussed, including Trello, Basecamp, Google Docs, GoToMeeting and Google Hangouts. The primary issue when discussing these tools, is the difficulty in teaching clients how to use the software, and that often because there is no common understanding of how to use the system (as opposed to Email), the system will become disorganised:

The biggest failure we had was probably with Basecamp, and it was—naming things is hard.
When you get an email on the Basecamp, guess what it gets as a name? Forward colon—like
some random name, or like someone attaches a file, you are never going to—any sort of
volume on a project like that in Basecamp, we had 15, 20 things with indecipherable names.
Now you can try to find a screenshot or some design, and you're clicking through one after
another. I'm never going in there again. Just send me the thing, please. That was a colossal
failure. It does get really out of control really quickly. (Participant 3)

4.3.4 Complexity with web design

While the previous podcasts focused on communication with clients specifically, this podcast focuses more on an holistic view of the web design process, including other stakeholders within the web design process.

- *In a client project, what other kind of stakeholders do you communicate with?*

154

When asking the participants what other types of stakeholders do they find important in web design projects, some interesting types of people were mentioned:

> *The finance guy. The food train into the finance guy who signs the check as soon as possible because nothing matters until that guy decides what he wants." "He won't be contacting us. He doesn't care what the end product is, but the one who controls the financial piece is the one we need to talk to because he's got a number in his head already. (Participant 3)*

> *We also might be working out—usually if we're talking to someone, we're going to be talking to someone from marketing. Depending on what industry you're talking about, there's usually some pretty hefty requirements that are going to come in from people who aren't marketing. (Participant 3)*

> *Usually, the person we're talking to isn't going to be across—the person that's reaching out isn't going to be across all of the areas." "Your requirements are going to be a little skewed, and you just need to allow for not having the complete picture yet. (Participant 3)*

This can lead to a number of communication issues, especially when dealing with a separate organisation:

> *I had a [project] where the person I was talking to told me that they needed—the thing needed to have a timeline in it, and that had come down from above them. Pretty much everyone on the way had a different version of what that word meant, like it was just—so I was getting from them what they thought a timeline was, and then I'll hit that, and then they were like, "Yes, you've completed the goal of doing the timeline. We're going to show that to people above." We had a meeting that like, "Where's the timeline?" We showed them the timeline, and they'd be like, "No, no, no. This thing?" Then they kind of win again, and there was another timeline. Now this thing has like four or five timelines in their project. (Participant 1)*

> *All the knowledge gap comes back into an email as well because sometimes you get an email from someone that you've sort of had an conversation with before you know they're involved in the project, but not really with you directly. Then you'll get some piece of feedback, and you just look at it sideways for a while and you go, "Do I engage with this person, or should I just*

go back to the person that I've been talking to because this is like so far on another planet
that we don't know if we just let it go or just try to keep it with that one." (Participant 3)

The discussion moved to a major difficulty with client work is taking over projects, or doing project handover. The lack of documentation was noted as a serious problem during this process, and often the work would be restarted due to a lack of insight into the current state of the process:

I found that if you do any sort of changeover in the middle of a [project], you're in a bad spot
because even if you go back to the designs and you go—the designs aren't going to be
matching up at all with what we've created at this point because they were created way
before. There's very little that you can point to and say, "This is the truth." It's really hard to
capture enough information to convey it. (Participant 3)

4.3.5 Podcast Findings and reflections

A number of requirements emerged from the podcast study, from insights provided by the participants:

•   Late joining of projects by both clients and designers was a common aspect of the communication process. Currently, tools do not handle this effectively, with manual transition being required;

•   Bridging the knowledge gap between designers and clients (bi-directionally) is a core requirement that communication tools must support.

•   Separation of public and personal communication is a large concern of designers and clients, especially when considering tools more suited to public discussion such as Facebook or Twitter.

The podcast study was an attempt to adapt traditional focus group and interview methods to a method that was more informal and relatable to the user group being studied (web designers). Data is collected through the activity itself (recording the podcast), and the discussion is evaluated through the editing approach. The method is designed to gather rich qualitative feedback, rather than facts about the industry.

4.4 - Current Tools for supporting Designer-Client Communication

An important aspect of this research is to investigate and understand the diverse types of solutions that are either designed to support designer-client communication, or have been adapted by web designers to support their work in practice. A quantitative study was conducted to examine the current range of digital applications and services (tools) that focus on supporting business communication. The purpose of this tool investigation is to understand the direction and focus of existing communication tools, to identify what features they provided, and to discover how they integrated into designer-client communication. The study was conducted in two iterations, with the initial study conducted in 2010 and iterated upon in 2014. Digital communication tools range from traditional and universally used methods (e.g. Email and Phone), to newer popular tools (e.g. Skype, Google Docs), to more modern and tailored tools to support remote cooperation (e.g. Basecamp, Slack).

A total of 153 communication tools were identified and examined. The analysis of tools in this study was adapted from the classification system provided by Penichet et. al. (2007). It is important to note that this study is focused on digital technologies and tools - rather than design tools such as brainstorming or physical prototyping. While these techniques are common and well utilised within designer-client communication, this study is focused on tools that are primarily used to support communication outside these face-to-face collaborative tasks.

Penichet et. al. (2007) builds upon the traditional CSCW time/space matrix presented by Johansen (1988), which measures collaborative tools by their time and location, combined with the methods of cooperation that they support: coordination, collaboration and communication. This study, however, also examines their relation to an existing communication ecosystem and how these tools co-exist, integrate with or replace other forms of communication commonly used within the industry.

The communication tools that were examined were discovered through a variety of methods:

- informal recommendations by web designers,
- web based articles which discuss better support for communication,
- interviews with web developers (see Chapter 4.2), and
- CSCW and Social Software literature.

80 tools provided collaborative functionality (providing shared areas for collaborating around content), 100 provided communication support (both synchronous and asynchronous), and 89 had a focus on the coordination of projects and teams. 58 of tools were required to be deployed within a business, while 118 tools were offered as Software as a Service (SaaS), with some offering support both types of deployment.

4.4.1 Context of use

The space/time matrix (Johansen, 1988) was used to verify that the variety of tools examined was consistent with the focus of this thesis (Figure 19). Although the majority of tools now support both collocated and remote collaboration (through the ubiquity of the internet and mobile computing), the categorisation of space was done based on a judgement of their use case in relation to designer-client communication - rather than technical feasibility. For instance, video conferencing is technically feasible in a collocated manner but does not have a relevant use case in the context of designer-client communication. Same space communication tools received less focus due to the reliance on client/designer interaction within the context of web design. From the study, it can be seen that the majority of tools available to support client designer communication are focused on asynchronous communication. The majority of tools focus on supporting remote communication rather than on collocated working. This is understandable as communication breakdowns most often occur remotely. Although the time/space matrix is not as relevant as it was during the earlier days of computer science (due to the ubiquity of the internet), it does assist in representing how tools are intended to be used.
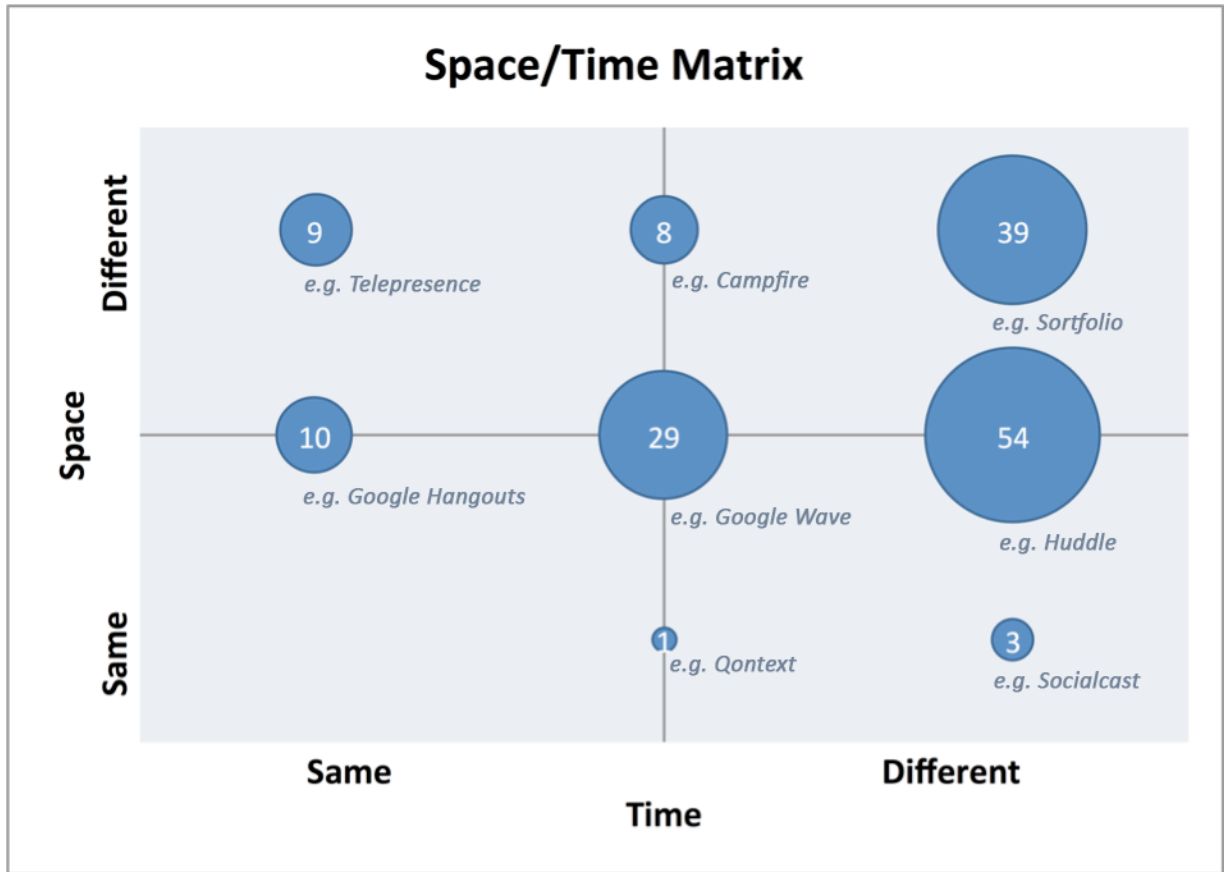
Figure 19: Space/time matrix categorisation of tools explored

4.4.2 Focus of the tools

Each communication tool was given a single keyword to describe its primary focus. The majority of tools examined focused on supporting conversations between workers and providing organisational support (Figure 20). The study does not attempt to cover every tool available to support this work; however, it does represent the range of popular tools marketed towards supporting designers in their work.
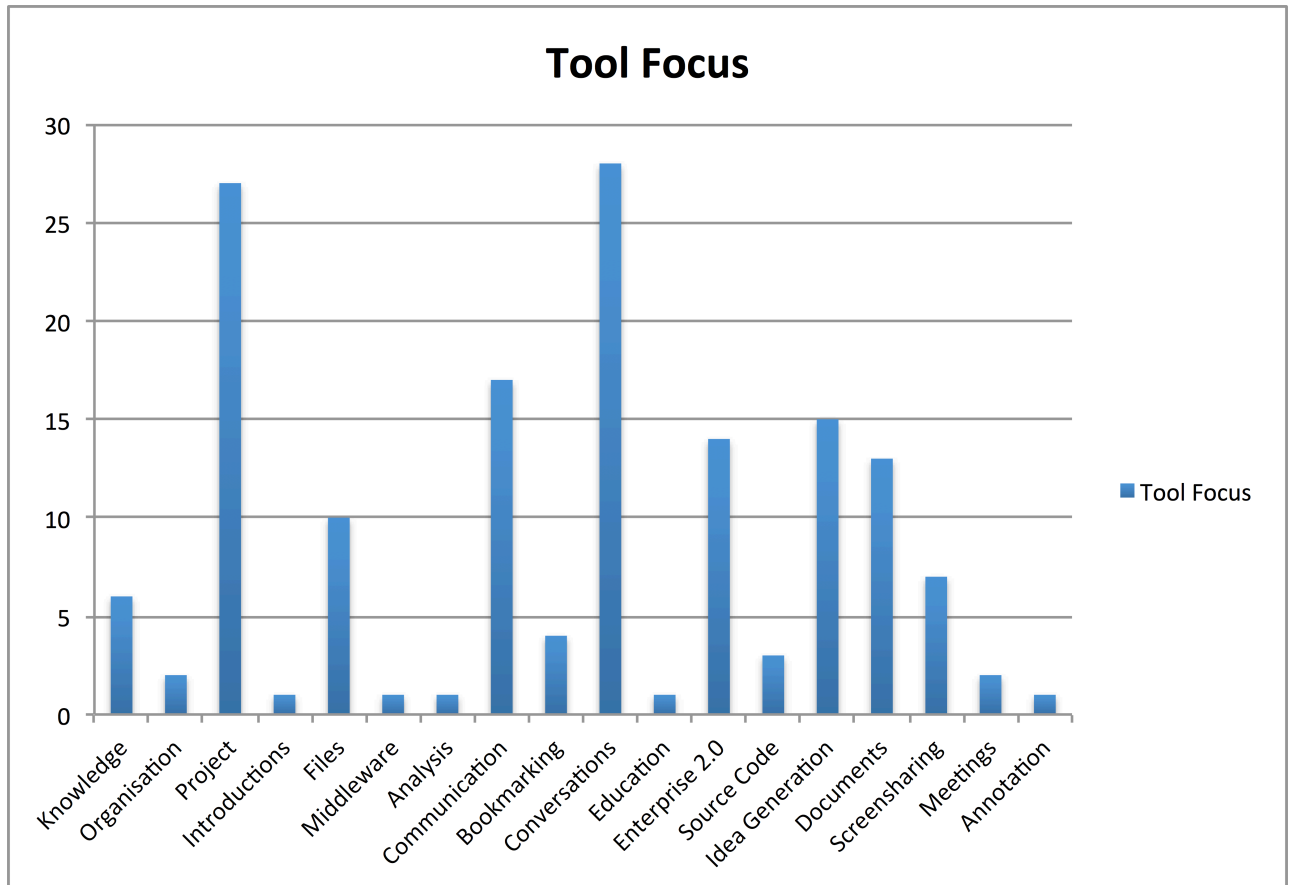
Figure 20: Primary focus of existing communication tools

4.4.3 Tool classification

Using the Penichet et. al. (2007) method of categorisation, each tool was given a code (in the form Letter-Number). This categorises the tool based on its time/space matrix position, as well as its focus on supporting collaboration, communication and/or coordination (Table 5). Table 6 presents all tools and their classifications based on their most relevant use cases within the context of designer-client communication.

Table 5: Penichet et. al. classification key

Key	Value
1	No time, different space
2	No time, same space
3	No time, different & same space
4	Different time, no space

5	Different time, different space
6	Different time, same space
7	Different time, different & same space
8	Same time, no space
9	Same time, different space
10	Same time, same space
11	Same time, different & same space
12	Same & different time, no space
13	Same & different time, different space
14	Same & different time, same space
15	Same & different time, different & same space
A	Coordination
B	Communication
C	Coordination & Communication
D	Collaboration
E	Collaboration & Coordination
F	Collaboration & Communication
G	Collaboration, Coordination & Communication

Table 6: Penichet et. al. classification key of explored communication tools

	A	B	C	D	E	F	G
01	0	0	0	0	0	0	0
02	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0
04	0	0	0	0	0	0	0
05	**10**	4	**13**	4	3	3	2
06	0	0	2	0	0	0	1
07	**7**	4	**12**	**15**	**8**	1	**7**
08	0	0	0	0	0	0	0
09	0	0	0	1	0	**7**	1
10	0	0	0	0	0	0	0

11	0	6	0	0	0	4	0
12	0	0	0	0	0	0	0
13	0	2	1	0	0	4	1
14	0	0	0	0	0	1	0
15	1	1	**10**	3	1	4	**9**

The most common categories of the tools found in this study were:

A-05: Coordination - Different time/different space
These tools focus on organising client information to provide designers with information related to their clients and projects, including contact, milestone and meeting information. Notable tools include Google Calendar and 37 Signals Backpack.

C-05: Communication & Coordination - Different time/different space
These tools focus on project organisation as well as providing a narrative of communication and are more likely to provide two-way integration with other services such as Email and Google Docs. C-05 tools do not focus on direct collaboration; rather they create a shared space where assets and communication is stored. Notable tools in this category include Basecamp and OneHub.

C-07: Communication & Coordination - Different time/all spaces
These tools are similar to feed driven social software such as Facebook and Twitter by providing a service where designers and clients can communicate and coordinate meetings. The difference with these services compared with C-05 is that they are more likely to be used within the same space as ways to send information while being collocated due to their immediate and shortened nature. Notable tools include Ning and Yammer.

C-15: Communication & Coordination - All times/spaces
These tools may provide some level of collaboration, but they primarily provide a space for designers and clients to communicate and coordinate activities. These

services are more focused on either communication or coordination, and focus on acting as the only method of their respective focus. Notable tools include Slack and Beehive.

D-07: Collaboration - Different time/all spaces

This category of tools is focused more on providing an area where users can work on creating and editing during different times. The aim of these tools is to provide an area where users collectively create and edit content and assets relevant to the project. Notable tools include MediaWiki and Confluence.

E-07: Collaboration & Coordination - Different time/all spaces

These tools do not provide direct methods of communication, but they instead provide methods of adding and annotating information and assets related to the project. Notable tools include Jira and Dropbox. Dropbox is an example of a service that may not immediately appear as a method of coordination, its ability to provide notification in use serves as a method of awareness to provide a level of implicit coordination; however, does not allow real-time collaboration.

F-09: Collaboration & Communication - Same time/different space

These tools are focused on providing real-time interaction between users in different locations, most commonly video conferencing or screen sharing. The most notable tools were Telepresence and GoToMeeting.

G-07: Collaboration, Communication & Coordination - Different time/all spaces

These tools provide a platform that provides a wide variety of communication, collaboration and coordination support for designer-client interaction. These tools are built assuming that the collaboration will be conducted at different times rather than real-time. Notable tools include GitHub and GoVisually. GitHub in particular is a simple platform that over time has been extended to support awareness between users and discussion forums around artefacts to discuss features and other aspects of projects.

G-15: Collaboration, Communication & Coordination - All times/spaces

These tools aim to provide a centralised platform to support all aspects of remote and collocated project work, including many forms of communication channels within a single package. G-15 tools are primarily focused on enterprise where the majority of users are within the same organisation, rather than small businesses with a large number of external collaborators. However, these tools were included in the study as they have some traction within larger web design businesses with longer client relationships (where clients may be specifically trained in their use). These tools provide two-way integration with tools such as Email but favour users working within the ecosystem. Notable tools include Open Atrium, Novel Vibe (formally Pulse) and SalesForce Chatter.

As with Penichet et. al.'s (2007) findings, the most common categories were using odd time-space patterns (05, 07 etc.), which is the most common form in CSCW applications. Unlike their findings, however, few of the tools in the study were within the B category, which include commonly used tools such as Email and Instant Messaging (IM). While this does not necessarily highlight a lack of tools similar to the traditional methods of digital communication, it does imply that the tools discovered in the study provide either different or additional functionality to tools such as Email and IM. There were a number of tools available specifically designed to support this context; however they attempt to compete with each other at a feature level. Some tools (Wave and Slack) provide new insights to the future of communication tools; however, they are designed primarily for internal business use and are less considerate of cross-organisation communication.

4.4.4 API Support

This analysis also examined how common it was for these collaborative tools to provide Application Programming Interfaces (APIs) to allow designers and developers to extend the functionality to serve their needs. APIs do not provide direct integration with other tools; however, they do enable developers to create this functionality. Out of the 153 tools that were examined, 71% provided some form of API to extend or adapt the service. Although it's not possible to know how widely

these APIs are used for each of the services, their availability suggests that there is the potential of developer communities for many of the tools. Most commonly, the API support provided a data representation of the information within the tools, lending both read and write support through the REST (Representational State Transfer) protocol (Fielding & Taylor, 2002).

4.4.5 Integration with other communication methods

An important aspect of this tool analysis was to explore how these tools integrated with other existing forms of communication and collaboration. Of the 153 tools, 89 tools provided any integration with existing communication tools. This integration was often not automated, requiring manual intervention (such as cc'ing an automated email account). Integration with Email and Microsoft Office products was the most common form of building on other applications (Figure 21). An observation on this aspect of the tools was that most integration was made available after the tool was released which suggests that much of this integration may have been done based on user feedback and market needs.
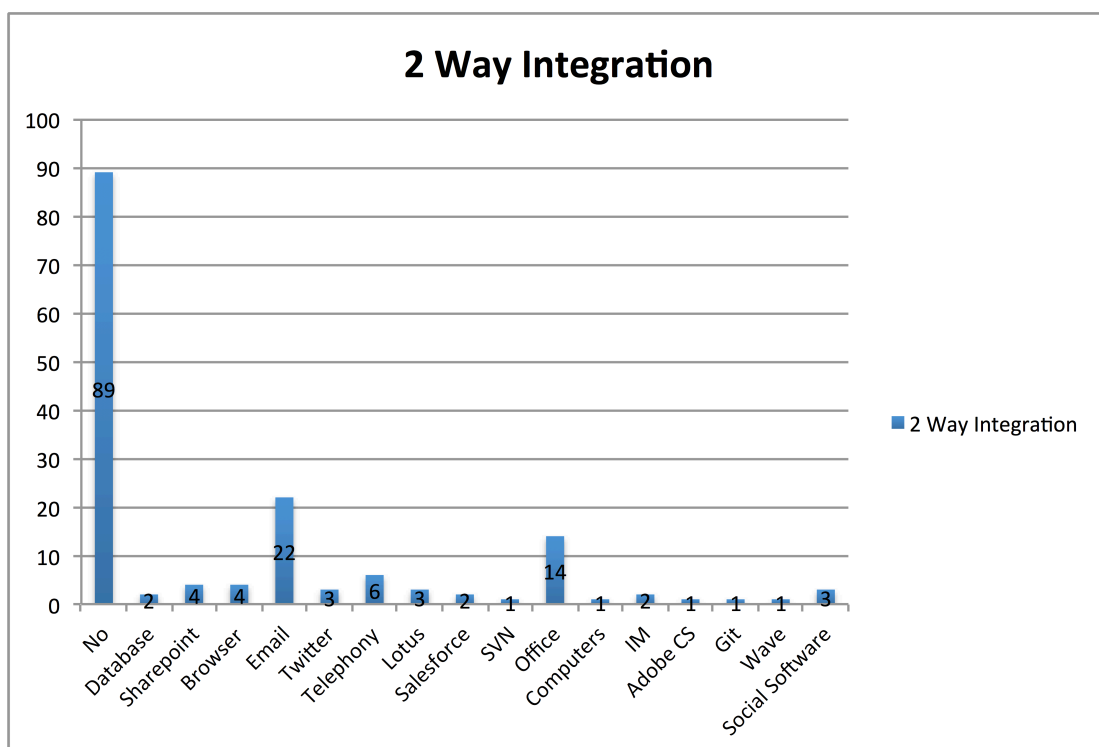
Figure 21: Two-way integration with other communication tools

It is important to note that this integration does not include file-sharing services such as Dropbox, which have become increasingly popular as a way to integrate file synchronisation into communication tools. These services have become well integrated due to limitations surrounding mobile platforms; however, this tool analysis study is not focused on the transfer between desktop, web and mobile platforms.

4.4.6 Notable features

Throughout this tool analysis there were a number of features that were targeted specifically towards the challenges that designers and clients face in communication:

Focus on Email notification - Most tools support some integration with Email, however the primary use of Email is to notify users when they should revisit the service, rather than using Email as a way to interact with the service. This leads to two problems: firstly the users Email is overloaded with a number of notifications, and secondly the user is required to open the service to understand the context in which the notification was sent. This use (or misuse) of Email also promotes the idea that the service is not worth visiting unless they receive an Email. Communication tools need to tailor email notificiations in a manner that works for the user, rather than being too disruptive, or alternatively, not being disruptive enough (leading to lost communication).

Targeted API design - Although many tools provide API support, the design of the APIs is targeted towards a specific type of use, rather than being a broad API that can provide creative integration. Some aspects of the data (such as user information) is limited by the API, and it requires the user to use the service to manually retrieve this information.

Isolation of communication tools - In categorising tools into Penichet et. al.'s (2007) classification system, tools that support coordination and communication (B) and tools that support collaboration and communication (F) are less common than other forms of Groupware. This implies that tools that provide either collaboration or

coordination assume that users already have in place means for communication. However, these collaboration and coordination tools do not leverage and integrate with existing communication channels.

Desktop and mobile support - This study was conducted over a significant amount of time (over 3 years), and during the study there was a strong shift from web-only services to ones that provide either desktop or mobile interfaces. This shift may be due to the easing development requirements of the systems, however this may also be an approach to notify users of updated content in these systems. Users who have either desktop or mobile applications can be notified more easily, and they may access the service faster than navigating to the website.

Shallow two-way integration - Some tools that were studied allow for two-way integration with other services, in particular with services such as Email (and more specifically with systems such as Dropbox). However, this integration does not leverage the capabilities of the service that it integrates with, and in particular does not leverage the knowledge that already exists in the tool. For example, some other kinds of services such as Tripit, will watch a user's Email for airline or hotel bookings, and automatically incorporate this data into their systems.

For more information regarding the tools that were analysed, refer to Appendix 1: Review of Existing Designer-Client Communication Tools.

Chapter 4.5 - Analysis of Current Tools and Methods to support Designer-Client Communication

From the studies conducted throughout Chapter 3 and Chapter 4, a number of themes emerged related to the current tools that are available to support designer-client communication.

Integration Issues

While these tools do integrate with other tools, their integration may have unintended consequences. During a discussion with a project manager on a web project, the manager mentioned a side effect of the Basecamp technology and its integration with Email:

> *The team decided to use Basecamp primarily because it was an all-encompassing tool to support projects - task and event management, centralised storage of information and collaboration. Not everyone engaged with Basecamp but, for those who did, engagement fairly quickly waned. Basecamp used email to keep people informed of what information in Basecamp had been changed and to remind people of tasks and events.*

> *At this point in time, the project was going through a relatively high activity period. Therefore, the information stored in Basecamp was changing rapidly. The initial settings for these notifications together with level of project activity meant that project team members received quite a large number of emails generated by Basecamp. After a few weeks, the team indicated that they felt inundated by these emails and started treating them as if they were spam - either ignoring or deleting the emails without reading them. I pointed out that they could adjust settings in Basecamp to reduce the amount of emails they received by opting for either a daily or weekly digest; however, no-one opted to do this. They simply stopped engaging with Basecamp. Some indicated that it was an additional task that was outside of how they normally managed information. They preferred using email and meetings for communication and Dropbox for storage of information, as it was part of their 'normal' practice.*

> *To some extent this then caused me, as project manager, to adjust the way I used Basecamp. I stopped assigning tasks to people and reduced my general usage of Basecamp*

so as not to cause emails to be generated, and adjusted how I worked to fit in with team members' normal practice.

It seemed that the initial experience of feeling inundated by emails had caused people to form an opinion that Basecamp was annoying and a burden. This perception was added to by the fact that Basecamp was something additional to the tools team members were already using as part of their normal routine. (Project Manager)

This is an example that illustrates while technologies can build on top of existing communication channels, they should be aware of the nature of the communication, and provide users with easy ways to manage their integration. While Basecamp does provide Email integration, it does not act in a manner suited to the communication technique, which presented the service as an additional hurdle for members of the project.

The perception of Email and Skype

Within the research and tool building communities, Email is considered a legacy tool, which has become out-dated in its use for supporting rich communication (Johri, 2011). Many of the tools that were analysed focused on being a viable alternative to Email, stating that many of the issues related to supporting collaboration. However throughout the interviews Email was described as the backbone of client designer communication, and, in fact, most stated how effective the tool was in supporting web design work. While designers have issues with Email as a technology, its ubiquity and flexibility in terms of communication makes it a vital aspect of the communication process. This flexibility has allowed designers to communicate in ways not originally envisioned in the concept of Email (such as transferring rich media assets), and the limitations with Email are minor compared with its *ad hoc* use. In particular, designers who had tried actively to replace Email with other communication technologies had more appreciation towards Email. Similarly, Skype was discussed as a technology that was not particularly suited to designer-client communication but one that was regarded as effective in communicating with clients. In particular, designers stated that their clients were likely to have Skype, and it

provided a good middle ground between sending an Email and having a face-to-face meeting.

Client Initiated Communication Methods

In some occasions, the client proposed new methods and technologies for supporting both collaboration and communication. In one instance, the client was already familiar with Zoho Office (a collaborative document editor), and asked the designer if they could use it. The designer agreed to use Zoho office, and while not familiar with its use, felt it was the best choice because the client was already adept at its use.

Building of the narrative

One observation throughout this study was the lack of tools that heavily build upon the existing ecosystem of commonly used communication methods. Commonly, tools that support communication advertise themselves as alternatives to traditional tools, but they do not offer direct integration with the services that they replace. Thus in terms of capturing the entire communication narrative, designers are required to train users to use unfamiliar communication tools and, where need-be, manually copy information that bypasses the tool into it directly.

Additionally, communication support tools rarely provide a long-term visualisation of the entire communication narrative, instead focusing on the moment-to-moment communication. Narrative visualisations are offered mostly by tools that focus more on project coordination; however, these focus on the coordination of the project rather than the communication and are structured around milestones and meetings rather than communication.

Ubiquity and ease of adoption

An important aspect for the usefulness of these tools is to examine the ease of use of adoption and how in use these tools are in everyday life. As an example, Skype is a relatively modern tool that has become commonly used for designer-client communication. Although the use of Skype in this context is reasonably new, as a

tool within everyday life it has become popular, so it is more likely that clients already use Skype, and if not, have an understanding of its use. In addition, Skype does not solely act as a replacement of an existing form of communication, and is not initially adopted as a direct replacement for traditional phone calls. Rather it is also a new method of communication (video conferencing) which had not previously been well established outside of the enterprise environment. If a client wants to engage with the designer through synchronous communication, they can either use the traditional method (phone calls or face to face meetings) or Skype. When choosing Skype, there are a multitude of benefits for the client: seeing the availability of the designer, being able to text before calling, being able to videoconference or share their screen. In addition, clients may find Skype a more preferable solution, as access to the designer may be more efficient for the client than finding the phone number of the designer and calling.

This does not imply that new tools that are less well known than Skype are not relevant for designer-client communication. Rather these tools need to provide a compelling reason for their use to the designer in a way that the designer can then justify their use to the client. In addition, Skype does not remove the issue of having yet another communication tool (in fact, the API provided by Skype is quite limited in accessing archival information).

Platform support

An interesting observation over the length of this three-year study was the recent rise of the mobile platform and support of this new medium by communication tools. The majority of tools in the study now provide some level of mobile support; however, the user experience is often a replication of the desktop computer functionality. This is a pattern that is common across all forms of services. Communication tools in particular can benefit from providing a mobile friendly user experience for users. A good example of a customised mobile experience is Basecamp by 37 Signals, which provides a native application that primarily focuses on two aspects: a quick overview of the progress of the project and being able to find information efficiently (Figure 22). In discussions with designers, they stated that while mobile was not a priority to

communicate with clients; they still needed quick access to information when required.
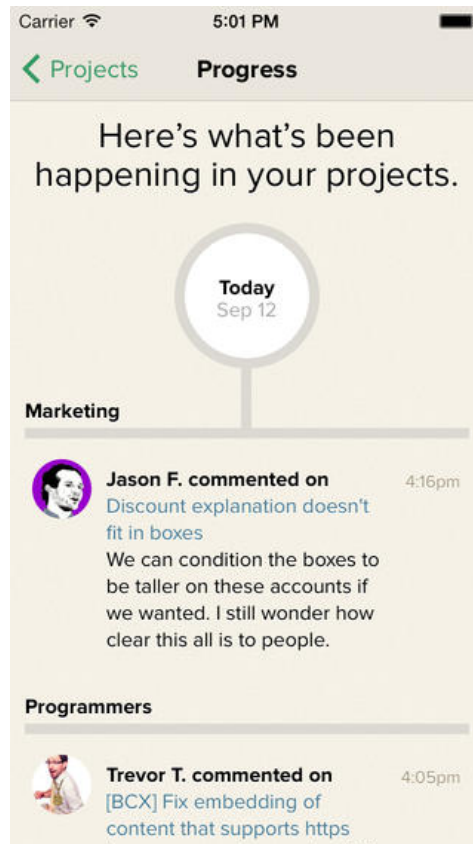
Figure 22: Basecamp mobile progress interface

Support for working media

The nature of web design work relies on a number of rich media file types that require specialised tools. These kinds of files include graphics (Adobe Photoshop and Illustrator files), source code files (including HTML, CSS and JavaScript), as well as document formats (such as Microsoft Word and Excel documents). During this study there were few tools that recognised these file formats in a way that allowed designers immediate interaction with these document types. Tools that did provide the sharing of files for the most part did not provide contextual editing or annotation functionality to these tools. Many of the tools did not offer previews and provided less functionality compared with Email management tools that provided previews of attachments. Instead, designers were required to collaborate with users around exported versions of these documents (most commonly images and PDF files). This creates disconnect between the source file and the exported output file. This has

172

some benefits, as designers have complete control over their working files. However, in practice this means that the designer must manually compare the exported file with the working file to examine the annotations provided.

Some tools that did provide this functionality included Redpen (which allowed clients to annotate Photoshop documents directly), and GitHub (which allows users to comment on specific aspects of source code from a power users perspective). GitHub in particular, allows an effective transition between client feedback and working files. Designers can update files that users have commented on, and then reply to the comments directly within the service. These comments are then emailed to the user directly, so they have immediate awareness of changes based on their feedback. This form of integration has many benefits in keeping the client aware of progress. However, some designers commented that providing clients with direct access to GitHub occasionally led to confusion and miscommunication.

Long term support, changes over time
During the initial time of the study, 122 tools were examined and categorised. During the second iteration of the study, an additional 33 tools were added to the study. However, many of these 122 tools changed which category they represented over time.

A number of tools (such as Google Wave) were no longer operational, which presents concerns with designers investing their communication structure into services that are operated as businesses. In comparison, traditional methods of communication such as Email and IRC are independent of a single infrastructure; many of these services (along with all communication data) are entirely controlled by the company that creates the service. In the Google Wave example, the service was not shut down due to unfortunate circumstances of the company, but rather the company simply changing its focus.

To assist users in the shut down of the service, Google allowed users to capture all of their information, as well as provided an open source version of the service so that

users could continue to use it if they chose to. In contrast, some other tools that had shut down during the study did not provide this service. Providing archival services can be beneficial to designers when choosing long-term technologies that run independently of a single operator - as well as for designers to consider and investigate how their data can be archived if the service is to shut down in the future.

The disconnect between internal and designer/client communication tools
A number of the evaluated tools were discovered through designers who employ these tools to assist in communicating with clients. Throughout this thesis project, I continued to discuss with the designers who participated in the interviews (Section 4.2) over time how they used and tried new tools in their practice, any benefits that they found from these tools, and some of the limitations which they had encountered. As an example, one designer discussed their use of Asana:

> *We track everything that is being done and all of our future tasks in Asana. As a team we try to work asynchronously so we try to keep a lot of our communication on the tasks in Asana, which helps to enable remote work. Its notification system is the best I've used for getting a live stream of what's currently going on and being able to jump in to tasks / conversations when it matters. (Client A)*

And also with regards to client communication within Asana:

> *We're experimenting with it. Where we've invited other stakeholders the feelings are quite positive about the transparency of work going on. We have mixed feelings about projecting our system onto people who shouldn't really have to deal with it and even mixed feelings about clients creating tasks in the system because we follow some pretty strict processes on how tasks should be described and where they should be put. (Client A)*

When inquiring how clients communicate with the designers:

> *Primarily whatever tools they are familiar with - so email, phone, maybe Skype. (Client A)*

Another design firm tried a number of tools for improving the documentation process and client communication:

In terms of tools we've used Basecamp and Confluence the most, Confluence is great for internal use, especially documentation (both dev features and client communications). Basecamp's biggest problem is managing communications; the threads just blow out and quickly become useless in terms of finding stuff from the past. (Client B)

The designer suggested that Confluence seems interesting from a client communication perspective, but it had a number of issues:

Because of Confluence's licensing, it's really setup as an internal communication tool more than anything. Each user takes up a spot in your license. It might work for clients, but it would depend on the client, the more switched on client, yes. The less technical client that has hard enough time with email, probably not. (Client B)

When asking how client communication gets inserted into the Confluence system:

What is supposed to happen is the AM [account manager] is supposed to take out the important parts and put it into something that makes sense for us, and put it into a checklist…the email remains, Confluence is more for an AM to allocate feedback or tasks to us. (Client B)

Another client discussed during their first client trial using Basecamp to manage client communication:

I'm attempting the first time with Basecamp, but separating some parts for only internal use and others for the clients - and I still talk by phone and email with the clients. The motivator for Basecamp is to trial it for use with all clients, its still not the best approach. It's not versatile, surprisingly pragmatic but still very limited compared to email. However, I will still use Basecamp for keeping track of the project, but just internally. The best thing about email is I can use it as a current and historical catalogue, I run everything through rules for each client. Extremely powerful because it goes back to 2006. (Client C)

Although designers experiment with giving clients access to internal communication tools, they are wary of the issues it can cause. However, the designers can see the potential benefits of tools that combine both internal and client communication (thus

their experimentation). Unfortunately, and most commonly, the method in which client communication is collected into the internal web design firms knowledge base is through manual entry by the designers. Communication tools need to provide users with a way to thoroughly browse through previous messages, to find important information within the context of the larger conversation.

4.6 - Tools: Conclusions

This chapter focuses on the current state of tools to support designer-client communication, to understand which tools are available to support the web design context, how they are used in practice and what limitations designers encounter with them. This study of tools is done by first categorising the range of tools which are available, to consider their suitability to support the web design context. Secondly, I present an interview study and a podcast study, both of which seek to understand through stories how these communication tools work in practice as well as their limitations. I then provide an analysis based on the results of these studies, to qualify the state of these tools and the issues that are present in existing tools.

Although there is a diverse set of tools available to support designer-client communication, they primarily focus either on ways to replace existing systems of communication or methods to organise project information. There are a number of concerns with adopting new tools into their communication process primarily based on the limitations of existing tools which they have experimented with:

- How easy is it to transfer existing knowledge into the tool?
- What are the beneficial functions that make communicating with clients more effective?
- How easy can clients adopt the tool?
- How easy is it to train the clients in its use?
- How well does it work when clients use other methods of communication in the moment (integration with other tools)?
- How is information exported and archived from the tool?
- How does the tool support rich media and source file assets?
- Does it provide methods of annotation or commenting on assets?
- How does it provide real-time or asynchronous interaction?
- Is it focused on supporting in the moment communication, a project lifecycle or organisational knowledge (what is the context of use)?

- Does it provide APIs that can extend the functionality of the tool?
- How does it contribute to understanding the narrative of the project?
- How does it support both internal communication and client communication?

Through these interview and podcast studies I found that although there are a wide range of experiences from people on tools which resulted in successes and failures to support designer-client communication, there are a range of situations when communicating with clients that could currently be better supported by technology. CMC tools have many features which are greatly beneficial for supporting designer-client communication within the web design context. However, the features and benefits of these tools are less important in practice than their degree of integration with the existing communication ecosystem, especially with the familiarity of the communication methods for the client.

Although designers experiment with providing access to internal tools for clients, designers most commonly rely on manual input to connect client communication with internal organisational systems. In addition, the adoption of these tools is a major consideration, especially with the understanding that designers are the primary agents when getting clients to use the technologies as well as providing support for the tools. An interesting finding during these studies was that clients themselves also offer suggestions for methods of communication that they are already familiar with. Although these tools may not be the best tools to support the task at hand, the client's familiarity with the tool may make it beneficial over other methods of communication.

Chapter 5 – Challenges: Creating new tools to support Designer-Client Communication

5.1 - Introduction

The analysis of the current state of CMC tools to support designer-client communication that was conducted in Chapters 3 and 4 identifies a number of limitations that affect the success or failure of designer-client communication and the mediums that they use. This chapter investigates the challenges that designers face when designing new tools to support designer-client communication within the web design context. Based on the findings (Chapter 3 and Chapter 4), this chapter identifies a number of challenges that communication tools have to overcome to be adopted by web designers to support client communication. Based on these challenges, I investigate in detail how the adoption process of new tools takes place within design firms and ways in which these tools can be better considered and positioned to be adopted by web designers. The focus of this Chapter is to highlight the issues associated with adopting a newly designed method of communication into a pre-existing ecosystem of communication and the considerations of tool adoption by both designers and clients.

5.2 - Breakdown of Challenges in Current Tools

Although on occasion new communication tools are introduced by the client (such as in Section 3.6), the web design firm is better positioned to suggest to the client communication technologies to support the project. They will make these suggestions based on their own analysis of the client's technical competencies and environment. In Chapter 3 and Chapter 4, a number of challenges were discovered in communication tools being adopted within web design firms:

Competing with existing methods of communication:
An important finding of Chapter 3 was that designers do not consider Email a bad communication technology for client communication; instead it offers them a wide variety of flexibility in how they communicate with clients. Many of the communication-centric tools that were identified in Chapter 4.4 focused on similar methods of communication to Email, but offer more features and project management integration. The challenge for tools that seek to replace staple methods of communication such as Email are much greater than those that offer new functionality not core to existing tools. For example, Dropbox has similar functionality to Email in terms of providing ways to share documents; however, it focuses solely on document sharing, and does so in a way which bypasses the existing Email limitations. Dropbox also provides a way to hyperlink to uploaded files, allowing designers to include Dropbox links directly into emails where it is appropriate. In this sense, Dropbox may co-exist and improve Email, rather than requiring the user to replace Email immediately.

Seamless adoption:
As observed and discovered in Chapter 4, designers are wary of new and unpopularised methods of communication, preferring methods that are already in universal use as generalised communication tools. There are two reasons that this may be the case. Firstly based on the interviews and podcasts in Chapter 4.3 and 4.4, designers often experiment with new methods of communication and during this

will often use traditional methods of communication out of frustration when the technology fails. Another possible reason that they may be wary is that by overloading the client with more methods of communication, the narrative of the communication may be further segmented, which may prove problematic in the later parts of the design process.

As opposed to developing new methods of communication, many of the limitations of adoption and ready-to-hand issues with new technologies can be negated by integrating on top of existing methods of communications. VideoThreads (Barksdale, Inkpen, Czerwinski, Hoff, Johns, Roseway & Venolia, 2012) is a system whereby asynchronous video messages can be shared between team members across locations. From their study, their first recommendation was that these systems are best when integrated into existing methods of communication. "Not surprisingly, most of our participants wanted VideoThreads integrated into their email tool. They wanted to be able to leverage the address book and email notifications...Providing access anytime and anywhere was also important to participants. They wanted more anytime access to the tool." (Barksdale et. al., 2012)

Based on the Penichet et. al. (2007) categorisation method, Chapter 4.4 lists and analyses the tools that support designer-client communication. Many of these tools were considered to be in the same category as each other and, for the most part, offered a higher level of functionality (in terms of supporting communication, coordination and collaboration) than the universal tools that designers commonly use (as seen in Chapter 4.2). However, these tools are not already adopted, requiring designer's to train client's in their use.

Providing project insight:
Many of the tools that were discovered in Chapter 4 focused on providing ways to manage both the design process, and ways where clients and other stakeholders were giving awareness of the progress, and well as comment on certain aspects of the design. These tools (such as Basecamp and Asana) provide a number of features to manage web design projects, including task lists, calendars, bug

reporting and contact information for stakeholders within the project. Additionally many of them provide the ability to ingest information from a specified email address and also offer email digests to be sent for each activity. However, as discovered in Chapter 3, although many design firms evaluate these systems and quite often use them internally, functionality that enables client interaction is for the most part unused. Primarily this is because clients have pre-existing methods of communication that they are familiar with, and will most often communicate through those channels.

Support to documenting and search the narrative:

Apart from providing ways to interact with clients, communication tools within web design also act as an informal method of documenting the design process. Communication tools such as Email (and to a lesser extent Skype) create an archive of communication that has happened throughout the design process. Designers in turn, often refer to this narrative of communication by searching through previous messages, appointments and notifications, in particular to find key pieces of information and to reflect on prior communication with the client.

Support for knowledge transfer and awareness:

A major challenge of new tools is the ways in which they can support knowledge transfer and awareness between designers and clients. One of the biggest concerns that designers discussed with regards to Email is the problem associated with its explicit messaging support, where each individual has to be explicitly sent messages. Although Email provides some functionality to support this (reply-all), designers mentioned that clients were notorious for replying directly rather than to the group. New tools need to provide ways where all members' part of the design process can be messaged simultaneously, while not significantly affecting the signal to noise ratio of the communication narrative. As an example, Basecamp provides quick methods to contact all stakeholders easily; however, it increases the noise in the narrative (as mentioned within the interviews). Additionally new tools need to provide a way in which past messages and the narrative can be easily shared with other designers. This is done poorly by existing methods of communication, with

Skype being unable to seamlessly record conversations, and Email requiring manual sending of each message through forwarding functionality.

Support for both internal and external communication:
Although designers use a variety of communication and collaboration tools for internal use, these tools were not widely used for external communication with clients. However, of all the tools discussed by the designers (Chapter 4.2 and 4.3), tools that were in use for working with clients were those that were also in use internally. Many of the newer tools such as Dropbox and Skype were used internally as informal methods of communication prior to being used for communicating with clients. This brings to light a potential challenge where tools that provide designer-client communication should also be usable internally without client communication.

It is unknown how important this challenge is to address for every tool, however it may be beneficial for tools to provide internal communication support, so that the adoption within the design firm is done prior to dealing with client communication. Examining the tools that were trialled with client communication, in particular Basecamp, provides a strong level of internal communication support for designers.

Support for rich media:
Web design is a field that utilises many forms of digital media, in particular images, documents of website content and source code, as well as more recently mobile applications and video files. Currently the tools that designers use to communicate with clients are flexible in the types of media that they deal with; however, they are limited in the functionality they provide for these types of media. New communication tools need to provide the ability to share, organise, document and communicate around these kinds of media, as well as provide ways in which designers and clients can view, annotate and comment directly and contextually with the content.

5.3 – Requirements and Challenges for Designing New Communication Tools for Web Design

Throughout the investigations in Chapters 3 and 4, a number of requirements have been identified for tools to support designer-client communication:

1. Design without critical mass (Section 3.4)
2. Supporting the change and evolution of roles (Section 3.4 and 3.5.3)
3. Awareness of communication & inclusion of the right people (Section 3.5.3)
4. Simple on boarding for new users (Section 3.6.2)
5. Separation of private / public conversations (Section 3.6.2 and 4.3)
6. Support multiple communication technologies gracefully (Section 4.2)
7. Correct organisation of messages (Section 4.2)
8. Support ubiquitous communication technologies (Section 4.2)
9. Protective communication routing (Section 4.2)
10. Support for bridging the knowledge gap (Section 4.3)
11. Avoid notification overload (Section 4.4.6)
12. Support for rich media (Section 4.5)
13. Archival and historical catalogue support (Section 4.5)

Based on these requirements, as well as the challenges identified in Chapter 5.2, this section describes a number of challenges that new design tools should address when considering their adoption into the designer-client communication process. These considerations may not be necessary dependent on the type of tool being designed; however, one or more of these will affect how effectively the design firm will adopt new tools.

Pre-existing ubiquity
The primary challenge that designer-client communication tools must address is that they should be already in use by clients in other contexts. That is, the tool should be already familiar to clients prior to the engagement with designers. Tools such as

Skype and Dropbox have achieved this level of ubiquity, which greatly lessens the challenge of being adopted by designers, as they do not require time to train each client in its use.

Being work focused

Many tools that are already in universal use within the general public of Internet users have failed to be adopted by web design firms for communicating with clients. Social software, such as Facebook and Twitter provide effective methods of communication with clients; however, due to their focus on personal conversations and friendships have not been widely adopted by the web design community. This is primarily due to the level of awareness that these tools provide, in that they present themselves as a public forum, which may not be considered appropriate for discussing businesses.

Considering the existing methods of communication

An important factor for designers of new communication tools is that they should have a good knowledge of the existing methods of communication within the designer-client web design context. In particular, the design of the new tool should not simply replace an existing tool with the same limitations but should provide new ways in which designers and clients collaborate, based on limitations with existing systems. For example, there is much interest in improving the existing email user experience to better support how it is used regarding project work (Agrawal, Amrit, Jain, Bansal, & Krishna, 2013). In addition, communication tools should not work in isolation but rather provide mechanisms in which designers can use it in conjunction with other forms of communication.

Providing a compelling reason to adopt the tool

Similar to the challenge of understanding the existing methods of communications, tools to support designer-client communication should provide new functionality that is not effective in existing tools. For example: a tool to assist the client in debugging a problem they are having (in the case of the News Cube example). The current solution was using screen recording software and sending the file. This means that

rather than providing a tool that is more suited to communication for clients, the tool should address a single aspect of communication (such as improving sharing of documents). The new tool should also provide enough benefits for existing issues that designers already work around by adapting existing channels. Alternatively, existing methods of communication can be augmented to provide additional context to the email, such as providing thumbnails of links to videos and other media (Topkara, Pan, Lai, Dirik, Wood, & Boston, 2012), or by notifying users of important emails to help manage signal to noise issues within communication channels (Rector and Hailpern, 2014).

Supporting both internal and external communication

As discovered through Chapters 3 and 4, successful new tools that have been introduced to support designer-client communication should be flexible enough to support both internal (that is communication between designers) and external communication (with clients). This lowers the adoption level within the web design context, as designers can experiment with the communication tool internally prior to asking clients to use a different method of communication than they are used to.

Providing easy ways to document and search the narrative

One primary function which web designers rely on in communication tools is the ability to efficiently and effectively search past communication messages to find specific information. In addition, communication tools should provide a structured and easily understandable representation of past communications, to assist designers in reflecting on the communication narrative.

Providing low-level requirements to seamless adoption

When approaching client adoption, tool designers must be aware of the diverse technical competence level of clients. Many clients are not "tech-savvy" and are not familiar with newer and advanced kinds of interactions (such as language used in collaborative systems such as git). Instead, designers should build upon the mechanisms, language and designs that are already familiar to clients, taking inspiration from existing methods of communication such as Email, Skype and

Facebook, and focusing on core communication. Familiarity is crucial for the adoption of new communication tools, and the use in the way they were intended to. This familiarity is less about specifics (such as the meaning of CC), but rather the nature of the tool in everyday usage.

5.4 - Support for Designer-Client Communication Integration

This section proposes that the concept of two-way integration with existing communication channels may provide many benefits to tools aiming to support designer-client communication within the web design context. The primary challenge for the designers of tools to support designer-client communication is the hurdle of the adoption, both from the designer's perspective and also from the client's. In particular, the communication tool needs to provide an ease of adoption that does not require the designer to train every client in the use of it. Often, designers will wait until tools are in everyday use by the general public before adopting them in their communication with clients. However, there are alternates to lessen the adoption challenge, as in the way of Basecamp, by integrating other forms of communication channels (such as Email) directly into the tool. In this manner, the communication tool does not necessarily have to be adopted by the client. Instead, the client may continue to use the tools that they are familiar with (in the case of Basecamp, Email) while the designer can work with the new tool. Although there are many practical problems with this approach (especially in the way in which Basecamp has its own email account, and can sometimes over-share to the clients), it is a tool which many design firms have tested with clients.

Another common strategy for tool designers is to develop internal tools that can then be selective introduced to clients as the need becomes apparent. Through this strategy, web designers are not required to mentor clients into using the tool until it is required and can be used based on the designer's discretion. The transition from an internal communication tool to an external communication tool is greatly reduced, reducing the challenges of adoption. However, this strategy is limited to a client-by-client basis and can fragment the communication process of a web design firm.

In addition to the challenge of adoption by designers and clients, new communication tools gain opportunities by building on existing methods of communication. In

particular, they gain the information and knowledge which are already contained within these tools and can mine this information to gain a better understanding of the clients, the projects and the collective narrative of the relationships between designers and clients. However, as discovered in Chapter 4.4, few current tools have first-class support for integrating with other forms of communication channels in two directions. Even with tools such as Basecamp, Email integration is poorly implemented, requiring clients to email a specific email address, and other emails direct to the client are lost.

Two-way integration with existing communication tools (considering that the new tool can send and receive information with the existing tool) is technically possible with many of the already in use communication methods (in particular Email, Phone and SMS). However, there are many challenges and considerations that must be taken into account when considering this method for negating issues of adoption. One communication tool that does focus on two-way integration is Slack. Slack provides a number of connections to other forms of communication, and captures their data as group messages within the system. However, while Slack's integration is well executed and easy to setup, it has limited use in the context of designer-client communication, and is instead focused on internal communication.

In addition to the practical considerations, it is important that the use of existing communication channels in sending information does not break from the anticipated use. For instance, Email, Phone and SMS all have a pre-existing understanding in how they should be used. Using these channels too often or in inappropriate ways (such as Email spam) may cause annoyance or distress to the clients, leading to situations such as email overload (Penz et. al., 2013).

5.5 - Challenges: Summary

This chapter outlines the challenges which communication tool designers face when creating tools to support designer-client communication within the web design context. Unlike enterprise systems, the tool designer cannot rely on management to enforce the use of specific tools, and unlike generalised tools they must focus on supporting the context that they are designing for while trying to minimise the challenges of adoption that arise. There are many types of considerations that should be addressed by tool designers when designing for this context, but most importantly the tool should address the challenge of adoption by both designers and clients.

There are a number of strategies to address this adoption challenge, however one effective method is to integrate and build upon existing methods of communication. Using this method, the new tool may provide new kinds of functionality and purpose to designers, while providing clients and other stakeholders who do not use the tools ways in which they can interact with the tool.

There are many considerations which must be given when deciding whether to develop two-way integration with other communication channels, both from a practical perspective (which requires a large amount of work) and a design perspective (new tools should not break the understood best practices for the existing communication channels).

Chapter 6 - enSense: A platform to facilitate the creation of tools to support Designer-Client Communication

6.1 - Introduction

The challenges presented in Chapter 4 highlight limitations in designer-client communication that result from the use of communication tools within the web design context. Chapter 5 highlights the problems associated with developing new tools for the existing web design context - specifically the limitations of integration with the pre-existing set of communication channels.

From the identified challenges, this chapter outlines the design and implementation of a a research prototype: enSense, a web-based middleware system that connects to a number of communication technologies, and then provides a REST (Representational State Transfer) based API to interact with these communications. enSense is not an acronym, but represents a platform that senses communication and engagement between designers and clients. The focus of the enSense platform is to allow creators of designer-client communication tools to effectively design and develop tools that can be adopted into current web design practice without requiring large changes in communication practice. enSense does not aim to be a product; rather, it aims to assist new methods of communication to overcome the challenges that were identified in Chapter 5.

A platform approach is taken in this research, rather than a bottom up tool creation approach, because of the level of complexity of developing tools that integrate on top of existing methods of communication. In the creation of new tools that take this

approach, the majority of the platform would be created each time, and each tool would require a significant amount of resources and configuration. A finding from Chapter 4 was the lack of tool integration, and a possible reason for this is the complexity involved in individual tools providing this integration. An advantage of this approach is that it provides web designers with a method to engage directly in the creative exploration of tool design, rather than acting as users being designed for.

The chapter first outlines the platform design, including the rationale for the design in the context of application design. Based on this design, the architecture of the platform is presented to demonstrate how the platform aims to provide support for developing CMC tools. The architecture is designed from a practical perspective to highlight the issues with integration with other communication channels.

An important aspect of the enSense platform is how communication is modelled. The platform is focused on extending existing communication structures, and this modelling provides a generalised protocol that is appropriate for various forms of communication, regardless of the type of communication. The method designers of CMC tools employ to interact with the platform is through the use of a REST API.

The design of this API is presented in Section 6.5, not only from a technical perspective but also in explaining how such an API is designed. The design of these APIs is of vital importance when creating platforms that other designers and developers can extend. Finally, the implementation and deployment of the enSense platform is explained to demonstrate how such a platform can be deployed for use in the web design industry.

6.2 - Platform Design

The enSense platform aims to be a middleware technology that allows developers and designers of communication tools to leverage the existing knowledge and communication infrastructure from already adopted communication platforms such as Email and Skype. The platform is not designed to be a production quality implementation, but rather a research prototype that enables an iterative and reflective design practice while working with designers and developers. The platform is designed to support the Mashups (Benslimane, Dustdar & Sheth, 2008; Cao, Riche, Wiedenbeck, Burnett & Grigoreanu, 2010) style of application design, where tools build upon existing sources of knowledge to provide new ways to interact, manipulate and visualise pre-existing data. As opposed to existing visualisations of communication that focus on surface data (McDonald et. al., 2012), the enSense prototype focuses on capturing raw communication and processing it in a way that transforms it into visualisable data.

The premise of the enSense platform is that tools to support designer-client communication can be more effective and more easily adopted. Moreover, as these tools utilise and contextualise the communication information, this contextual meta-data can be attached directly to the information. As the designers use more enSense-enabled tools, the body of knowledge is extended to contextualise a piece of communication for use by the collection of tools connected to the platform. enSense does not require users to communicate in certain ways, or use specific kinds of tools or structures. Rather, it aims to provide a way to capture the breadth and depth of the persistent conversation (Erickson, 1999) between designers and clients so that conversations can be visualised, analysed or reflected upon.

The primary role of the platform is to enable the creation of new communication tools that build on the knowledge that exists in currently used general-purpose tools, and allow new tools to feed back into these tools. The platform aims to be delivered either as an online service designed as Software as a Service (SaaS) (O'Reilly,

2007), or a deployable system within the business. There are limitations and benefits to both of these approaches, but ultimately deployment will be decided based on the infrastructure of each individual business; however, both SaaS and deployable versions will be offered to participating businesses. The final platform implementation will be used to inform a design framework that outlines best practices for designing Social Software within this context.

For the purposes of this thesis, the platform is named enSense and is based on three phases derived from Roseman & Greenberg (1996) as shown in Figure 23:

- Collect – Collection aspects of the platform are based on the ideas of contextual widgets, interpreters and discoverers. The platform will offer functionality to gather information from existing communication tools, either through pre-existing tool APIs or through a plugin based architecture.
- Share – Sharing functionality based on the concept of aggregators extracts meta-information from the content that has been collected, and combines this with information provided by the user through privacy and sharing preferences. This information is aggregated based on this meta-information.
- Extend – The platform offers an API to allow new communication tools, including services, a way to utilise this shared knowledge and feed back into existing communication tools.
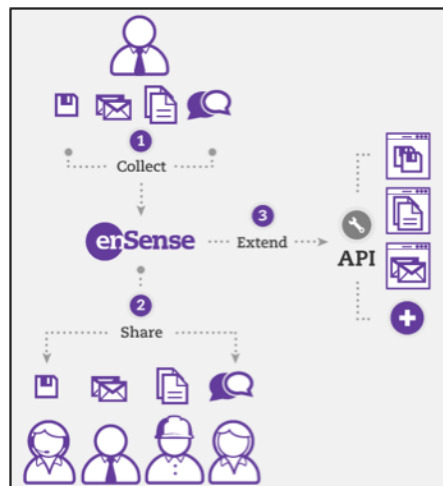
Figure 23: enSense three phases

Integration between existing communication tools and new tools is conducted through the platform and, as such, privacy and security is addressed centrally, rather than requiring each tool to perform these abilities. This means that tools can be used in a similar way to design pattern (Alexander, Ishikawa & Silverstein, 1977), where a tool can be used to solve a problem by adding contextual meta-data to the information. Cross-application understanding of data is important, with meta-data providing information to non-specific applications about its meaning. Additionally, "users need to use multiple applications offering support to address specific rather unpredictable aspects of a task" (Kohlhase, Kohlhase, Jucovschi, & Toader, 2013).

Users typically register to the enSense application through an enSense enabled tool or through the enSense website, and can add a number of accounts of communication channels that they currently use in practice. Where possible, these credentials are added using industry standards such as OAuth to ensure security and assist in adoption. During this study, the enSense platform supported a number of services:

- Email
- Social Media (Google, Facebook)
- Messaging (Twitter, App.net)
- File storage (Dropbox)
- Source Control (Bitbucket, GitHub)
- Notes (Evernote)
- Telephony (using Twilio)

These services were chosen for two reasons: they were perceived to be popular by web designers (based on Chapter 3 and 4), and they were easily to integrate with. While the majority of commonly used channels are integrated, of notable exception is Skype, which, due to its peer-to-peer architecture, cannot be captured by the platform. As channels are added, enSense ingests the historic data that is then archived within the channel and organises the communication into interconnected

objects between messages and between people. enSense monitors these channels, and, as new information is sent and received, it is ingested into enSense.

enSense separates the content of the communication channels from the people who are involved in the communication. As similar names across channels are found (such as the same email of a contact on both Email and Facebook), enSense collates this into a single person, so communication across channels is stored together. In addition, a tagging mechanism allows developers and applications to store meta-data either to a specific message or to a person. This information is stored as a named key value structure, to provide a descriptive context of the meta-data being attached. For example, the application "To do List" may know that a specific email is related to a task to be done in the CBD. This will be represented as:

[Todolist,   location,   "Brisbane CBD",   public]

The final element in the above structure is the publicity of the information. Meta-data can be added either as public or private, and this indicates whether other applications can see this information. This allows transfer of knowledge between applications, establishing context across the platform. As the key value structure also lists the name of the provider, multiple locations may be stored about a specific communication where the context may differ. Applications may search an entire collection of communications based on their meta-data.

A communication message ingested by enSense is only accessible by the user to whom it belongs. However, a user (or an application with a user's permission) may choose to create a shared container within the platform known as a repository (Figure 24). Repositories are collections of communications in which multiple users may store some of their communications and a single message can belong in more than one repository. Any messages stored within a repository may be accessed by users who have access to the repository. This allows a designer to create a repository for a particular project and allows multiple designers to all have access to the repository.

An important factor the repositories concept is that messages can be added to repositories automatically, without requiring manual intervention. Because of this, repositories are based on a series of rules, and when an incoming or archived message from any communication channel matches these rules, it is automatically added to the repository. Manual management of messages is also possible, but automation is anticipated due the amount of communication. Repositories act as an extension to the user's communication collection, and accessing all messages received from a specific person will not only show messages for the user, but also from other users who have shared communication.

Rules are based on a sentence structure and are similar to rules in Email applications. While this may not be the most effective design for creating filters, they are well known to the design community and easily understood, using a tag metaphor. Additionally, they can evolve from usage patterns, such as tagging specific conversations. An example rule is:

Any <message type> from <users> that contains <keyword> or <meta-data> add to <repository>

These shared communications may also have meta-data attached to them. To mitigate potential privacy risks within a real-world environment, registered users are required to provide a company name in which they work during registration. By default, repositories can only contain users from the same company to ensure messages aren't compromised to users outside of the company.
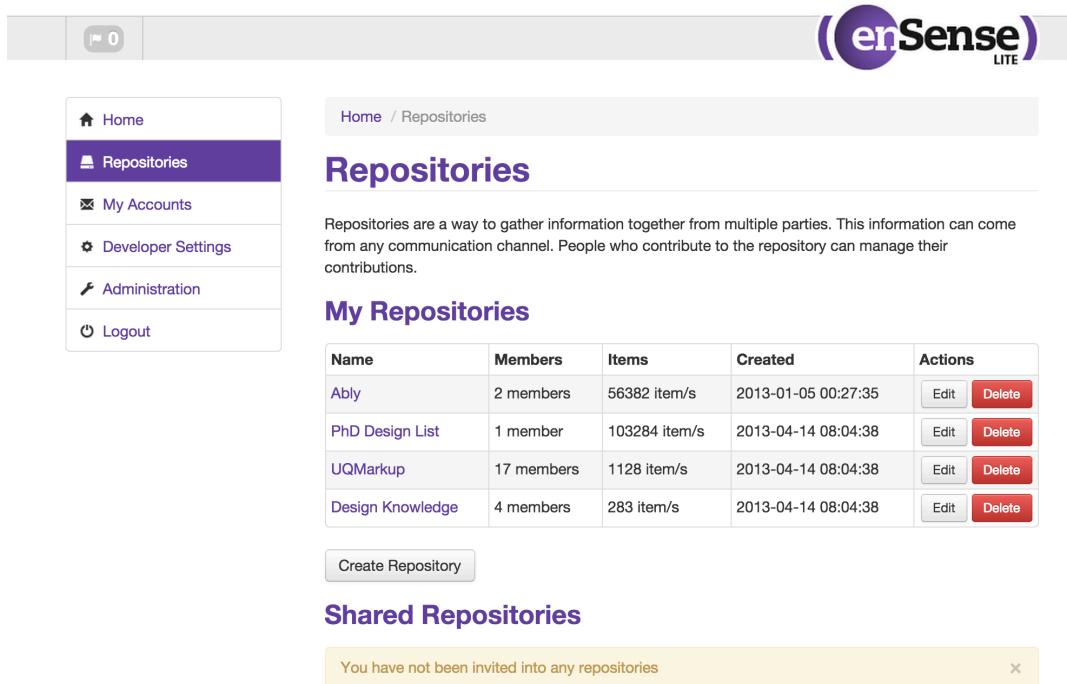
Figure 24: enSense repositories

As well as allowing applications to access and collect information, enSense also allows applications to send communication messages on behalf of the user. This is important as it allows the application to directly contact a client without requiring them to adopt a new piece of technology. enSense is able to look at the various communication channels that a specific client uses and choose the most appropriate channel based on the client's user behaviour and also the nature of the message. This two-way communication means that as a client responds to this message, enSense ingests it and the applications may further communicate. While the designer uses new and tailored tools to conduct communication, the client is using the tools that they are most familiar with.

The enSense platform is a research prototype, and thus allows designers to "share" communications to the researchers and attach comments to illustrate their designer-client communication. Any of these shared communications are only used to better understand the nature of designer-client communication and are not published without the designer's direct approval. The platform records analytics of usage by applications and their users.

6.3 - Platform Architecture

6.3.1 Platform Overview

The enSense platform is a web-based middleware system that connects to a number of communication services, and then provides a REST (Representational State Transfer) based API to interact with these communications. The enSense architecture is designed in a modular structure, so that new communication methods and new applications can be integrated into the platform without requiring re-architecture. Figure 25 shows a summary view of the enSense architecture.
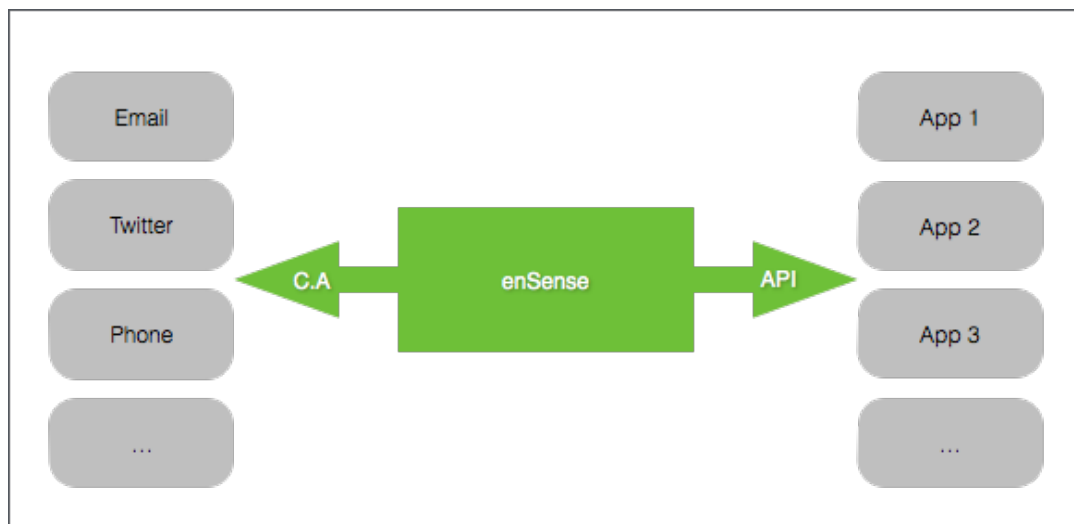
Figure 25: enSense platform architecture

In this architecture, enSense is a middleware that allows applications to access and manipulate content from communication channels. Two interfaces are central to enSense. The first, the Applications API, is the way in which applications communicate with enSense. The second is the Com-API (notated as C.A), which allows enSense to interact with a number of pre-existing communication tools. Rather than streaming communication data directly from the C.A to the API, enSense collects data from the C.A. through a batch process and stores the data internally. By storing communication directly within enSense, enSense can organise, filter and associate the communication data to enable a fast response to applications requesting information through the API. This also allows for enSense APIs that support bulk time range and filter operations, across multiple channels and users.

The primary method of interaction with these APIs is through the pre-setup filters that are created either by applications or by users. While some channels (such as Email) can be scraped without reading the message body (by extracting headers), there are performance and analytical benefits to storing the entire message within the service.
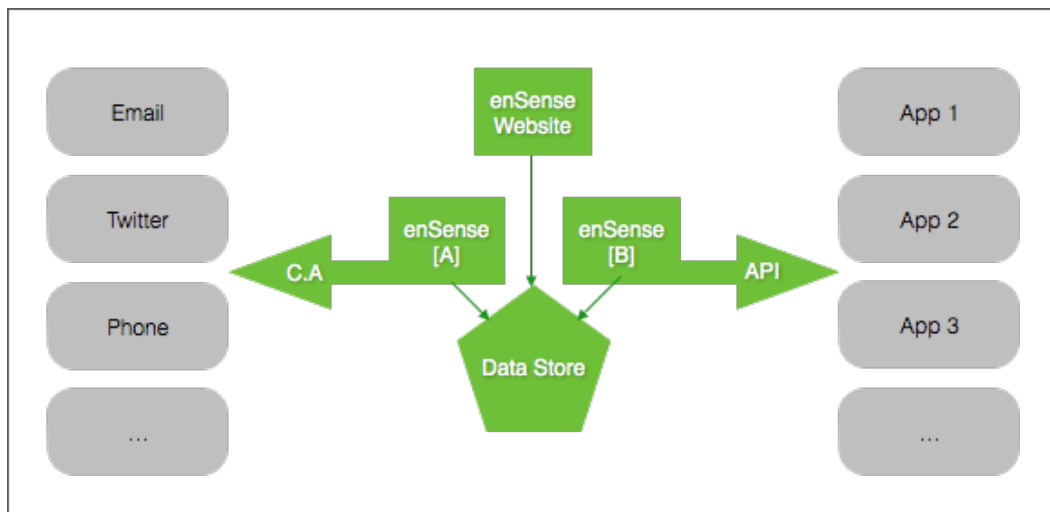
Figure 26: enSense platform architecture detailed

Additionally to the C.A and the Application API, a user facing web application is used to allow users and developers to register, manage their communication and application accounts configure various aspects of their account, and allow the ability to browse and manage their communications (Figure 26). While the user accessible website is not required to be used beyond registration, it was important to allow users full control and visibility of how their information was being used.

6.3.2 Communication API Process

The communication API process is responsible for a number of roles, with the primary role being to interact with each of the services that are supported by the platform. The communications API does not have an application or user interface, rather it is a daemon (a process which runs as a background process) that continuously monitors the communication tool accounts of enSense users. The communication API runs an algorithm that concurrently gathers information for each user. Information regarding the status of the communication API is stored so that applications and users may view the current status of the ingestion.

The workflow for the enSense service process is:

For each enSense user (as concurrent threads):

    For each account which the user has added:

        Connect to the account using the C.A. module

        Ingest any messages that have not been previously gathered

        For each new message

           Insert the message into the database, and build meta-data based on
the applicable rules

        Update or send any messages requested by applications

        Close the connection

For more information on the Com API see 6.4 - Communication Modelling.

6.3.3 Application API Process

The application API is a REST (Fielding & Taylor, 2002) based web service that provides applications a way to communicate with the enSense platform. The application API deals with the authentication, authorisation of applications and users (through OAuth 2 authentication), and allows applications to retrieve, filter and send messages through the users enabled communication accounts. In addition, the application API allows meta-data to be attached to messages, as well as enabling the management of rules and repositories.

For more information on the Application API see 6.5 - Designing Human-centred APIs

6.3.4 Data Store

The data store consists of two databases: a relational database (MySQL) that stores user configuration information and a graph database (Neo4J) that stores communication messages, meta-data about the messages and relationships

between the messages and between users. The relational database manages a number of aspects of the system:

- enSense user information (profile and authentication information)
- Company information (enSense users can only share within a company)
- Communication account authentication information
- Rules (that are performed on communications)
- Repository container information
- Other platform configuration information

For any information related to communication messages, the graph database is used. As opposed to traditional relational databases, a graph database stores information in a series of nodes, which have properties and relationships (lines) to other nodes. A node may be of a specific type or an extended type, which has additional properties. Each node in the enSense graph database is either based off:

- A person node - information about the particular user, such as their name. A person may or may not be an enSense user.
- An account node - information retaining to a specific account.
- A message node - an individual message within a communication channel, including a single email, tweet or phone call
- A repository node - a representation of a repository that has relationships with messages.
- A meta-data node - a piece of information that is related to one or more messages describing the message. These nodes are managed by applications or rules.

A Person node is never directly attached to a Message node, all relationships between a person and a message have an intermediary Account node. This provides flexibility when dealing with accounts being managed and also allows messages from multiple communication channels to be assigned to a single user. A simplified example of the relationship between these nodes shows the types of relationships that exist between nodes (Figure 27).
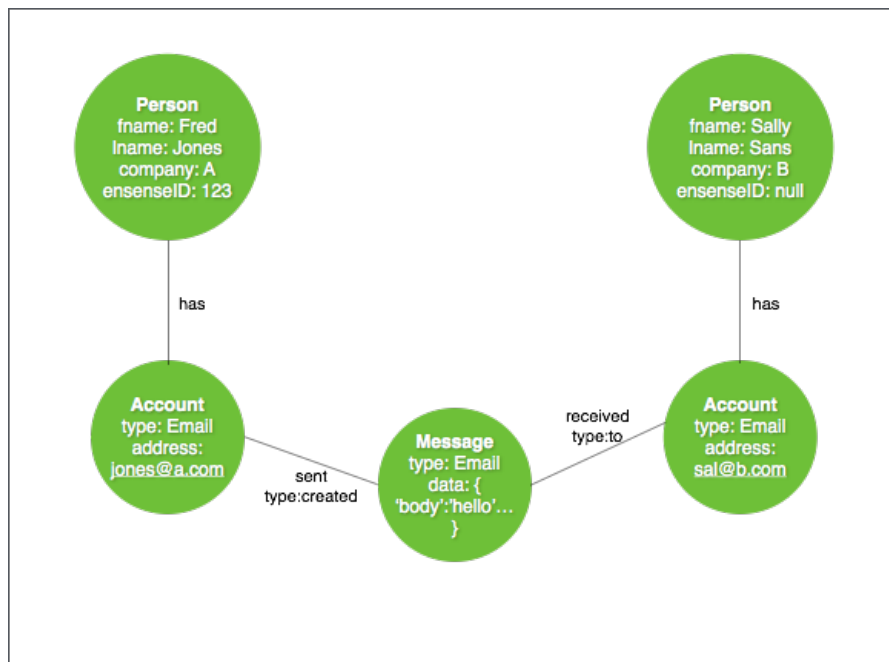
Figure 27: enSense communication schema overview

6.3.5 Architectural Evolution

The enSense platform had an evolving architecture that continued to evolve as more understanding was gained about how web designers and clients communicate. A number of aspects of the architecture were introduced due to new information about client interaction:

Repositories and sharing - initially, communication messages were required to be shared explicitly by a designer. However, feedback from designers highlighted the need that messages of a certain type should always be shared in many situations - such as a new designer or developer being added into the design process after it has commenced. Designers also suggested that this type of implicit sharing could also act as a safety net for miscommunication, such as forgetting to copy members of the team on a conversation. Rules (designed in a similar manner to rules in Email clients) provide a way for designer's to automatically add communications to repositories.

Batch capture of messages - initially, enSense did not store information directly within the system, instead only storing meta-data about the messages. When an application requested communication data, these messages would be gathered synchronously by the platform. However, this introduced issues in providing real-time access to data, due to the differences in the technologies of the various tools. Additionally, service outages and technical issues proved to create issues of stability and reliability in the platform from a user's perspective.

Graph database - the most difficult aspect from an architecture perspective with enSense was the nature of communication messages and how to efficiently catalogue the large data-set for quick retrieval by applications. Early prototypes of the system were created using relational databases; however, the structure changed continuously based on each new type of communication message, and relating messages was difficult. Various kinds of NoSQL databases were tested, such as document stores (MongoDB), and key value stores (Cassandra). However, the graph database (Neo4J) allowed for a conceptually simple method for cataloguing communication messages and creating various relationships between conversations and individuals. While some limitations were encountered with the overall size of the database, the relationship of digital communication between designers and clients is effectively represented by this form of database.

Common authentication mechanisms - enSense was initially created so that each communication technology had an individual module that dealt with authorisation and authentication with the service. During the development of enSense, more integration options with the various technologies became available. By using a common method of authentication (OAuth), the integration with communication methods became both easier to implement, and also provided a common method for adding accounts by users.

Message overloading – message content may be duplicated across many communication channels. enSense needs to aggregate duplicate messages together, to reduce noise, especially around notifications across channels.

6.4 - Communication Modelling

6.4.1 Modelling communication

A challenging aspect of aggregating data from multiple communication channels is the way to model a single compatible interface for communications of differing types, including but not limited to an Email, an Instant Message or a Tweet. As opposed to traditional information management, conversations are "an unfolding process in which the definition of a topic is continually changing" (Introne & Drescher, 2013). This becomes more complicated as the inter-relationships of communications are identified with varying kinds of users and the relationship between messages. Additionally, there is the mapping between a communication and multiple individuals or businesses, represented by contact addresses specific to the communication channel.

The method of communication is important as the message is structured according to the technology in which it is constructed. These vary from conversation style messages (such as "hello" within an instant messenger application) to a long and carefully constructed email with attachments of mock-up designs that are sent to all stakeholders. Some facilities are not available on all methods of communication while some are better suited for particular tasks. As an example, Skype allows for much richer methods of communication (real-time voice, video and synchronous awareness) compared with email. Although this implies that a specific method will be used depending on the type of facilities required to communicate the information that, the critical key is the adoption of a communication method amongst all users that are involved in the conversation. Commonly, people will use the method they are most familiar with rather than the best method to communicate the message. As an example, it is common for users to send email attachments to be edited, rather than using a collaborative text editor.

The most important factor for understanding a specific message within a conversation is the purpose for communicating. There may be more than one

purpose for the communication, and the purpose will most often be triggered by a previous message or action. Some example purposes include (from Chapters 3 and 4):

- To coordinate meetings
- To transfer knowledge
- To ask for feedback on a design
- To reiterate requirements
- To answer technical questions during support
- To provide awareness

Each of these purposes does not necessarily affect the method of communication; however, it help frames what the message is about, what triggered it and what response it aims to produce. While there are ways of categorising communication messages (Winograd & Flores, 1985), the purpose of the message is specific to the context of the larger conversation.

It is also important to note that the larger conversation in which messages exist is not necessarily exclusive to digital methods of communication. The artefacts themselves may be considered methods of communication, providing information to other participants who then continue the conversation through a digital communication method. Additionally, non-digital methods of communication such as F2F meetings may also trigger or be triggered from digital communication.

When examining these messages in context (in the form of a conversation) a number of patterns can be observed. These patterns do not necessarily provide the purpose of the individual messages, but rather for the entire conversation. For example:

1. A user emails the client to discuss a technical issue.
2. The client then emails the designer to investigate the issue.

3. The designer may then either resolve the issue and contact the client or may inquire for more detailed information from the user. Once the issue has been resolved, the designer will then email the client (and sometimes the user) to detail the resolution for the issue.

While the individual messages have specific purposes (such as acknowledging the issue), the conversation exists to solve a technical issue encountered by a user. The importance of this distinction is that individual messages, while important, do not exist in isolation from the larger conversation. Although the purpose and the method of communication may be relatable across many examples of communication, the communication is unique due to its context of the relationship between the designers and the clients. This relationship is also not static, but is dynamic as it evolves throughout the project and will likely be represented across multiple communication channels.

When examining these digital conversations it is important to recognise that digital records of communication do not explain the full context of the designer-client conversation. Systems should be careful in their analysis, in order to ensure they do not misunderstand a users intention based on their action or inaction. External factors play a critical role in how a message is constructed or delivered. For example, a client who does not reply to an email from the designer may have a number of factors contributing to the lack of response. The client may be attempting to construct a response; however, it is just as feasible that the client is busy and has not had a chance to review the email, the email was missed, or the response was given through a different channel. It is important that this is taken into consideration while analysing communication messages and in particular emphasises the importance of qualitative methods when determining the purpose of the message or identifying patterns within conversations.

Each of these factors creates a challenge for those designers wishing to leverage existing communication channels. The dynamic nature of the designer-client relationship, as well as the purpose and method of the message leads to a large

amount of ambiguity in how it is represented within the system. While patterns of communication may be identifiable digitally, it is important to ensure that pattern is representative of what occurred, to ensure that the information is not being misrepresented.

Within the design of enSense the importance of the representation of communication is prominent as these will be transparent to the users of the system (with the primary users being application developers who are using the application API).

There are three perspectives that are important to consider when designing models to represent data:

- Conceptual Schema - the scope of the model, the language around the concept, used to scope the model
- Logical Schema - the programmatic structure of the model
- Physical Schema - the physical means to store the model

The evolution of database systems to support the storing and retrieval of data means that the design of the data structure is highly dependent on the system that is built upon to store the data.

6.4.2 Database Schema Design

When considering the design of the enSense data (large amounts of unstructured communications across a variety of users), it was first important to consider the type of database that would be used to house the data. This is not only important from an implementation perspective, but also from conceptualising how the data will be stored as well as how information can be related. The structure of the data is important from a number of perspectives, including:

- How capable is the search methods?
- How easy is it to relate information?
- How flexible is the representation?

- How can the data be effectively represented through an API?

- What are the performance bottlenecks in reading and writing data?

- How does the information scale?

Due to the size and complexity of the data being stored as well as the dynamic attributes of different communication methods, NoSQL provides the most appropriate method for storing communication data. A number of NoSQL solutions were examined with regards to communication data, and it was found that Neo4j provided the best flexibility in representing communication based information for enSense.

Neo4j is a graph database where messages consist of nodes that have strong ties between each other through relationships. Each node can hold nested data of various structures that allow messages of differing types to be represented as the same type of node. Relationships not only connect these nodes but also can, in addition, contain meta-data about the form of relationship. This allows for the datastore to be a more accurate and simple representation of a collection of messages and users. Graph databases are different to other forms of databases in the methods that they query the data. As opposed to querying for a collection of data based on parameters, a query begins with a single node and then collects information from other nodes based on their relationship. This enables an anticipated need of the API, whereby accessing a message node, it is simple to query who sent the message, which users the message was sent to and other messages within the conversation as relationships can exist between nodes of the same type. Neo4j also provides a native REST API and query language to perform many-node lookups, suited to branching communication narratives.

From this preliminary background research, the enSense data model design consists of two database schemas in tandem: a relational database to hold relational information about how the API is used (such as user accounts) and a graph database (Neo4j) that holds the communication information (Figure 28).

Figure 28: enSense graph database

6.4.3 Conceptual Mapping

From a conceptual perspective, there are three main nodes required to represent collections of communication messages of users: User, Account and Message (Figure 29). The focus of the conceptual mapping is the storage of and relationship between, groups of messages, irrelevant of whether the message owner is or isn't an enSense user. This is important, as not all users will be registered with the system (instead found through their communication with enSense users). Within the scope of this research, it is anticipated that clients (and, therefore, messages that belong to clients) will not be encouraged to register as active users of the system, as the purpose of enSense is that it can be effectively used by individuals without requiring critical mass across the project team.
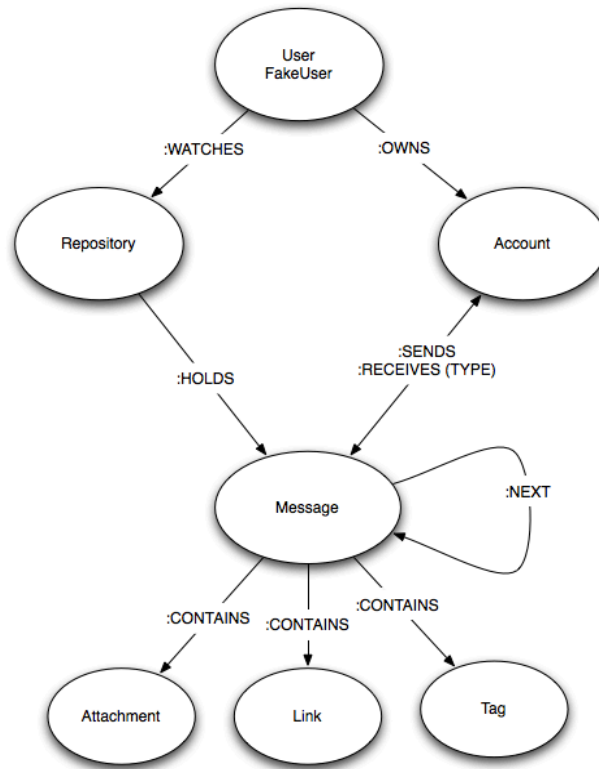
Figure 29: enSense conceptual mapping

6.4.4 Data Modeling

Rather than constructing an entirely new data model, using formalised meta-data naming conventions (such as Dublin Core) or abstracting from an existing data format (such as email structure), enSense adapts the ontologies specified in the Oscaf/NEPOMUK project for representing communication within the enSense platform. The focus of the NEPOMUK is to "create a standard and reference implementation for the Social Semantic Desktop" (Groza, Handschuh, & Moeller, 2007). In particular, this structure focuses on the representation of "real-life industrial use-cases", in particular focusing on the "user needs regarding collaboration". The ontologies that are of particular interest with regards to representing communications across protocols are the NMO (NEPOMUK Message Ontology) and the NCO (NEPUMUK Contact Ontology). Although these two ontologies are not implemented directly, their designs serve as an underlying conceptual framework for the enSense data structures.

NMO, the message ontology, examines various forms of communication in detail and uses a over-arching category of a "message", which has a number of common properties: the sender, the receiver/s, the time at which the message was sent and received and the current status of the message. This message category is then sub-divided into a number of "domains": email, SMS/MMS and calls. Each of these domains are valid messages; however, they each have distinct structures of information and meta-data. In addition, the NMO supports the concept of conversations, where a number of messages are linked together. Rather than grouping them by time, NMO acknowledges that such a representation is "too simplistic". The enSense Message data-structure is structured in a similar manner, where all message nodes share a common structure but have additional attributes relevant to their media type.

With regards to contacts, the NCO takes into account a wide variety of structured information to represent a person or company. enSense follows this representation at a simplistic level, with less detail around the nature of the individual but with a similar relationship with messages and conversations. The ContactMedium representation in NCO is represented as an "Account" in the enSense data structure, while the ContactList is dynamically generated through the graph joined through related messages.

The Nepomuk ontology does not provide a similar sharing container as the "Repository" node within the enSense conceptual mapping. This aspect of enSense does not emulate an existing form of message sharing, rather it is a new way in which archived messages can be shared at a later date and can be shared implicitly through rules, rather than explicitly sharing it at the time.

6.5 - Designing human-centred APIs

This section focused on the design of human-centred APIs (Application Programming Interface), that is the process of developing techniques to support the design of CMC tools to support designer-client communication. The application API is the protocol and mechanism in which third party applications that are developed can leverage communication data through the enSense framework. Although the design of APIs for third parties is not necessarily new, initial findings were that beyond the technical and semantic aspects of APIs, little has been written about the user centred design of APIs. In practice (as seen in the evolution of commercial APIs), the importance of well-designed APIs is crucial to simplify the development of APIs. Poorly designed APIs are much more likely to be rejected and un-used by developers, due to the effort related to understanding how to interact with the service. Therefore, I use the term human-centred APIs as APIs that are designed fore most to be used by developers, rather than as a programmatic representation of data models. Human-centred APIs are not only the programmatic API, but also encompass the documentation, usability and learnability of the API itself.

The purpose of an API is for a service to provide the mechanism for other applications to interact with the service through a standardised manner. Even though the concept of APIs has existed since the beginning of programming (in essence any interaction between subsystems is conducted through an API), APIs between disparate services and technologies that are freely available are relatively new. In particular, APIs that are accessible through Internet technologies such as TCP/IP have enabled new functionality and ways to interact with many popular online services.

6.5.1 Technology

Two technologies are most prominent for supporting web based APIs between services: SOAP (Simple Object Access Protocol) and REST (Representational State Transfer) (Fielding & Taylor, 2002). SOAP has traditionally been the standardised

protocol for interacting with services (primarily within enterprise systems); however, recently REST has become the de-facto standard for service APIs, with strong support from the major companies within the industry. The change from SOAP to REST is primarily driven by the complexity of SOAP and the simple and easy to understand nature of REST. In particular, REST is built upon the standards defined in HTTP, which is well understood within the industry. Moreover, the interaction between services with REST is well defined, as opposed to SOAP where the interaction is defined through configuration by the service provider. Most interestingly is that REST has become the standard primarily for its easily understood concepts, simpler and more standardised interaction. Despite this, the REST standard only specifies how the technical interaction takes place, it does not consider how the APIs are presented to users (specifically *API Documentation* and conceptual presentation of the selected API). The design of this aspect of the API is currently created by API developers in isolation and without any standardisation.

Furthermore, REST ensures that interactions with the web server are stateless. This means that any API call performed on the service can be done in isolation and does not require a shared state between the server and the client. This simplifies the interaction between the API and the client application significantly, as the client can interact regardless of the servers current state. As a simplified example of a REST API, a simplified example of the enSense REST API is described (Table 7).

Table 7: REST API endpoint examples

Endpoint	Method	Function
/messages	GET	Gets the list of messages
/messages	POST	Adds a message to the system
/messages/3	PUT	Updates a message
/delivered	GET	Gets the messages which have been sent by the user

In this example, the REST API provides a number of endpoints, which correspond to a URL pattern. The URL that is called is a combination of the endpoint and the API domain - in this example http://ensense.net/messages. The method (which is part of

the HTTP specification) states how the endpoint should be called with the current standard being shown in Table 8.

Table 8: REST API method usage

Method	Usage
GET	Retrieves data from the service
POST	Sends new data to the service
PUT	Updates existing data in the service
DELETE	Removes data from the service

The benefit of this structure (over SOAP) is that by knowing the endpoint and its method, the user can make an assumption of what the result will be. The PUT, DELETE and GET methods are idempotent: they can be called multiple times without affecting the result, while the POST method is non-idempotent: if it is called multiple times, multiple entries will be created. The problem with this structure is that beyond the formal endpoint signature, there is no obvious understanding of what data will be received and what data should be sent through the method. Many APIs solve this problem by providing programmatic responses to endpoint calls either by letting the caller know the response of the method or by providing error responses (which can leverage the HTTP response codes) with messages to explain how to use the method. Because of this lack of explanation by the API, API designers create large *API Documentation* interfaces to give insight into how the API works in a human readable format.

Both REST and SOAP support a number of formats for the transfer of information between the API client and server, and the server dictates the available formats. Most commonly, SOAP uses XML to encapsulate and encode data, while REST support both XML and JSON (however JSON has become the de-facto format). When the server responds to the client, this format is how the returned data is structured. In addition, any structured information that is sent to the server from the client is encoded in the same manner.

6.5.2 Design of Rate Limiting, Pagination and Authentication

With the defined REST specification, a client has the ability to effectively interact with a service. However, in practice there are pragmatic issues related to the implementation of REST APIs that requires management of authentication and authorisation. There aspects of the API are often overlooked when considering the design (human centred) aspect of the API. While these methods of restriction do not necessarily violate the REST protocol, they limit its practicalities. In particular, popular commercial services with REST APIs include extra ways to control and enforce client interaction through: authenticating, rate limiting and limiting the life of accessible information.

A major hurdle with interacting with current REST web services is with regards to rate limiting and the limited life of accessible information. Both of these issues are not due to the nature of REST or due to the design of the API, rather to ensure that some users of the API do not abuse its access. The most common method for controlling the use of the API is through a rate limiting mechanism. Each client of the API has a limited number of endpoint operations that they can do within a certain amount of time. This means that clients may be unable to work with the REST API based on what they are attempting to accomplish (a common issue with services such as those looking for themes across Twitter).

Authentication is a challenge within any form of API, as they must provide access in a way in which the client cannot capture private information of the user (in particular, authentication details of the service). The API has to deal with three aspects of authentication:

- Authentication: checking whether credentials correlate to a user's account
- Authorisation: checking whether a user has access to the requested resource
- User data: interacting with data based on the users credentials (for example: selecting the users messages).

The current standard protocol for authentication and authorisation for REST APIs is by using the OAuth (currently OAuth 2.0) standard, which has been adopted by the most popular services. Although OAuth provides a secure and generalised method for authentication and authorisation, it is convoluted in comparison to the simplicity of the standard REST concepts. Primarily this is for security, as unlike traditional web based authentication, third party services never have access to the user's real username and password. Unfortunately, this additional overhead of authenticating (in particular due to its back and forth nature, and use of hashed access credentials) puts a burden on users of the API and reduces the ability for API users to pick up and experiment directly with these APIs.

In addition to these technical setup issues, authenticated endpoints results in a more complex interaction between the client and the server. Endpoints that retrieve or save data based on the authenticated user react differently depending on the server. For instance the GET /messages endpoint needs to react differently based on whether the authenticated users details have already been captured by the system. This additional overhead complicates the immediate understanding of the endpoint, and requires users of the API to be able to have a much more detailed understanding of the various states which the endpoints may respond with. The aspects of authentication and authorisation in API design are critical to consider when designing for humans, in particular the transparency of the authentication state.

6.5.3 API Documentation Interface

API Documentation refers to the official reference material that the API designer writes for developers, for use when developing software with a particular API. *API Documentation* is usually a combination of tutorials and interactive reference material.

Although REST provides an easy to understand structure that follows a standard HTTP request pattern, authentication and the format which data is sent requires additional understanding about the API. API designers create this in-depth

documentation about how to interact with the API, and the various forms of messages with which the API responds. Consequently, *API documentation* becomes the primary method where users learn how to interact with the service. Because of this, the documentation interface is an essential part of creating APIs that are human-centred.

There are a number of aspects that the *API Documentation* should provide:

- An introduction to the high level functionalities of the API - what it does and does not support
- Which technology does it support, what protocol (REST or SOAP) does it support
- Information relating to authentication or other concepts which are common across the API
- Any recent updates to the APIs
- How the API can and cannot be used (from a policy perspective)
- A structure of how the API is organised
- Documentation (and community documentation) for each API endpoint
- A method for quickly interacting and testing the API directly
- Libraries and examples for common languages for accessing the API

In addition to this, each endpoint should provide information related to:

- How to access the endpoint
- The status of the endpoint (any current issues related to the data)
- What parameters / data can be sent to the endpoint (and whether it's required or optional), as well as the type of the data
- An example of both the request and of the result which is returned
- Any errors which may occur and how to identify them
- Information related to authentication, rate limiting and pagination
- Aggregated example uses for the endpoint
- A way to directly interact with the information (to experiment with the endpoint)

Most commonly all of these elements live within a single website that developers can access. In some cases (especially those which change their interaction based on the type of client connecting) the API should provide website level configuration to select which subset of the API the user is primarily interested in. For example, if an API provides different endpoints based on whether the client is a native or web-based application, the *API Documentation* should provide a method through which the users can choose to only see documentation related to their needs.

6.5.4 Examples of *API Documentation* interfaces

The Twitter API is a well known and popular REST based API, and was an early web-based service to provide full API access to their system. The documentation interface that Twitter provides to its developers is under continuous evolution, originating as a wiki. Twitter provides a simple and easy to use website with both straight documentation for every endpoint which is available and also documentation related to tasks that a user may be interested in (for example, "Working with timelines").   Although Twitter provides most information related to the API, their community support is located on a separate website, which means that examples of how to use the API are not collocated with the API documentation. In addition, there is now way to interact directly with the API, as the API explorer is in a separate area of the website.

A very popular social API is the Facebook API, which provides a thorough developer portal. Due to the nature of the Facebook API (which provides a number of different forms of APIs), the API documentation is segmented into areas based on the user's needs. For each of these, the Facebook documentation provides three sections: Quickstart (to get users familiar with the concepts and API structure), Reference (which provides the API documentation) and Advanced Guides (which promote better techniques for interacting with the API). Facebook also provides a detailed understanding of how the API has changed over time and also provides insight into how the API will change in the future. Additionally, the Facebook API uses the users authenticated profile to show examples of API use. This lets the user not only see

example responses to endpoint calls, but also gain an understanding of the response as the data that they view in the documentation is from their own personal account.

The current Google API is an excellent example of how **not** to create a human-centred API and instead create documentation focused around the technical structure of the API architecture. Google has provided API support to its services for a long time, and because of this it has had a number of legacy documentation sources that have become out-dated. This provides a strong example of the need for a good API documentation architecture that can be kept up to date. Currently the Google API documentation bridges across four different websites, with many broken links and no-longer relevant information. Additionally, the documentation lacks in-depth examples of use and areas for discussion.

6.5.5 enSense API

Based on the research that was conducted on how other APIs are presented to users (in particular the Twitter API), the enSense API was designed and iterated upon with the aim to create APIs that were easy to read. In this, the *API Documentation* was created before the API, based on anticipated requirements of the users, which then drove the development of the API (example in Figure 6.7). This streamlined the API development process, as API endpoints were created based on a need by need basis, rather than providing a broad but shallow range of APIs.

The enSense API was built by modifying the Doku wiki platform (for simplicity), with content sections of the wiki generated automatically using the Doxygen code generator (Figure 30: Example of the enSense API documentation browser). The workflow for this API design process was:

- Look at the current *API Documentation* for gaps in the API
- Program a skeleton method within the API system which represented the need

- Write documentation around the skeleton method for how the method would work

- Generate a new version of the API wiki

- Iterate on this process until the API documentation was correct and well-explained

- Write the programming required for the API endpoint to function

- Iterate on the endpoint based on user feedback

This API creation process meant that the focus of the API was based on an underlying user need in relation to the existing endpoints, rather than simply exposing the underlying models.

Filters API

The filters resource allow developers to manage functions to repositories to automatically manage tags and other meta information.

Method	Resource	Description	Status	Private
GET	filters	Lists all filters that exist for each repository, optionally with a repository ID.	🟢	
GET	filters/{id}	Get a specific filter.	🟢	
POST	filters	Adds a new filter to a specific repository.	🟢	
PUT	filters/{id}	Updates an existing filter.	🟢	
DELETE	filters/{id}	Deletes a filter.	🟢	
POST	filters/cloned/{id}	Clones an existing filter.	🟢	

Figure 30: Example of the enSense API documentation browser

6.5.6 Community Support

Although the *API Documentation* is required to be sufficiently verbose to provide enough information to users for them to be able to effectively understand the API - it is also important to offer users a space in which they can interact directly with the designers of the API. Currently many API providers do not offer this form of community interaction and instead rely on developers finding answers through other mediums. However, from examining existing API services, the ones that do provide an integrated community with social features are much easier to adopt - as members

of the community discuss issues, methods of performing certain tasks and give code examples of how to interact with the API. An excellent example of this is the PHP online documentation, which is dominated by comments from the community showing examples of how the functionality can be used to perform certain tasks. This allows users to quickly search not necessarily on the official name for the endpoint, but rather for the kind of information that they are looking to retrieve or save. In addition, it is important that this community functionality (comments and example code) is built directly into the API documentation so that it is immediately visible to users of the API, and information related to a specific API endpoint is located in the same area of the documentation.

6.5.7 Other considerations for human-centred APIs

An important aspect of creating human-centred APIs is the concept of Onion Skinning the API (Berglund, 2013) - whereby the core functionality of the system is not exposed by the API, but rather a series of abstracted endpoints that are simpler and are more easily understandable for new developers. This is most important for supporting legacy applications while still having the ability to evolve the API. This type of API design considers a multi-layered approach to API design, that is an inner API that interacts directly with the system and is designed for use by the developers of the system (but can be leveraged by other developers when needed), and the outer API that is designed to be used by end-user developers of the API. There are a number of benefits to this method. In particular, the inner APIs can be designed to best structure the interaction with the system for the developer, while the outer API can be designed explicitly around developer requirements. In this manner, new internal APIs can be created without requiring changes to the external API, and new external APIs can be written without requiring new underlying functionality. From a pragmatic perspective, this allows a series of abstract interactions represented by the external API, while the internal API may contain more specific data interaction.

6.6 - Implementation, Deployment and Challenges

6.6.1 enSense implementation

The aim of this section is to provide an insight into what was learnt through the iterative development of the enSense research prototype. enSense is a web-based middleware platform that provides four primary functions:

- Collect information from a variety of communication channels
- Organise and categorise this information
- Present this information through a REST based API (Battle & Benson, 2008)
- Send information back to the communication channels

For more details on the concepts related to these elements refer to Chapter 6.3. The implementation was conducted as five main components (Figure 6.9).
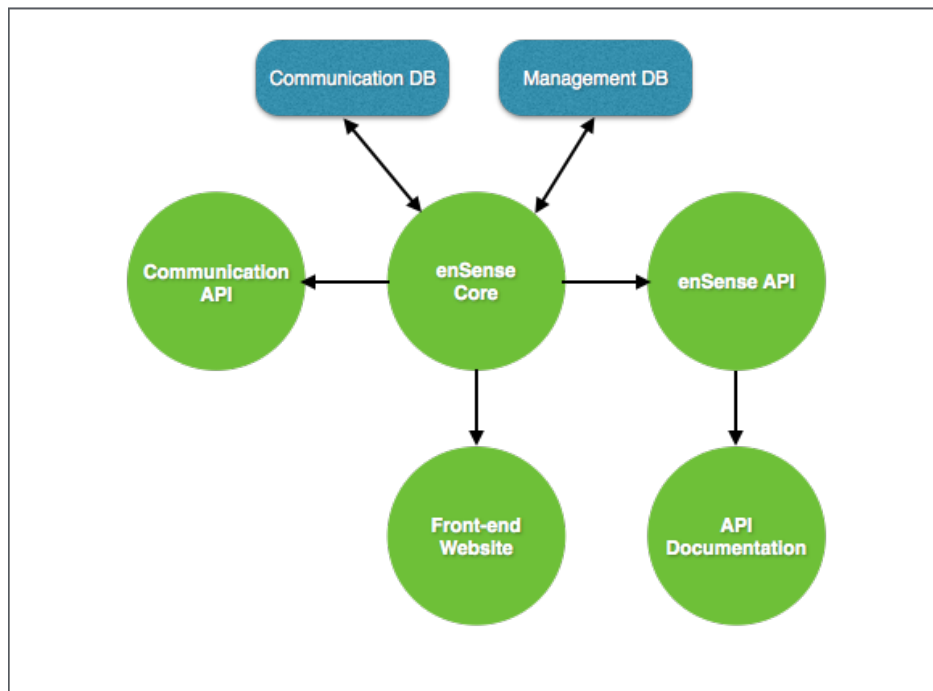
Figure 31: enSense components

The enSense core

The enSense core is the primary piece of middleware that deals with the database saving and retrieval. This component is the primary interface to the database, and acts as internal API for the developer API and the enSense front-end website. The core is the only component that has access to work with the encrypted management database, and also deals with any asynchronous tasks which enSense uses. The core is also responsible for the logic that categorises incoming messages from the services layer and adds context based on rules and repositories. The enSense core is programmed in CakePHP.

The services layer

The services layer component is a Java daemon process that operates continuously in the background of enSense. The service layer monitors active account details within the enSense core (using a REST API) and for each active service the system polls the relevant communication platform to capture any new information. This information is parsed and added to a queue (Rabbit MQ) that the enSense core then processes. The queuing system is used for this so that the services layer does not overload the enSense core. In addition, the enSense core can provide visual feedback to the user about the progress of their data ingestion.

The API

The API component provides the interface for third party applications to interact with information stored within enSense. The API is a REST based API (Chapter 6.5), supporting both JSON and XML formats. The API interacts with the data through an internal API provided by the enSense core component. As with the core, the API is programmed in CakePHP.

The enSense front-end

The enSense front-end website is the website which allows for users to register, login and manage their connected communication accounts (Figure 6.10). The front-end website is separate from the enSense core, and uses the API to communicate. The purpose for this architecture is to ensure that the API is flexible and that the API

is working as anticipated. Any API interactions that are of a sensitive nature (and should not be publicly accessible) are only accessible to the enSense front-end component. The front-end website also allows for third party applications to be embedded in it through the use of iFrame's. The front-end website is written in CakePHP but is primarily a client-side website.
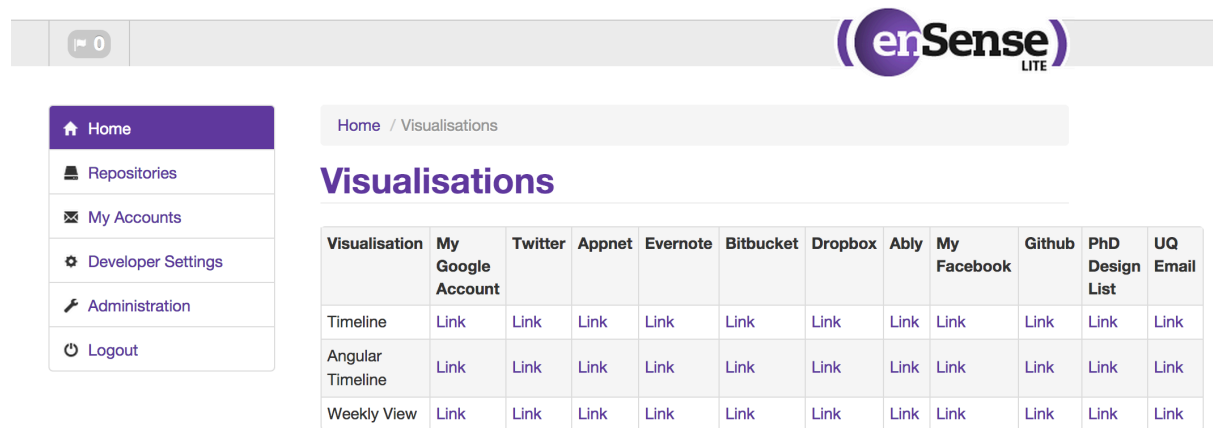
Figure 32: enSense prototype front-end website

The enSense API Documentation website

The *API Documentation* website provides information to developers on the various APIs provided by enSense, as well as guides and libraries to interact with the platform (Figure 33). The documentation website is built on top of Doku-wiki, and is auto-generated by Doxygen. The documentation website also provides the ability for users and developers to comment on specific APIs. This functionality is provided by Disqus.

REST API Overview

API Availability Legend:

Status	Description
🟢	Operational and no known issues
🟡	Currently under maintenance
🔴	Major issues or currently under development
🔒	Private API - Not available to most developers. These APIs are still presented to open discussion on opening up these APIs

Coms API

The coms resource allows the retrieval of communications by the logged in user as well as coms which are shared with the user.

Method	Resource	Description	Status	Private
GET	coms	Returns a series of communication messages.	🟢	
DELETE	coms/{id}	Removes a communication message from ensense (not the source)	🟢	
POST	coms/{id}/metadata	Creates metadata with a value for a specified communication ID.	🟢	
PUT	coms/{id}/metadata/{key}	Updates metadata with a value for a specified communication ID.	🟢	

Figure 33: enSense documentation website

In addition to the component implementations, enSense relies on two data systems, which are only accessible by the enSense core. These two databases have distinct purposes within the platform:

The management database

The management database is a SQL database, containing registration, project and account information for each registered user and team. This database does not contain any communication information; however, it does contain foreign keys for users that are also represented within the communication database. Due to the nature of the management database (account details and user registration information), information in the database is encrypted as a security measure.

The communications database

The communications database is a NoSQL graph database and represents all messages that have been ingested by enSense. The communication database uses

Neo4J and represents each communication message as a node connected to multiple accounts. Each of these accounts is connected to a user node. If the user node is an enSense user, this is represented by the foreign key of the user from the management database. Meta-data can be attached to each of the nodes to establish context. This allows the system to lookup all messages related to a specific meta-data key, and also quickly examine the relationship between those messages. For more information related to the schema of the communication structure see Chapter 6.4.

6.6.2 Deployment and iterations

The development of enSense was conducted over three iterations of development, with each iteration based primarily on user feedback and reflections on the development process. The iterative implementation of enSense was a learning exercise, to understand the complexities of developing systems that provide real-time API access to a variety of communication channels.

The initial version of enSense was built as a single component (using CakePHP), and was developed primarily as a small middleware platform that provided direct access to a user's communication data (Figure 34). This version was primarily used to test the validity of the concept, and to understand the technical limitations and challenges based on the nature of the kinds of data being ingested. From this initial version, a number of challenges were encountered:

- Each new communication method being added required a restructuring of the architecture of the system
- The storage of the messages (using SQL) became increasingly difficult to filter and categorise
- Querying messages which were related was very slow
- The API development was increasingly difficult due to the nature of the SQL schema

- The interdependency between the various aspects of the system (in particular the API and front-end website) meant that any changes to the front-end impacted the entire system.
- *API Documentation* was written manually
- The main problem with the initial version from user feedback was that the system did not provide a clear outline of what the platform could provide, was too unstable during development and was too slow to interact with (through the API).
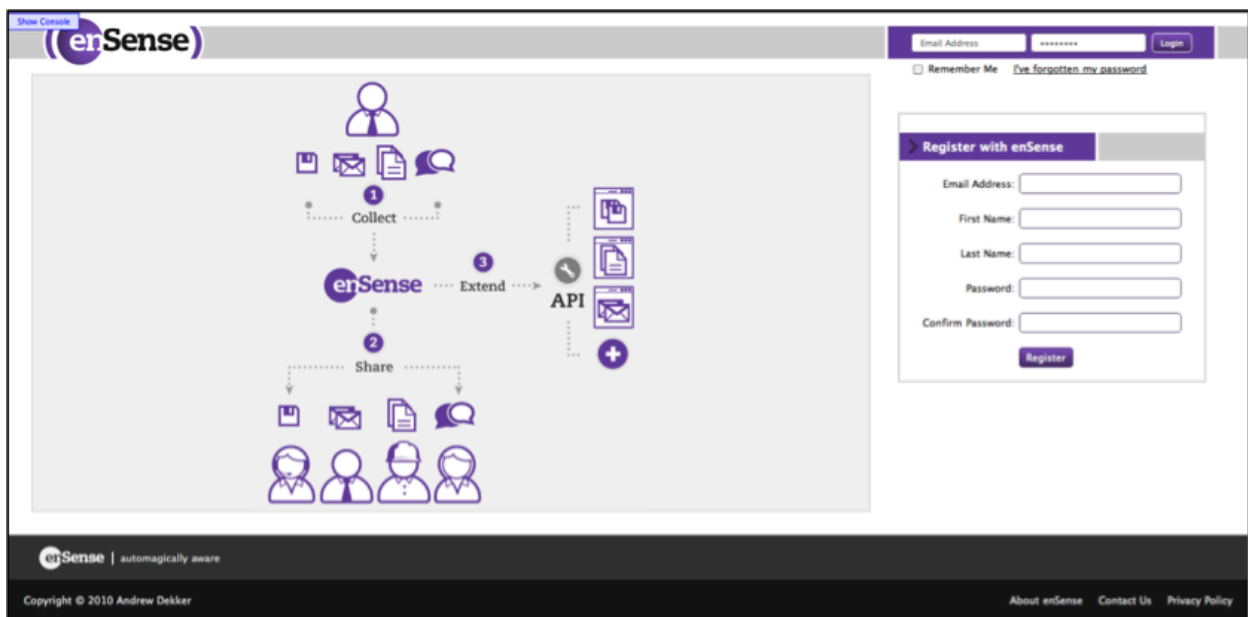
Figure 34: First iteration of enSense

Based on the findings of the first iteration of the development, the system was re-architected based on the identified limitations. A number of alternatives were reviewed based on the limitations encountered with SQL, with a graph database being the most appropriate method to store messages and their relationships (Cassandra, MongoDB and other document stores were considered however graph databases are more conceptually similar).

The system was decoupled to reduce the problems with inter-dependency and performance issues (of communication ingestion) that occurred in the initial version. Three components were designed: the services layer, the API (which consisted of the API and the core) and the front-end website. The core interacted with the front-

end system and the services layer through the API and the Services API (which used a queuing system for asynchronous operation). The front-end website provided users of the system with more insight into the state of the ingestion of their accounts, as well as the information which had been captured. In addition, an app-store interface was designed so that applications built within the platform could be advertised to other users to register and use (Figure 6.13). This allowed users to quickly build up context meta-data about their communication messages by adding a multitude of applications. In addition, this allowed me to examine how an application that was designed to solve problems within one business would work for different web design firms.
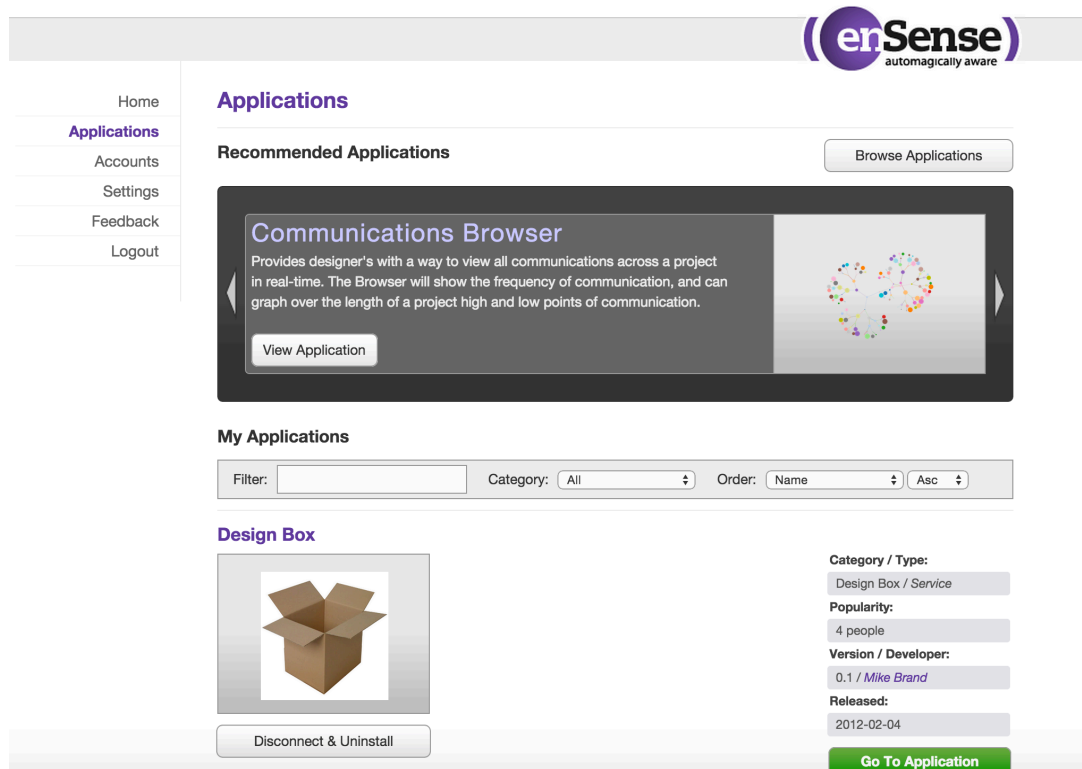
Figure 35: Second iteration of enSense

Participant's were very excited about the potential of an app-store environment and were very supportive that it was an important part of the enSense platform. In addition, the services layer component had been designed to support any number of communication methods, using a services plugin architecture. A number of services

that aimed to be used (in particular Skype) were unable to be used due to lack of integration options (Skype at the time had recently stopped the availability of its API).

Based on the ambitious scope of the second iteration development, a third iteration was developed primarily as a research prototype of the concept and was known as enSense Lite (Figure 6.14). Rather than implementing an entire platform with app-store, enSense Lite was developed as a minimum viable product (MVP) to evaluate the concept of enSense. This version was streamlined and performed a subset of the functionality which enSense aimed to provide:

- Users (and teams) can register into the system
- Users can add their accounts, which are ingested into the enSense core
- Users can access this information through the API
- Users can send messages through the API and attach meta-data to messages
- A limited number of communication types were supported

The enSense Lite system is focused less on creating new novel applications that add context to the captured information, and more about capturing existing designer-client narrative, and providing real-time access to the knowledge through a standard API Figure 36. This iteration was based on having a better understanding of what can be gained through the contextualisation and use of the existing communication narrative.
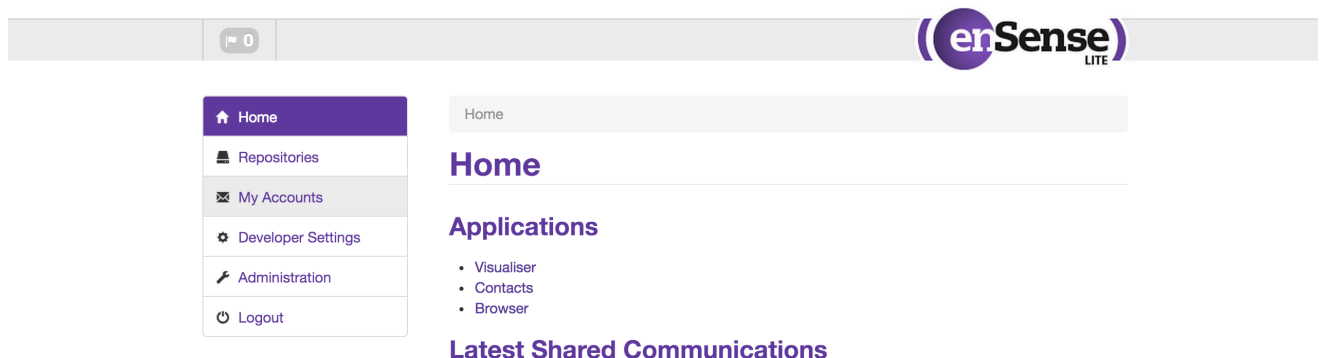
Figure 36: Third iteration of enSense - Applications

The methods of communication that were supported by enSense was reduced to simplify the implementation of the research prototype (Figure 37). The services that were examined for integration were based on earlier case studies in Chapter 3 and the review of existing tools in Chapter 4.4. In particular, the only methods of communication supported were those that had a way to access their information using REST API (whether directly or through a third party API), and those which supported OAuth for authentication. A major issue with the first two iterations of enSense was creating a user experience where adding accounts of various types followed a similar process. By constraining the tools to those that supported OAuth, the effort required was reduced. Specifically, the services which enSense Lite supports are:

- Email
- GitHub
- Evernote
- Twitter
- App.net
- Dropbox
- Bitbucket
- Facebook
- Google

Additionally, enSense Lite also provided the ability for users to add other services through Application Manual entry (to allow third parties to act as communication channels). This allows for users to integrate in-house communication tools into the platform.

Figure 37: Third iteration of enSense - Services

The most notable exceptions to this list were Skype and traditional phone calls. Skype was unable to be integrated due to the limitations of the API - in that the API was being removed and interacted with the desktop Skype client rather than the server. Phone calls were possible to add in through the Twilio service (which is a third party service); however, the setup procedure is far more complicated, and required participants to change their phone setup to make this work. Although Twilio provided a method to incorporate phone calls, it would be burdensome on the participants. Manual entry was added as a way for applications to add information into the context that was separate from existing types of communication. Participants requested this to be added as often they found they had new communication knowledge which was independent of existing communication messages (until now the assumption was that any data generated by applications could be stored as meta-data on top of specific messages).

6.7 - Competition Process

This section outlines the process undertaken to facilitate the evaluation of enSense as a platform. Applying a competitive aspect to collaborative design challenges to improve the engagement with groups is not new. Park, Son, Lee & Bae (2013) conducted Crowd VS Crowd, where teams of designers were teamed up with crowds (other individuals) collaborate to compete with other teams to develop unique solutions to design problems. "Contests are a historically important and increasingly popular mechanism for encouraging innovation." (Boudreau, Lacetera & Lakhani, 2011). To recruit designers and developers to test the system, a competition process was designed in which participants were encouraged to participate in creating a tool that helps in some way with communicating or interacting with clients and leverages their existing communication data by using the enSense API.

Potential participants were encouraged to think of everyday issues that they encountered with clients, and to think of ways in which these problems could be solved with applications with applications that could build on top of their existing communication archives. The competition was based on other similar competitions in the hacker and developer field, where participants are engaged to build applications on top of open data sources.

Rather than providing an incentive to deliver the best application based on a set of criteria, all participants who completed applications were offered a small prize of free services, as well as the code for the enSense platform in the future. This offer of access to the source-code aimed to provide some sense of safety in that any application that they developed could be used in the future. The registration for the competition was done through a website (Figure 6.16).
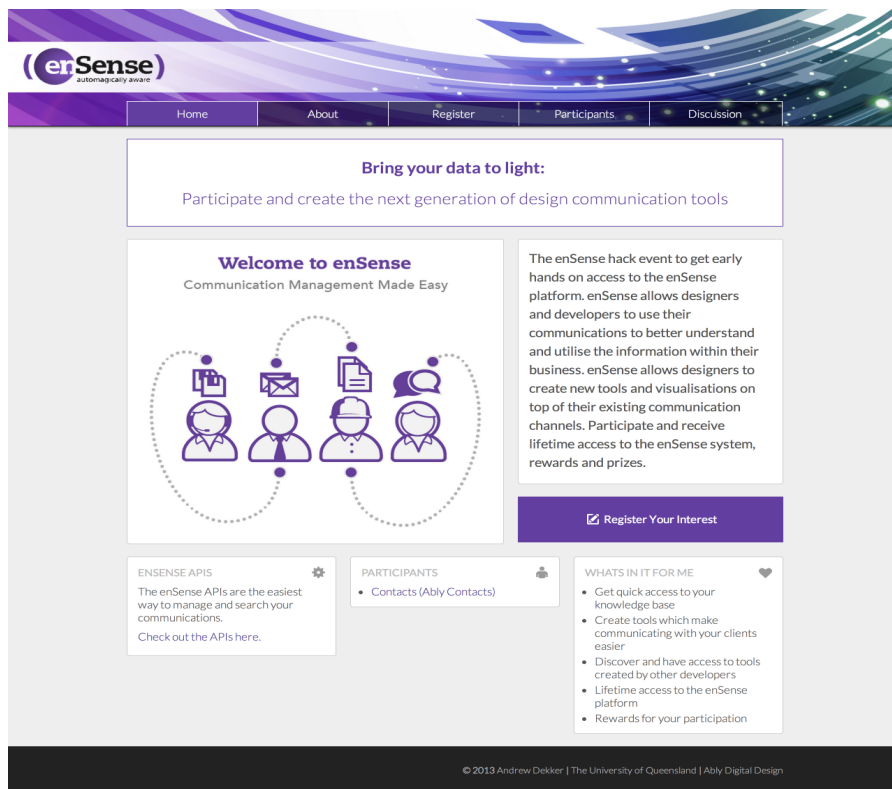
Figure 38: enSense competition website

The hack competition was advertised through prior connections developed through the study, social media and local web design networks. The hack had no official start or end date, and instead registration to the competition did not give the user immediate access into the system. On registration to the competition, users were given a number of details that they needed to fill in (with the assumption that more than one developer may be interested in the same project):

- The name of the team
- The name of the project
- The URL of the project
- A description of the project
- User details

This information would be inserted into enSense, and the account was set as disabled. This allowed me to review their project idea, decide whether the project would be feasible given the current state of the prototype and determine how long

the project would take to complete. This also gave me insight into what kinds of problems participants were interested in focusing on. The primary purpose of this was to ensure that the system was capable of supporting the kinds of knowledge and integration required, prior to them beginning development.

The design competition was limited, due to practical constraints, as well as the negative implications of adding additional competitors (Boudreau et. al., 2011). However, the authors found that in this study, multi-dimensional challenges have less negative implications in this regard. Rather, the competition was aimed to be a collaboration with both the competition organisers and the competitors, the competitive aspect was used as a way to promote the study, as opposed to looking for a ranked list of solutions.

A number of ideas emerged from the competition registration:

Real-time visualisation of communication:
The idea of the real-time visualisation was to produce a large screen display of all communication activity across a design firm in a node line visualisation. This visualisation would provide designers with a quick overview about which projects were being actively worked on and which designers were working on the project at the time. The visualisation would also show rich media that was being shared between the designer and client to see the current state of the project.

Project timeline archive:
The timeline idea was to produce a visualisation of all communication of a project so that designers could reflect on how long different aspects of the design process took. These timelines could be compared across many projects, to identify issues in the design process and examine the communication messages directly to understand the cause. The timeline could also give insight into when specific clients were most likely to be active, and which communication channels they were most likely to use.

Communication feeds:

The communication feeds idea, in the words of the participant, was to "create streams of communication, organised by the client/organisation". In this, the idea was to produce a Twitter or Facebook style feed of communication activity, ordered in chronological order, by all communication across the designers. Because of this, designers would be able to watch as new communication occurs in specific projects and also get up to speed quickly on a project with which they were unfamiliar. The concept was based on the need by the creator to be able to keep track of projects that they weren't directly involved in and know which projects were being actively worked on.

Design feedback communicator:

Suggested by a number of designers, this idea was to track design mock-ups and changes between the designer and client. As a designer sent mock-ups, and as the client responded with feedback, this communication would be captured and presented directly to the designer. An extension to this idea would be to directly incorporate the feedback into tools such as Photoshop. The designer would be able to directly send the client the mock-up (from within Photoshop to the client's preferred communication method), and as the client replied, these design changes would appear as annotations directly within the authoring environment.

To do list:

One designer mentioned that often their to do list was a list of requests from clients. The designer suggested that they would like to create a to-do list service which was automatically generated based on client communication, and that each to-do would be linked back to the original communication. Once a to-do was completed, the client would be contacted automatically.

Change log:

A large issue in web design is changes that are made to the design by the client after the contract has been signed. Web design contracts will generally include costing's involved with late design changes; however, these are often lost in the process. This

idea was suggested to track these changes, and to notify the client and designers with an updated list of changes and the costs involved. This would keep the client in the loop, give them immediate feedback to the costs involved in the changes and also automatically document changes for the design firm.

Automatically generated blog:

The automated blog was an idea that looked at being able to quickly publish useful communication directly to others within the design firm. Similar to Tumblr, the blog would include short snippets of communication that were of interest to other stakeholders. The information would be text, audio, imagery or video communication.

Raw details capture:

The idea that was suggested was to examine incoming communication for usernames, passwords and other specific information that the designers and clients would send. The service would collect this information and store it in an easy to browse interface. As these details were updated and sent, the service would identify them and update the details. The designer suggested that they do not have a centralised location for this, and their email is the only place that this is stored.

Attachments repository:

The attachments repository was an idea where attachments that were sent by clients were automatically categorised based on the content of communication. The idea was that clients often send many attachments of website content and images, and these attachments are often hard to find, especially when communicating with clients through multiple technologies. An extension of this idea by another designer was for a service which would automatically attach content sent by a client to a sitemap generated by the designer, so that content was easily accessible when designing the website.

From the concepts that were proposed through the competition, some of these proposals were carried through to prototypes (Chapter 7), either by the participant or

in collaboration with myself. Due to the scalability, technical and privacy limitations that were found in the research prototypes, not all ideas were able to be prototyped effectively (see Chapter 8.2). Very few of the proposals discussed how these new tools would integrate with the existing methods of communication that were present in their context.

6.8 - enSense: Summary

This chapter describes enSense - a prototype middleware platform designed to provide an API for designers to create applications that leverage existing methods of communication to support designer-client communication. The enSense API is a REST based API which captures information from a number of different sources of a user's existing communication methods. The purpose of the enSense API is to investigate what kinds of new systems can be developed if designers had immediate access to designer-client communication narrative. enSense has also been developed to better understand how to capture, categorise and contextualise the large amount of information already contained within existing communication channels. The platform captures information from a wide variety of communication technologies, including email, source code repositories and social media. Due to technical limitations some communication channels (in particular Skype and Phone calls) were unable to be effectively captured due to their lack of open API capabilities. The enSense platform leveraged a graph database for contextualising and creating relationships between messages across various platforms.

A focus for the design of enSense was to develop an appropriate architecture that enables applications to leverage the existing designer-client communication narrative that exists in a number of already-present channels. To do this, the architecture was required to be modular and had to integrate with a wide variety of communication technologies. In addition, the platform was required to work in a way where privacy was respected, yet at the same time enabled sharing of communication where it was appropriate. From the iterative design, I found that by creating repositories of communications, users were able to share a large amount of data using rules without it making all information public. The structure of these rules is similar to other systems and is an efficient way of filtering communication information. However, these rules may introduce problems when incorrectly created or misunderstood, or when unrelated messages match the rule. Because of this, the rule based implicit

sharing required users to be kept updated when information was being shared, and provide them with a delayed time in which they can act where necessary.

An unanticipated aspect of the enSense implementation was the amount of time required for understanding best practices for designing APIs for quick and easy adoption. Although there is some significant research literature into the technical design of API (Fielding & Taylor, 2002), designing APIs that are easy to understand, easy to adopt and easy to use (based on reference material) is lacking. Based on this investigation, it was found that the design of APIs provides seven features:

- Guides for getting the API configured and used as quickly as possible
- Libraries and tools to support a multitude of languages
- Standard API practices such as rate limiting and authentication
- Rich *API Documentation* for each API endpoint with a variety of descriptors
- All forms of error messages which may arise when using an API
- A quick and interactive interface to test API endpoints
- Ways in which the community of developers can comment on aspects of the API and share code comments

Overall, the implementation highlighted a number of technical and logistical issues related to capturing the entire narrative of communication across a number of technologies. In particular, some universally used communication technologies do not provide sufficient access without significant effort on the users behalf. In addition, the amount of communication knowledge present throughout a design project is spread across multiple communication channels and multiple users, and collection, categorising and using this information has many challenges related to privacy, big data and scalability. In addition, there is little research on designing user-centred APIs, in terms of designing APIs that are focused on ease of understanding, adopting and using them.

Chapter 7 - Applications: Case studies of using enSense

7.1 - Introduction

The previous chapter, Chapter 6, outlines the design of the enSense prototype platform, which was designed to allow designers to create applications to support designer-client communication within web design practice. This chapter presents an exploration of how the platform can be used through a number of applications that were created on top of the enSense platform. The purpose of this exploration is to how providing methods for integration with already in-use communication tools can affect the design of new communication tools (based on the challenges outlined in Chapter 5). This chapter goes through the design, implementation and use of a selected number of applications. Each of these applications builds upon the enSense platform to enhance their ability at supporting designers in their work with clients. Three applications are detailed: Communications Browser, Contacts and Progress Tracker. Interviews and data from each of these applications was collected to provide a detailed overview of the conceptual design, design evolution, implementation and the use of the application in practice. The focus of this chapter is to demonstrate a number of ways in which the enSense platform can be used to support the web design context, rather than evaluating the applications themselves.

7.2 - Communications Browser

7.2.1 Overview

A major challenge of designer-client communication is to be able to document and reflect on the entire collection of communications across the entire design process, and across the whole firm, rather than individually (Prilla, Pammer, & Grogstie, 2013). A primary method of organising communication information by users is through the ability to contextually search through the long history of communication (Grevet et. al., 2014), providing users with immediate access to the archive of the communication narrative. Reflection on the communication across the entire design process allows for the design firm to:

- Capture and document the design process
- Examine where communication was required within the design process
- Quickly find old messages which hold some importance
- Analyse the communication process for issues
- Compare communication process between a number of web design projects

The communications browser was an application that I designed based on a challenge that appeared, that the communication between designers and clients was never documented at a project level and was not able to be effectively visualised or analysed across the entire design project. Visualisations can assist in reflecting on past projects, which can help in the sense-making process (Weick, 1995). The design of the communications browser was done in collaboration with two design firms, each of which expressed their need to be able to capture their communication process.

The concept of the communications browser was to capture a snapshot of the communication between designers and clients both at the time of communication, but also of previous project work to better understand and reflect on prior work. This style of visualisation is conceptualised in a similar manner to the claims made by

Erickson (2003), in particular that the visualisation should portray actions (in this case communication between individuals) present from a third person perspective (so that users may observe their own actions inside the whole communication), and that it supports macro/micro readings (both the entire firm's communication as well as individual communications). The communications browser aims is an example to showcase the utility of enSense and to help designers in identifying and actioning communication issues within a project (by the designer's interpretation of either a large amounts or little active communication in stages of the design process).

7.2.2 Similar Work

Initially I conducted a background review on possible tools that could provide this insight, however there are no tools that allow a user to capture and visualise a variety of communication channels together to understand the complete narrative. Tools that do present visualisations of communication do so at an account level, such as representing an entire email account's communication.

Immersion (Smilkov, 2014) allows users to select their inbox and visualise the people that they have communicated with over time (Figure 39). The intuitive interface allows users to select a specific time period and also re-centre the visualisation based on a specific contact. The visualisation uses a node-line based visualisation and is quick and intuitive. However, its use is limited within the context of designer-client communication:

- There is no way to isolate a number of contacts or messages related to a specific project
- The visualisation is not understandable based on time
- There is no way to filter the content of the messages to isolate their meaning
- The communication is limited to a single account
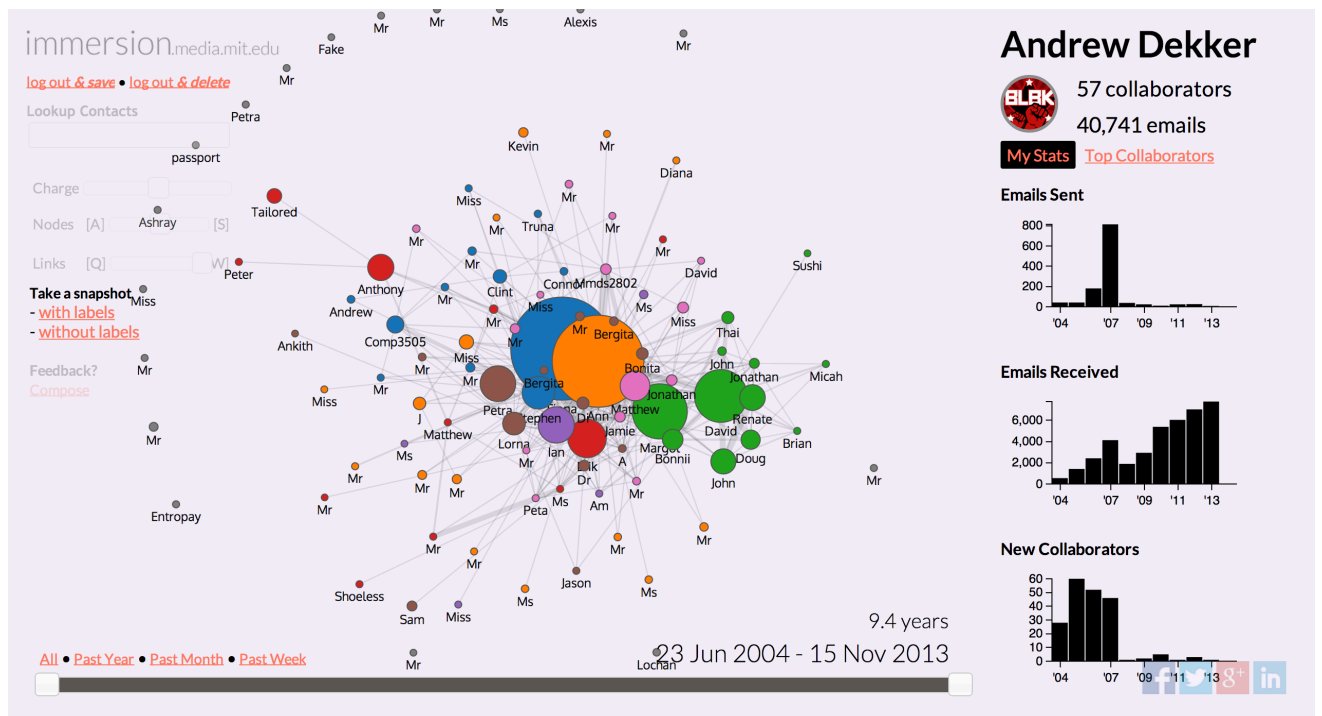
Figure 39: Immersion (Smilkov, 2014)

ThinkUp[5] is a service that provides analytics about a user's social media usage, and combines both Twitter and Facebook data (Figure 40). Although not directly relevant to designer-client communication, ThinkUp provides a strong architecture for capturing information from a number of sources and aggregating them to give insight into social interaction amongst groups of people.

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[5] https://www.thinkup.com/
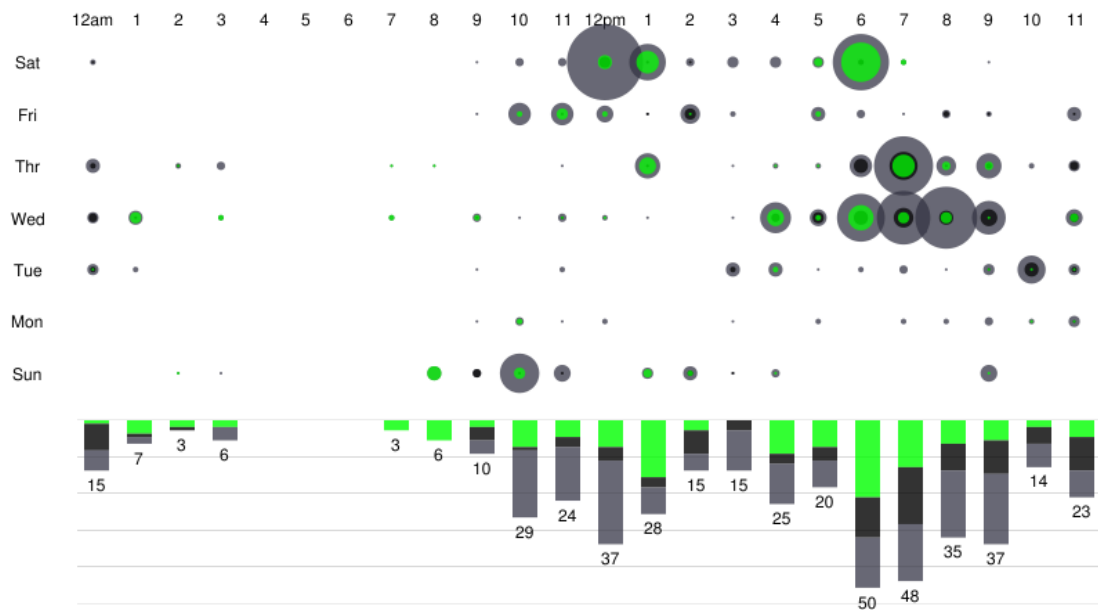
Figure 40: ThinkUp

Blueprint+ (Polaine, Aebersold, Bossart, & Mettler, 2009) is a method of visualisation for designing the flow of services that involve a number of participants. This method of representing service flows gives a visual representation to a narrative and gives an understanding of the relationship between different participants within the overall narrative. Although this representation is presented as a way in which designers can plan services, it presents an opportunity for visualising current and archived projects to enable users to reflect on the design and communication process with clients. In particular, Blueprint+ aims to include users emotions into the visualisation, although this cannot be accurately understood through communications, there is some level of approximation of the emotion or action within the communication that the system can understand.

Kalman and Ravid (2014) conducted a study where they visualised email inbox activity and management strategies of knowledge workers. The study finds that the strategies users employ to maintain information overload are diverse, and change between categories over time. In particular, the authors highlight the lack of longitudinal studies within this area and visualise the diverse nature of email inboxes.

7.2.3 Design Process

The design process was first focused on understanding which visualisations provided the best sense of a medium term (weeks) of communication between a number of people. Although many visualisations can effectively represent this, there are two dimensions that need to be considered, time (in the overall narrative) and the relationships between individuals through communication. Based on this understanding, the Communication Browser was designed to provide two visualisations, which could be filtered based on search terms:

a) A graph of the communication to view the relationship between individuals, and time is shown through interaction with the sliders on the right side (Figure 41)
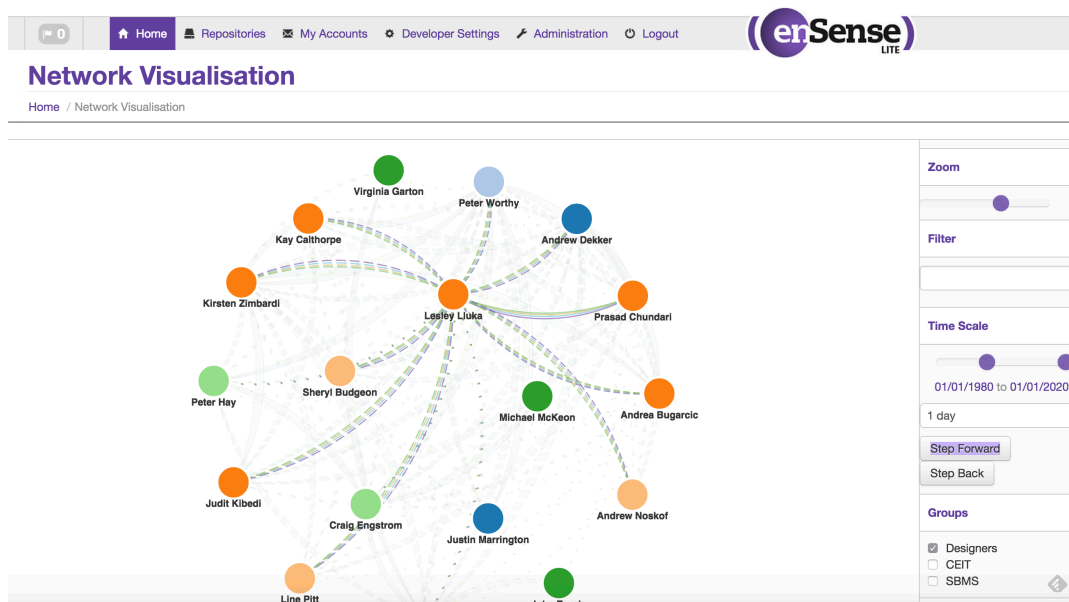
Figure 41: Communications Browser - Graph

b) A timeline of communication to show how types of communication occurred over time (Figure 42)
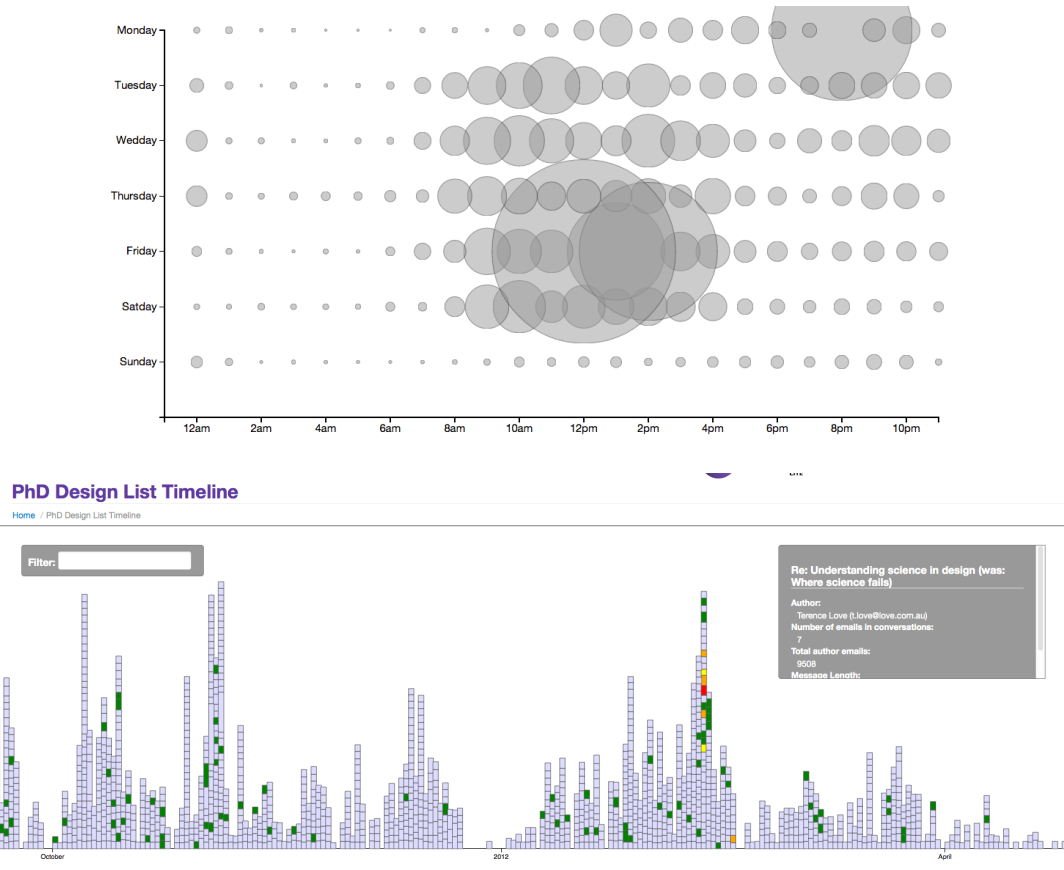
Figure 42: Communications Browser - Timeline

7.2.4 Implementation

The communication browser was developed using a variety of web based tools, primarily Angular JS to structure the interaction, and d3.js to provide the visualisation. The visualisation is represented in two ways: firstly as a graph between multiple users to understand their relationship (similar to Immersion (Smilkov, 2014) but within a pre-defined project) and a timeline to represent communication over time. Many of the enSense endpoints are used in this application, in particular /messages and /users, with specific date range filters.

7.3 - Contacts

7.3.1 Overview

A major problem that was highlighted by designers during the interviews and research into the web design context was the inability to efficiently find contact information and information within archived communication quickly and effectively. The contacts application builds on top of the enSense platform by analysing communication across a number of channels and providing users a way to aggregate accounts together based on whom they belong to. For instance, a client may email from two separate email accounts, as well as having Skype, Dropbox and Twitter accounts that they use to contact the client. The Contacts application allows the user to easily aggregate these client accounts into a single contact. In addition, the Contacts application can provide information related to the person on how active they are on each account, which allows the designer to better understand which account is preferable to send information to the client.

In addition to aggregating client information, the Contacts app allows designers to quickly search all communications related to that client regardless of which method of communication they sent it through. This allows designers to search all their communications (whether it be Email, Twitter or Dropbox files) based on the user who created the message. This allows clients with immediate access to communication for a specific client. There are a number of situations where this is beneficial:

- Looking for a specific piece of information
- Keeping track of unanswered messages for each client
- Quick access to communication on mobile devices
- Understanding the best method of contacting a client at the time

The Contacts service is not designed to replace existing mail clients; instead it is a helper to quickly understand the current status of communication, quickly find

specific communications from a client, and understand the best method at the time to contact clients. The service was designed as a web application, so that it could be used independent of the platform.

7.3.2 Similar Work

Many operating systems and email service providers provide ways in which email can be quickly filtered based on search terms for a specific client. During interviews with web designers (Chapter 4.2) and in the Newscube case study (Chapter 3.6), this ability to quickly find information with emails for a particular client was determined to be a valuable asset to designers. However these applications are based on a single account per person, and searching is performed within an application for a specific communication channel. Many operating systems now provide a universal contact list where many accounts are collated for a single contact; however, these systems do not provide instant access to the messages for that user. Some innovations have been conducted in this area, such as the group-collated feature in Windows Phone 8 and Blackberry messages; however, these systems are yet to become mainstream and work for arbitrary communication channels.

Unibox[6] is a recent email client that presents its interface as a "people-centric email client" - where emails are collated based on contacts rather than by the accounts setup (Figure 43). This allows designers to quickly peruse messages for a specific client and search for content within conversations with the client, rather than searching the entire account. However, Unibox focuses primarily on searching email, and doesn't have support for other communication channels. In addition, Unibox is focused on the type of message found in traditional email, rather than supporting other forms of searching (such as searching for comments on Basecamp or Dropbox files).

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[6] https://www.uniboxapp.com/
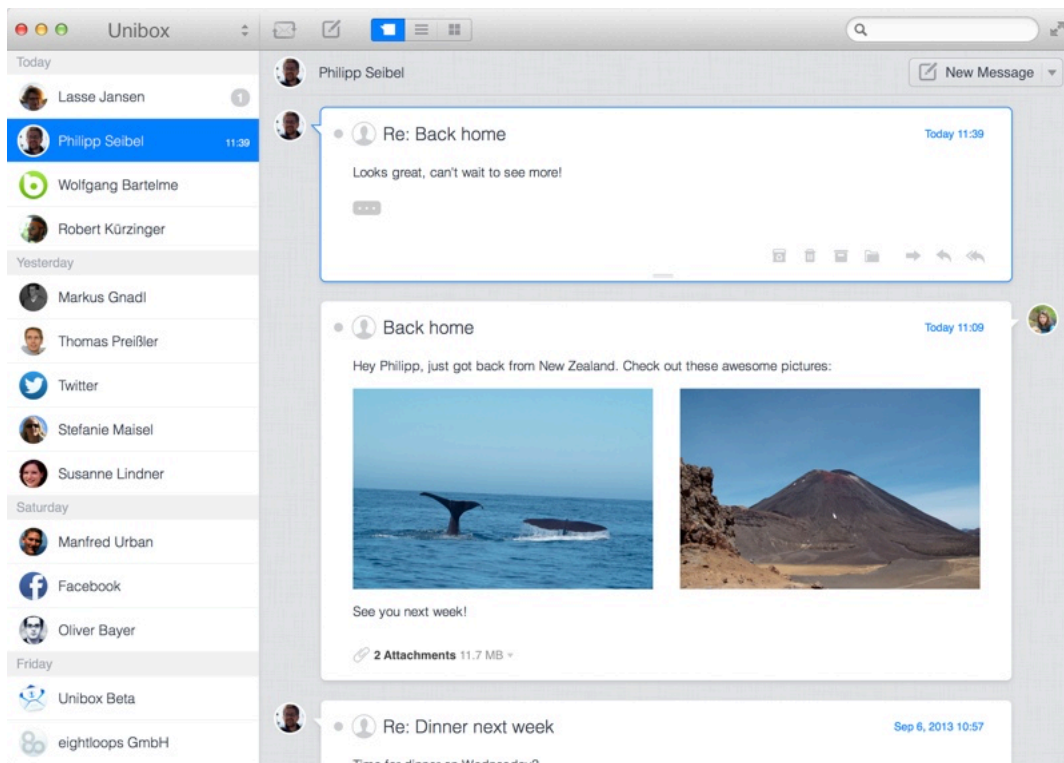
Figure 43: Unibox

7.3.3 Design Process

The Contacts application takes inspiration from many of the popular address book interfaces, by providing a quick list of all the contacts within the designer's mailing list (Figure 44). When the designer clicks on a contact, their information is then displayed, with the ability to modify the contacts information or add and remove other accounts to the same contact. In addition to this contact management, the application provides a list of all conversations with the contact, in the order in which it was received (with the latest messages first). The designer then has the ability to change the ordering of the messages or filter the messages based on search terms.
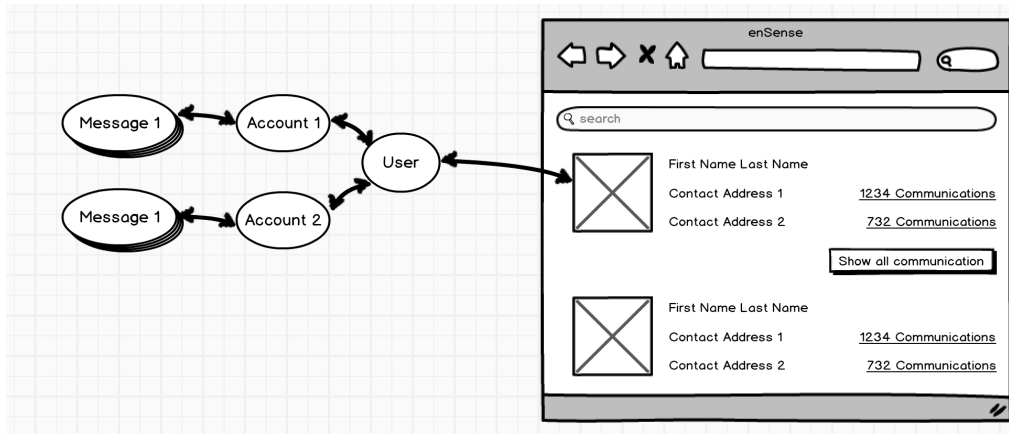
Figure 44: Contacts - Concept

The aim of this design was to be as simple as possible for designers to quickly browse conversations based on existing messages. As well as seeing their own conversations, the Contacts application will also show conversations that have been shared by other designers. This allows the designer to see all interactions with the client, including those that they haven't received directly.

7.3.4 Implementation
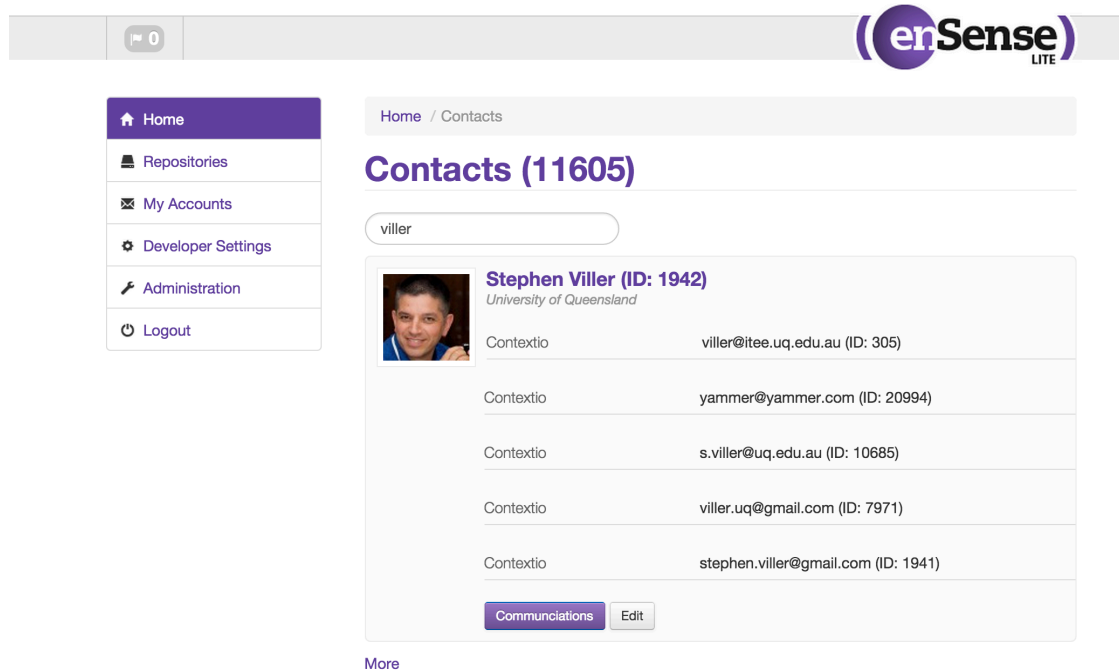
Figure 45: Contacts – Interface

The Contacts application is a web application written primarily in client-side technologies (HTML, CSS and JavaScript), but also uses a server-side architecture (PHP) to assist with caching and rendering of the conversations. The server-side application interacts with the enSense API, and then provides data to the interface to display. Angular JS and Bootstrap are used primarily to provide a simple and responsive user experience for designers whether they are using a computer or mobile device to access the application (Figure 45).

7.4 - Progress

7.4.1 Overview

Progress monitors actions performed by designers as they work to help capture their work over time and share it with others (available at getprogress.com) (Figure 46). The application was originally created independently of the enSense API, and then adapted to leverage the information within enSense. A participant, who is a web designer by trade, created progress. The participant describes Progress as an automated visual diary:

> *In its current iteration, Progress is a digital visual diary app. Just like a physical visual diary; Progress lets people (in this case, designers, developers, digital artists, hackers etc.), keep a daily journal, containing a mix of words and pictures. However, being a digital visual diary, Progress has some features that a standard diary doesn't. The app itself runs on a computer, and lets users 'watch' a folder for a project for changes. Whenever a change is detected, Progress records that the user is working, and keeps track of how much time they have spent for the day. It also prompts users to take screenshots of their work. (Designer of Progress)*

In addition to tracking the moment-to-moment work of a designer, Progress also provides an awareness feature that allows designers to be able to see what others are working on.

> *Users can comment and discuss the work each other are doing. Progress lets you also see anytime someone else in your network is working, and what they are working on. This can be shared to other designers, colleagues or clients. (Designer of Progress)*

I approached the participant to see how enSense could be integrated into Progress to give more contextual information to the visual diary, in particular times in which designers were communicating with clients. This integration with communication allows designers to see how their work changes based on communication with clients, and also see when snapshots of the works are sent to clients for feedback. Designers may also wish to share their diaries directly with clients.

When discussing with the participant the potential of incorporating enSense, a number of ideas about how enSense could augment the experience of Progress were generated:

> *I would like to integrate with enSense in two ways. Firstly, I would like enSense to let Progress know whenever someone is sending an email that relates to a project. Sending and replying to emails is a big part of my day, and currently, Progress doesn't really consider this as me 'working'. Using enSense to supply progress with that data, even if only for tracking how much time I spend on a project, I think would be a nice feature. Secondly, I would like to be able to share information from the visual diary back out to the clients through Progress. The ability to send an automatically digest email to clients of the progress being made would be great. As I use GitHub a lot, I would also like it to feature inside Progress. (Designer of Progress)*
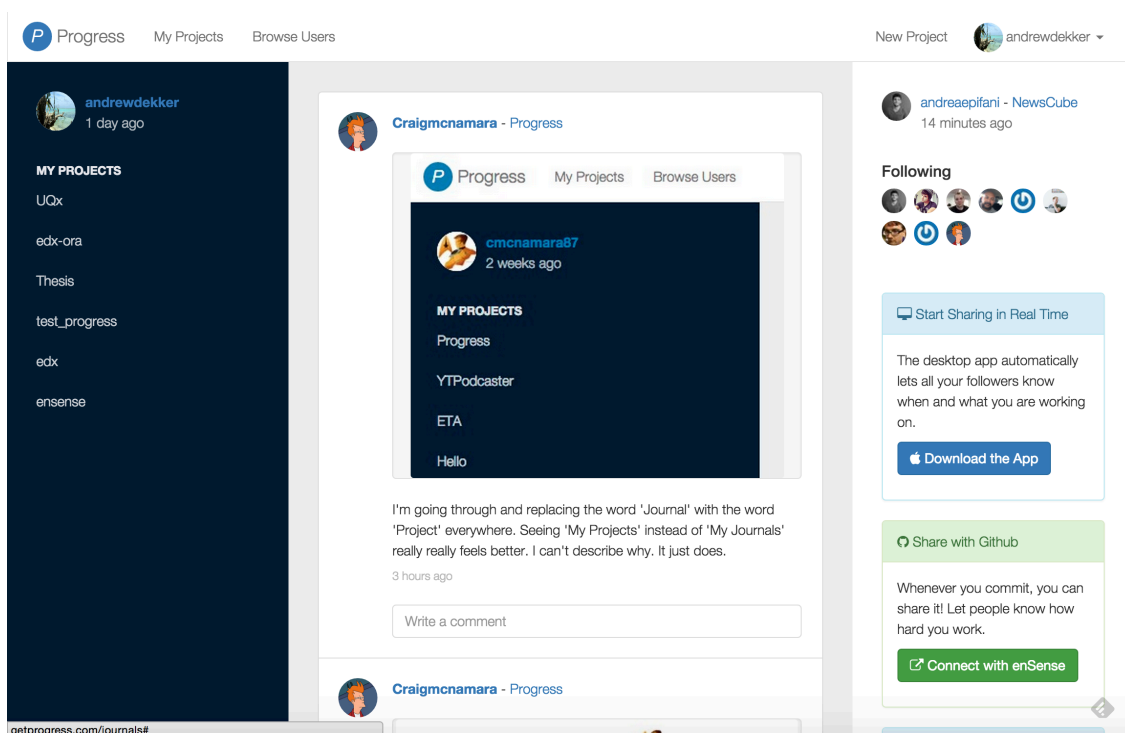
Figure 47: Progress Interface

7.4.2 Similar Work

Although a visual diary is a well-known method of reflection and documentation for designers, designers, rather than being automatically generated traditionally maintain visual diaries:

> *In the physical world, a visual diary / art journal is what it's similar too. But as for digital tools, there aren't many that try to do what Progress does. Dropbox is probably the closest. You have the awareness that other people are changing files on a project you have a shared folder on, and you can also share screenshots with other people. Though Dropbox can tell you files have changed, it doesn't really convey the 'progress' that has been made, you have to go try and work that out yourself. (Designer of Progress)*

Day One[7] is a diary tool popular with designers; however, it does not support automatic sharing aspects of specific diaries or automatically generated information based on what the designer is currently working on.

CaseLine (Bohøj, Borchorst, Bouvin, Bødker & Zander, 2010) presented a visualisation tool that aims to provide awareness and implicit collaboration between caseworkers and other members of the public. Users construct the visualisation through a timeline interface. The visualisation is focused on both implicit awareness between users but also affords direct methods of sharing information. The study shows that "timelines have potential outside of visualisations, and that they can be used for collaboration and as a boundary object between parents, caseworkers, and other stakeholders." (Bohøj et. al., 2010) within a caseworker context. Their work suggests that the timeline method of shared visualisation has the ability to show the complexity of contexts when many stakeholders are involved.

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[7] http://dayoneapp.com/

7.4.3 Design Process

The initial conceptual design of Progress was to be an internal communication and awareness tool amongst designers - a journal for a team of designers. This allows designers to continue to work, and allow the Progress tool to capture their work, and present it to other designers without requiring any intervention. Designers can also share screenshots of their current activity. The design of the application followed a highly iterative process, whereby the tool was developed over three weeks to the level of a Minimum Viable Product (MVP), and then iterated upon based on user testing feedback (Figure 48).
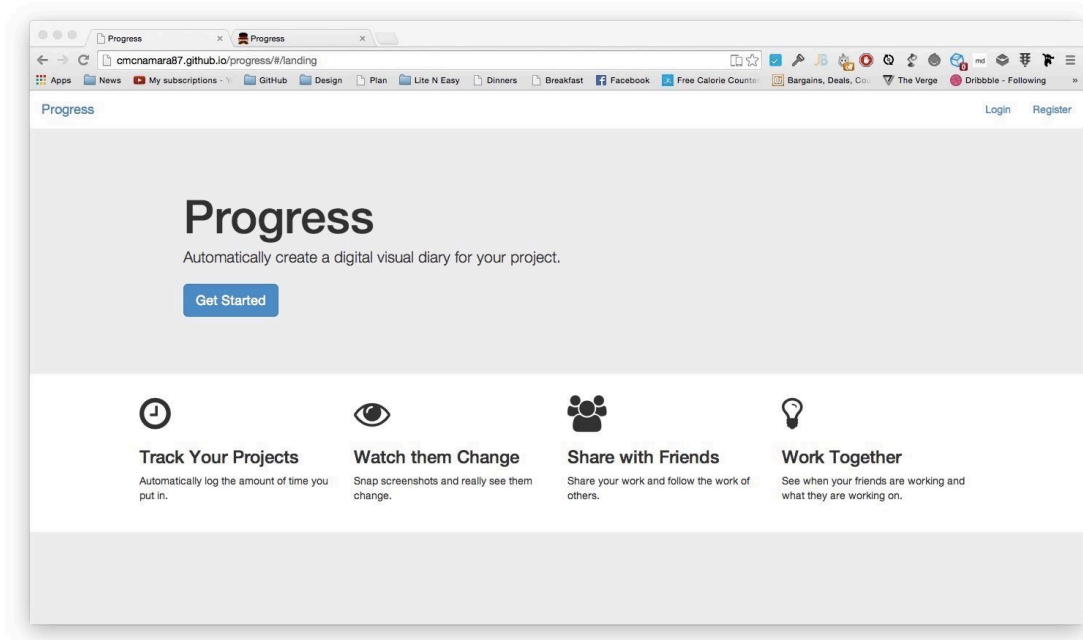
Figure 48: Progress - Minimum viable product

Based on the MVP, additional features were tested such as screenshot detection and uploading images. The focus was on being able to upload multiple screenshots simultaneously. The original system was focused on the time tracking, rather than the diary web interface (Figure 49).
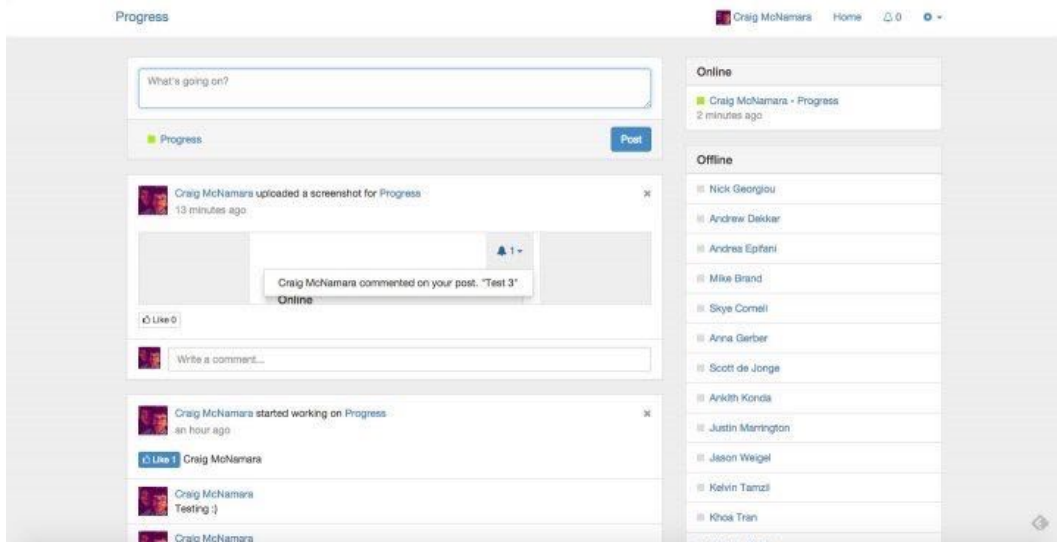
Figure 49: Progress - Diary interface

Based on feedback and reflection, the system was rebuilt with a focus on awareness with social feeds. Notifications were a central focus of this, providing awareness of others users activity back to the desktop application Figure 50 and Figure 51).
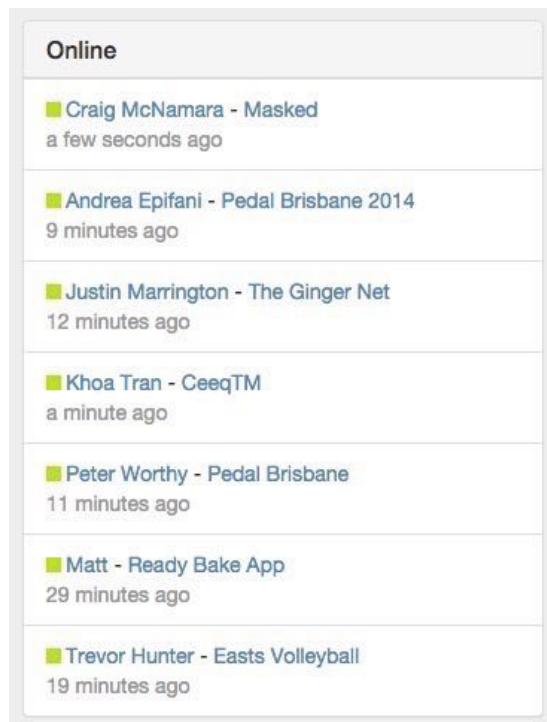
Figure 50: Progress - Awareness of other designers
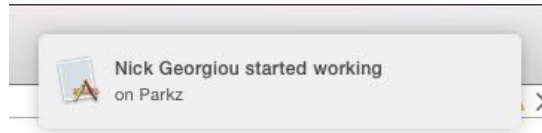
Figure 51: Progress - Desktop notifications

From this prototype, the service was further refined to focus not only on awareness, but on knowledge transfer between designers. Users not only used it to be aware of others' activity, but also used it as an informal and in the moment mechanism for providing feedback. Although some of the users used it for client awareness, the majority of use was for commenting and providing social interaction for the community of designers.

Despite these features, information related to the body of the communication was absent, and screenshots of work in progress would change dramatically without any observable reason. However, the underlying reasons for this was due to the nature of client feedback in many of the projects.

enSense was integrated into Progress to help alleviate this problem, and to better represent projects Progress over time. enSense would post on behalf of the user whenever they communicated with the client (through Email). In addition, work committed to GitHub (essentially milestones) would also be posted with the commit message (Figure 52). This enhanced feed gave a much better representation of the work over time, and the reasons for certain design decisions. Due to the privacy of Email, the contents of the Email would not be shared, only that communication occurred.
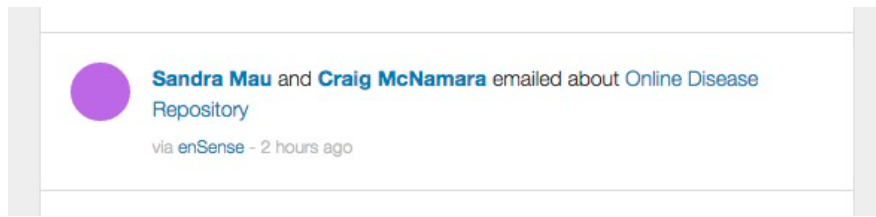
Figure 52: Progress - enSense posting on behalf of the user

Based on the feedback from users with regards to enSense and Progress integration, private projects (which aren't visible to followers) would allow for more detailed information to be shared about communication and would help give insight into the core reasons for design decisions.

7.4.4 Implementation

Progress is a combination of a web application and a desktop client for Mac OS that was implemented by the participant. The desktop application watches folders that the designer chooses that hold project assets. These may be documents, graphics or code assets (or other forms of media). As the user interacts and saves these files, the desktop client detects this and tracks how the file is changed. The application detects which assets are being accessed over time, and sends this information to the server. Designers can change which project they are working on by changing the assets which they interact with, there is no need for the designer to manually change which is the active project. The desktop client will also prompt users to take screenshots, which are captured by the desktop client and uploaded to the web application.

The web application presents designers a feed of their work over time, which can either be private or public. The designers may choose to share this explicitly with their colleagues or clients or analyse and reflect on their work over time. enSense integration allows the web application to also include information about communication between the designer and client over time - showing where communication occurred within the project's work. In addition, the designer may set Progress to automatically update the client with progress as certain intervals. The

desktop application is created in Objective-C and the web application is written in PHP and HTML/CSS/AngularJS.

enSense was added as a button into the Progress home page, and when clicked users would see the enSense connect page, where Email and GitHub accounts could be connected (Figure 53). Once connected, enSense would check their accounts, and match any seemingly related messages. Progress provided enSense with an updated list of projects, as well as meta-data keywords that could be used to filter messages. These messages would then be posted automatically into their progress feed based on the project which best matched their projects meta-data.
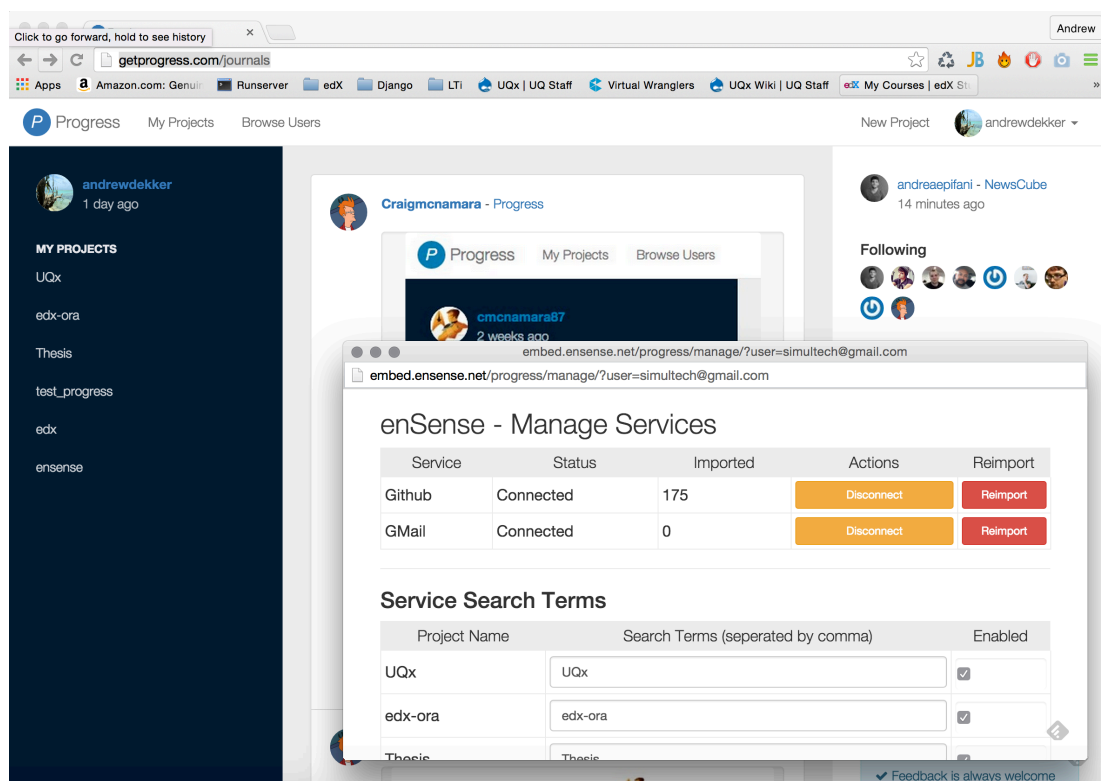
Figure 53: Progress - The enSense Connect interface

7.5 - Applications: Summary

This chapter presents three case studies of applications that were developed using the enSense API. The Communications Browser leverages the ability of enSense to capture an entire communication narrative of a web design project, to provide insights to the web designer that they can reflect upon. The Contacts application provides a way for designers to manage and track their clients accounts across a variety of communication channels and provide quick and easy search access to retrieve knowledge given by knowledge without searching across different mediums. Finally, the Progress Tracker application is a lightweight and existing application which tracks designer time across many projects. This application augments itself through communication data to create extra information about how designers work on particular assets within a project map and communicate between other designers and clients. Progress Tracker also allows designers to quickly provide updates to clients on their work and shows how designers with multiple clients switch projects based on messages received by clients.

Each of the applications described in Chapter 7 focuses primarily on solving a single issue related to existing design client communication. While these applications do not take full advantage of the enSense capabilities (in particular aspects related to sharing meta-data), the applications show how having access to the communication narrative enables new types of tools for supporting communication as well as enhancing existing applications.

The applications show the potential benefits of a platform such as enSense, as well as the limitations that the platform doesn't overcome. In particular, the platform is well suited to taking existing communication, and presenting it in a different manner. Additionally, the ability to store meta-data on top of messages is very powerful, especially when it can be shared across systems. As information from the Progress Tracker is provided to the client, the Contacts application can see that the progress was made aware to the client. However this inter-connectivity is conceptual rather

than implemented in these case studies (due to the limitations of the enSense Lite implementation), the potential benefits of this added meta-data mean that as applications are used, all applications which leveraging communication data gain a better understanding of the communication narrative. The biggest reflection from these tools is that they do not try to act as major methods of communication, rather they enhance the existing methods, building new methods of interaction with the same kinds of information that is already present in tools such as Email.

Chapter 8 - Evaluation: enSense and the DCC Categorisation Tool Canvas

8.1 - Introduction

This chapter provides an evaluation and reflection of the enSense framework, through its use by designers to create new tools to support designer-client communication tools. An analysis on how designers interacted with and used enSense details how enSense was tested using a competition for engaging with communication tool designers. A series of interviews with the participants who developed tools using the platform is used to understand and reflect on the design of enSense.

The canvas serves two purposes in the context of this thesis. As a framework, it is an encapsulation of the designer-client communication process that has been identified in the investigations reported here (Chapters 3-5). In this sense it is presented as a research output. At the same time, however, it has been designed in such a way that it also functions as a tool for people engaged in designing communication support for the web design context. For this purpose, it aids designers of communication tools to identify and acknowledge challenges within their own context and identify possible solutions by reflecting on their existing communication ecosystem.

The DCCT Canvas is not a fully comprehensive framework for designing CMC tools; it is instead a guide that assists designers in better understanding the problem context. The Canvas specifically aims to provide designers of CMC tools methods to create tools that better support designer-client communication rather than being

focused on tools for internal use. To illustrate the use of Canvas examples of its use are given based on the previous observational case studies (Chapter 3.5 and Chapter 3.6), as well the tools designed through enSense Chapter 7. A workshop was conducted to understand how web designers interpret the Canvas and how it works in explaining the problem context. Additionally, the workshop examines the ways in which web designer's work through the Canvas with communication issues they have knowledge of and discuss how the Canvas can help in their design of better tools.

8.2 - enSense Designer Interviews and Reflections

This section describes the analysis of the enSense prototype platform from the perspective of designers who are interested in tools design. The analysis of enSense was conducted through a series of follow up interviews with designers who worked with the system, as well as those who didn't but were initially interested in trialling its use within their design firm. The evaluation is focused on understanding the potential of platforms such as enSense. The evaluation was focused on participants who were willing and able to use the prototype system, and were willing to prototype on a research platform.

8.2.1 enSense Interviews

The interviews were conducted with a subset of the same participants as the initial interviews conducted (Chapter 4.2) and workshop (Chapter 8.3) – with a total of six participants.   The experience of these workers ranged from between less than a years' experience to over 20 years in the industry. Each participant either worked as a designer, developer, project manager or director within their respective web design business.

Table 9: enSense interview participants

Person ID	Business	Role	Experience	Used enSense
Participant A	1	Designer	7 Years	Yes
Participant B	2	Full Stack Developer	6 Years	Yes
Participant C	3	Designer	3 Years	No
Participant D	4	Developer	8 Years	Yes
Participant E	5	Project Manager	20 Years	No
Participant F	6	Front end developer	2 Years	No

The participants had varying levels of interaction with enSense, with three of them using the system directly and others only interacting with it through interviews and other interactions with myself (which helped guide the self-implemented case studies). It is worth noting that these interviews only focused on users who were either involved in the enSense trial, or those who were requesting the use it. People who chose not to participate in using enSense were not interviewed (due to ethics procedure). This may have lead to a positive bias in the interview responses. The interviews were focused on 6 topics that were covered in an informal style of questioning.

How did you find working with enSense? If you didn't, what reasons did you not?

This question established a base understanding of how familiar the participant was to the enSense platform. As few of the participants were involved in building applications using enSense, it was important to understand the reasons why, and whether it was due to practical reasons or due to the design of the platform.

Not having used enSense, but seeing the examples:

> *Yes - after using Basecamp and experiencing the problems I did think about creating something like enSense, some way of pulling all of the different communication and documentation channels into one portal. However time is a limiting factor, especially when working with prototype software that can't be thought of as a long term investment. (Participant C)*

Having used enSense:

> *It was extremely easy to integrate enSense into my application. I was expecting longer to integrate other methods of communication than being able to plug into a service. The integration works surprisingly well, and it had sensible default settings, I didn't have to change much functionality or design on my side. It would be different depending on the context and keywords supplied, however in my context it worked well. Some functionality was missing (extended GitHub functionality), which would be beneficial in the future. (Participant B)*

Are any of the applications which have been prototyped or designed for enSense appropriate to your context?

Participants were shown some examples of applications that were developed in the platform, and asked whether they felt that any of the tools would be relevant in their own work. The purpose of this question was to understand whether the tools which were designed were firm-specific or something which was relevant to other firms.

> *As a freelancer, I would definitely use a platform that integrates communication tools and address book. Something that could be universally used and would support any sort of I/O would be absolutely great, that way I could ask my clients who prefer to use emails to email me at a specific address and all the messages would get into the platform which would then take care of organising messages by client, in a unified way and, maybe, also prioritise work according to keywords in the messages… If the platform was then integrated with Skype, Facebook and other communication channels, I think it would be much easier to keep track of all the communication that happens between me and my clients as especially in the last couple of years, people have been using any sort of way to get in touch and all the important information about their work is everywhere and sometimes hard to recollect. (Participant F)*

Participants were keen on tools that provided direct relevance to their design firms and tools that could be used immediately. All but one participant provided ideas about how both the Communications Browser and Contacts services could be extended:

> *I would love to be able to look at communication over the scope of a project, and see, you know, a graph that showed where the project slowed down. Especially over a lot of projects, that way I could see where I could streamline my process. (Participant C)*

What are your thoughts on integrated communication technologies? Do you have any thoughts or concerns based on the enSense platform?

The purpose of this topic was to understand whether the designer feels that the enSense platform provides benefits by allowed integration between communication

technologies, and whether the designer has any concerns, in particular around privacy, awareness (of what is happening within the platform), or whether it may inadvertently affect other methods of communication.

> *New tools probably wouldn't be adopted. Everyone pretty much does their own thing. (Participant B)*

> *I think it's mostly good; however, there is a fear of accidentally sharing something that was not meant to be shared. Especially when things are automatic, you don't have direct control over what is shared. It's a case of trading privacy for convenience. (Participant F)*

This concern was seemingly universal throughout the design of enSense, with designers throughout the creation stating their concerns with how their privacy would be impacted by such a system. Participants did not appear directly averse to automatically sharing information; however, they wanted to be informed when sharing occurred.

How important was the API documentation? Were there aspects of the API that you would change?

The question of *API Documentation* is focused on what the designer thought of the API documentation of enSense, and how it compared in usability and learnability compared with other types of API documentation. This is of interest when considering how the platform was to work with, in particular in understanding through the use of these human-centred APIs (Section 6.5).

> *I think it is crucial to have well documented APIs… However, when not possible to document everything or when documentation are not available, it could be cool to have some sort of tool that goes thru all the API code and generates documentation according to the structure of the API functions... (Participant E)*

> *API documentation is very important. I like having a lot of examples in the API of how you would perform common tasks, not just listing what the API can do. (Participant A)*

The quick-start guide was very helpful, and the defaults in the system meant that it worked out of the box. I didn't read too in-depth into the documentation, but for beta documentation having status lights were useful. (Participant C)

API Documentation was less important to the participants than originally anticipated; however, this may be due to the emphasis placed on creating documentation that was similar in nature to other commercial offerings. The status lights were stated to be very useful in having transparency as to the current state of functionality in the platform.

How do you see adoption of communication tools that are based on enSense within your design firms?

This question is focused on whether communication tools that build on top of other forms of communication have a stronger perceived level of adoption amongst designers. In particular, this topic is about discussing the problems with adopting new tools, and whether enSense (and similar platforms) reduce or negate this challenge.

I think it sounds like a good idea. That is how everyone prefers to communicate, and I like how GitHub has integration with email, so more of that would probably be good. (Participant C)

Participants were again concerned with privacy especially in the professional context. Participants were interested in the idea, and were keen on tools building leveraging existing communication, but were less concerned on how it was accomplished.

It would probably be okay; the big thing would be privacy. Personal data is fine; however, as an employee my boss has to take responsibility for sharing the organisation's data. (Participant A)

What do you see as the role of platforms like enSense in designer-client communication tools in the future?

This question seeks to understand whether the designer feels that platforms which collate and aggregate communication channels are central to providing better designer-client communication within web design businesses.

> *In general, I think these sort of applications will become more and more important as the number of communication channels increase… I think the easiest way for people to switch over to a different platform would be to integrate the platform with as many external services as possible so that they wouldn't have to learn a completely new system. (Participant B)*

> *I would definitely use it again if it aided in the communication (I use GitHub now mainly for that reason). (Participant C)*

> *I think that things will become more implicit and less explicit, you won't have to go out of your way to provide awareness. Having a communication pipeline integrated with activity will reduce a lot of time spent on mundane communication to know where things are up to. I spend a lot of time on making others aware of where I am up to with my work. (Participant F)*

Participants were positive that aggregating communication channels into programmable APIs would allow new methods of communication that are easier to adopt. A number of participants were positive with regards to future tools that clients could use without adoption; however, they were wary of how well they would integrate based on existing tools, citing their previous bad experiences with tools such as Basecamp.

8.2.2 enSense Reflections

Overall the enSense prototype demonstrates some of the benefits that can come from integrating new communication tools with the existing communication ecosystem. However, the nature of the study (and lack of long-term evaluation of the tools) means that the success of adoption could not be evaluated directly. The implementation of the enSense prototype was more challenging than first anticipated. By extracting the entirety of the existing communication context, the amount of information and their complex relationships was difficult to model effectively, and was hard to relate concepts in the data due to the lack of identifiable

meta-data. This in large led to the issue of scalability in the study, with additional design firms dramatically increasing the amount of data being analysed and stored. Additionally, the development of a REST API that was robust and at the level of commercial APIs proved to be beyond the scope of the research. While proof of concept applications were developed and evaluated, deploying these applications into web design firms was impractical due to the amount, complexity and abstract nature of communication data across a web design firm. Additionally there were concerns around privacy due to the prototype nature of the platform.

Despite the challenges with the implementation and evaluation of enSense, a larger issue (and in turn finding) was in how tool designers thought about building on top of the existing the communication ecosystem. Designers were happy to leverage existing communication channel information, but were less inclined to think through the ways in which new information could be sent back through existing channels. Throughout discussions with designers it was apparent that a major issue with regards to this is their lack of reflection on the existing communication channels and how they are used in practice. This was also seen in the proposals suggested in Chapter 6.7. In addition, the proposed solutions were designer-centric, in that they thought about how the solution would affect them but not their clients. This issue is similar to the issue of existing tools that use two-way integration with other services such as email (Chapter 4.4). enSense shows a number of potential directions that could assist in the creation of new methods of communication tools by reducing the challenges associated with adoption (as proposed in Chapter 5.4). A major finding for the design of communication tools, is that integration needs to be considered early in the design process rather than added on at the end to be most effective.

8.3 - The Designer-Client Communication Tool Canvas Overview

8.3.1 Canvas Foundations

This section outlines the Design Client Communication Tools Canvas (DCCT). A major finding from the challenges which are identified in Chapter 5, as well as the design and evaluation process of enSense (Chapters 6 and 7), is the lack of consideration given by designers to the pre-existing communication channels within web design businesses.   Tool designers found it difficult to understand the problem they were aiming to solve from the client's perspective, and how their solutions can build on existing methods of communication. Although enSense provides a large amount of functionality to simplify this process, tool designers were continually challenged with how to conceptualise heavily integrated communication tools. This presents a need to assist designers in considering and reflecting on the existing communication ecosystem to understand how they can leverage existing communication channels. As stated previously, web design firms have the expertise and knowledge to create new methods of communication, but instead they rely on pre-existing solutions.

The DCCT Canvas outlines a series of considerations that can be used to assist creators of communication tools to better support the context of designer-client communication. The design of the Canvas is to help designers understand the problem and the context, and develop communication technology concepts with respect to these aspects. The Canvas does not present rules or strict guidelines, rather it is a way for the designers to express and reflect on the problem context.

The DCCT Canvas takes inspiration from a number of existing design frameworks, in particular the Frogger Framework (Wensveen, Djajadiningrat, & Overbeeke, 2004), the Locales Framework (Fitzpatrick et. al., 1996), the Design Framework for mobile systems (Dix et al., 2000) and the Design for Location (Macdonald, 2005).

Additionally, the visualisation and organisation of the Canvas takes much inspiration from the Lean Canvas (Maurya, 2012), which is in turn inspired by the Business Model Canvas (Osterwalder & Pigneur, 2010). Each of these frameworks and Canvases were analysed to understand how they contribute to their context by providing a number of considerations and concerns which are organised for the purpose of assisting in the planning and creation of solutions to contextual problems.

The Frogger Framework (Wensveen *et al*, 2004) provides a list of characteristics that demonstrate coupling between actions and functions when users interact with physical objects. The authors then present the existence (or non-existence) of natural couplings when users interact with digital interfaces and examine the feedback and feedforward of these interactions. From this examination, the authors present a framework that helps illustrate the couplings and interactions between users and specific objects (whether it be digital or physical). The authors present the framework as a tool that can assist designers on iterating existing designs by identifying (using the framework) un-natural or broken couplings, in particular around enhancing inherent information.

The Locales Framework (Fitzpatrick et al., 1996) is a CSCW spatial design framework that assists designers in examining interaction between individuals within both physical and virtual social contexts. The framework builds upon Strauss theories of social worlds and aims to assist technology designers in considering the social aspects of context. The framework is split into five aspects: foundations, mutuality, individual views, interaction trajectories and civil structures. Each of these aspects provides designers with an understanding of considerations to investigate within the context, including individual perspectives and the relationships between awareness and privacy.

The Design Framework for mobile systems (Dix et al., 2000) is a series of taxonomies that are used to help designers and research design and analyse context within mobile systems. The design framework is not used in isolation. Instead it is used to inform a computational platform architecture which assists in

supporting mobile devices in adaptive contexts. Rather than attempting to develop a framework which encompasses all forms of space, Dix et. al., focus primarily on the physical space of devices within the context.   The framework consists of four taxonomies of physical mobility: location within space, mobility through space, presence of bodies within the space and the awareness of these bodies. Each of these taxonomies is used to assist designers in categorising and reflecting on the physical attributes of mobile devices within the context.

The Design for Location framework (Macdonald, 2005) is a guide of considerations for designers who are aiming to create location based experiences. This framework identified a series of characteristics that are associated with locative experiences, and guides designers into better identifying how their design can be categorised. The framework then presents considerations essential when designing these co-located experiences, which are segmented into two categories: "the foundation" and "the experience itself". Both of these contain a series of considerations as well as methods that can be employed to better understand the design, in particular to iterate and evolve the design for improving the user experience. The considerations are ordered in a way that guides the designer through the reflective process, and includes pragmatic considerations such as the technical infrastructure available within the location.

The Lean Canvas (Maurya, 2012) and the Business Model Canvas (Osterwalder & Pigneur, 2010) are methods for business managers and start-up founders to structure and develop new or existing business models. The focus of these Canvases is on requiring the user to think through, and, in turn iterate, over time, various aspects of the business model. This iterative reflection tool assists users by making them think of various aspects to their business model from a holistic perspective of the environment, taking into consideration competitors, resources and customer segments.

The DCCT Canvas seeks to provide designers with a set of considerations that can be used to design new tools that support the designer-client communication context.

The primary representation of considerations is through the use of the Canvas, which aims to assist designers in understanding the problem space and context, and to better understand the considerations that their design should take into account. Similar to the Design Framework for mobile systems (Dix et al., 2000), the Canvas has been designed to be inter-related with the enSense framework, in that enSense provides a mechanism for the existing communication ecosystem to be leveraged. The DCCT Canvas targets multiple stakeholders in a similar manner to the locales framework, however; it targets the stages of understanding the audience in the same method as the Design for Location Framework.

8.3.2 Canvas Structure
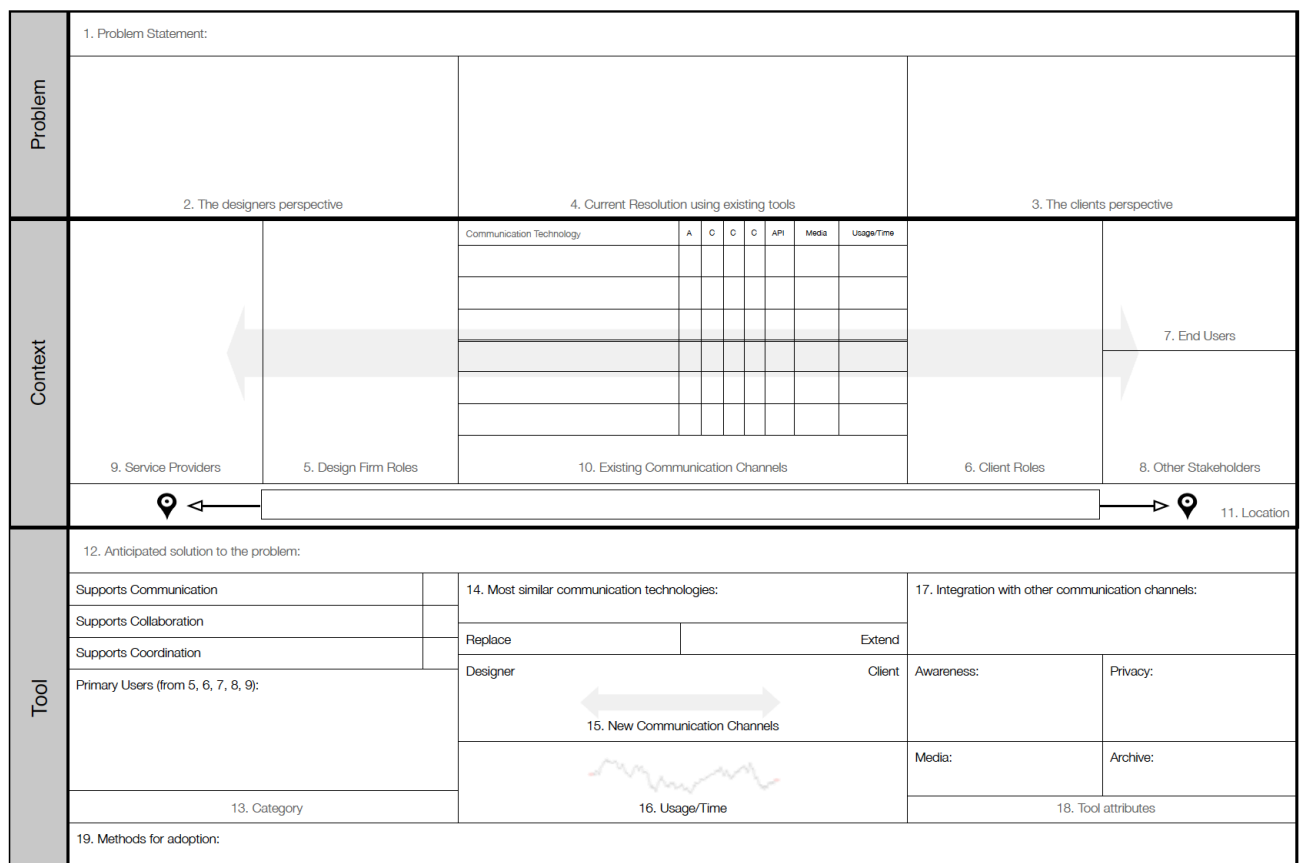
Figure 54: The DCCT Canvas

The canvas is organised in a manner that highlights specific designer-client communication issues identified in the empirical studies. For instance, the wide variety of communication channels or tools to describe the communication

ecosystem, the contrast between designer's and client's perspectives on the same issues, the broad range of stakeholders who are involved in and have influence throughout the process, and the clear need for any new communication services to integrate with existing universal channels (such as email). The Canvas (Figure 54) is segmented into three areas, each focusing on a specific aspect of the communication tool design process:

A) Problem:

This area focuses on establishing the problem by first defining a clear and short problem statement. The user of the canvas is then required to state the problem both from the designer's perspective and from the client's perspective. Finally, the user provides a description of how the problem is currently circumvented using existing methods and communication technologies. The aim of this area is for the designer to present the problem from the perspective of the web designer, and also from the perceived perspective of the web design client, who is likely to be either affected or partially responsible for the problem.

B) Context:

The goal of this area is to establish an understanding of the current context of designer-client communication in relation to the understanding of the design space. This section should outline (regardless of the identified problem) the current situations, in particular the current stakeholders in the designer-client communication, the existing methods of communication and the physical distance between stakeholders. This includes not only the designers and client, but also any other stakeholders in the project. A large consideration when designing for the web design context is the current ecosystem of communication tools. Therefore, the Canvas requires designers to highlight each communication tool which is currently in use within the context, whether and how they support a) coordination, b) collaboration and/or c) communication, and a reflection on how they are used in practice.

C) Tool:

The user first outlines what they anticipate will be the design of the tool that solves the problem stated in the initial problem area. The user then categorises which forms of cooperation support the tool will provide, and which users the tool will support. Based on this, the user then selects one or more tools from the existing communication channel which are of a similar category. Following this, the user anticipates whether this new tool will replace or extend the existing tool, how the interaction between designer and client will be conducted through the tool, and when the tool will be used throughout the project timeline. The user then describes which existing communication tools it will integrate with, and notes how the tools will provide awareness, protect privacy, support rich media and provide archival reflection.

The DCCT Canvas is intended to be used by designers in an iterative manner, in a similar way to the Lean Canvas (Figure 55). The Canvas can be used initially to help a designer understand the problem space, as well as describe the type of solution that they envision. As they design, prototype and evaluate the tool, they can reflect on their Canvas to determine whether they understood the problem space correctly, whether they understood the context correctly, and whether their initial anticipated solution was correct. The Canvas is focused on guiding two parts of the iterative design process: the requirements gathering stage and the design stage. Afterwards, the prototype and evaluation stages then inform the iteration of the Canvas based on findings. Because of this, the Canvas can be used at any stage of the design process.
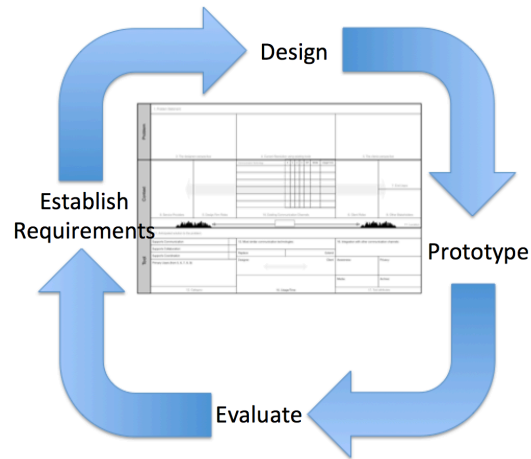
Figure 55: The Canvas in the iterative design process

In addition to its recommended use, the Canvas can also be used by web designers directly to document existing problems and contexts without providing a solution. This documentation can be collected over time to establish and understand common problems and patterns that occur through designer-client communication over a number of situations. This may then either be acted upon by the designers or used as a problem description to engage with a communications tool designer for further exploration.

8.4 - The Designer-Client Communication Tool Canvas Considerations

The DCCT Canvas is an encapsulation of the results of the problems identified through Chapter 5, with a focus on the potential of integrating with existing methods of communication. The purpose of the Canvas is to allow designers to document the problem space and context in a structured way in the design of tools to improve designer-client communication. It is intended to be used in conjunction with an existing iterative design process, to assist the tool designer in reflecting on the context that they are designing for. Table 10 details each of the sections of the canvas, showing how they have been informed by the studies presented in earlier chapters.

Table 10: Canvas sections

Step	Description	Intention
A) Problem	**The problem area focuses on the tool-designer describing the problem that they are designing for.**	
1. Problem Statement	In a short description, what is the problem which is being investigated?	Identify the problem in a clear and coherent manner (Chapter 3).
2. The designer's perspective	What is the problem that occurs from the designers perspective and what issues do you face because of it?	When discussing problems (Chapter 3), designer's would explain the issue from their own perspective.
3. The client's perspective	What is the problem from the client's perspective as understood by the designer, and what issues they face because of it? The purpose of this is that the tool designer does not focus on only solving the problem from their own perspective.	In previous discussions with designers, clients were identified as the cause of the problem. However, designers were sympathetic to the client's in their thought process (Chapter 4.2).
4. Current resolution to problem	Communication problems between designers and clients are worked around through in-the-moment solutions, how is this accomplished for this problem?	Based on Chapters 4.2 and 4.3, designer's get around many issues using existing methods of communication.
B) Context	**The context area focuses on the tool-designer outlining the context which they are designing for**	

5. Design firm roles	What are the various roles in the kind of design firm that you are designing for?	By exploring the web design process, the roles described were unique to the context (Chapter 3.2) and were dynamic based on the specific project.
6. Client roles	What are the client roles in the businesses you are designing for?	The client's that designers work with are varied (Chapter 3.2) and can consist of multiple people.
7. End users	What are the relevant end-users for these clients?	The end users are the target audience that the designer's are designing for (Chapter 3.2), and the client's are a proxy for them (Chapter 4.2 and 4.3).
8. Other stakeholders	Are there any other relevant stakeholders for the context that you are designing for?	Other stakeholders are important when examining the larger communication context, and may be involved indirectly in conversations (Chapter 3.3 and 3.4).
9. Service providers	What are the relevant service providers within the context (e.g. Hosting providers and Domain registrars)?	Service providers may not be directly engaged in designer-client communication; however, client's may be required to deal with them (Chapter 3.3 and 3.4).
10. Existing communication channels	Which communication tools are currently in use in the context? This question also asks designers to consider whether they provide awareness, are focused on communication, collaboration and/or coordination and whether they provide APIs for integration. In addition, the question asks the designer to draw a sparkline diagram of how the tool is used over the course of a project.	There are a large variety of tools available for designer-client communication (Chapter 4.4), and many of these provide different capabilities (Chapter 4.5). However, designers may use these tools in unique ways (Chapter 5.2).
C) Tool	**The tool area focuses on the tool-designer outlining their perceived solution based on the analysis of the problem and the context**	
11. Anticipated solution	Based on the analysis of the problem and context, briefly what is the solution to the problem?	Designer's may have an anticipated solution to their problem with the development of new technologies (Chapter 5.3 and Chapter 7).
12. Tool category	Based on the solution description (in 11), which aspects of cooperation will the	Communication tools can support various aspects of designer-client

	solution be focused on, and who are the primary users of the system (based on the context area)?	communication (4.4), and may be designed specifically for specific stakeholders in the design process.
13. Most similar technologies	Based on section 12, which other communication tools (from the context) are most similar (in their current usage) for what you are designing?	Communication tools introduced into a context may impact on the existing communication ecosystem (Chapter 5.3).
14. Extend or replace	Based on your understanding, would your solution be better to build on top of the existing communication tools or replace one of them (extend or replace)?	By building upon existing methods of communication, issues of client adoption may be negated (Chapter 5.4).
15. New communication channels	Assuming the use of the tool within the context, how does the tool fit within the existing communication tools? Is the tool designer driven or client driven?	Once the new communication channel is adopted, what is the ratio of use between the designer and the client (Chapter 5.4).
16. Usage over time	What is the anticipated usage of the solution over the course of a project (using a sparkline)?	What will the new tool influence, will it be at an early stage design process or later on (Chapter 3.2)?
17. Integration with other channels	How will the tool integrate with other communication channels, either through extension or by other forms of interaction?	Can the tool leverage existing communication channels (Chapter 5.4), and how will it integrate (Chapter 6)?
18. Tool attributes	What are the attributes of the solution? In particular what awareness does it provide, what is the level of privacy, what kinds of media does it support and how does it archive itself?	What aspects of privacy and awareness does the tool need to consider (Chapter 6)?
19. Methods for adoption	Based on the understood context and existing communication ecology, how is the tool adopted?	Adoption is a critical aspect to new designer-client communication tools (Chapter 5.4).

The Canvas is anticipated to be filled out during the early stages of the iterative process and provide a guide for tool designers to investigate the context and better understand at an early stage how the tool will exist within the pre-existing context and tool ecology. In the initial stages of the design, the user of the Canvas will complete the tool section. Once the tool has been designed, prototyped and evaluated, the Canvas is then updated based on the findings from use.

8.5 - Examples of the Canvas

The aim of this section is to illustrate the potential usage of the DCCT Canvas. Each Canvas was filled out by myself, demonstrating problems or contexts that have been investigated during the thesis, or solutions that have been developed during the evaluation of the enSense platform.

8.5.1 Examples of the DCCT Canvas in action

Example of extending existing communication tools (mock scenario)

This example focuses on how to better support clients communicating around design artefacts such as design layouts. This proposed tool aims to solve the issue of designers sending design artefacts to the clients for feedback and the client replying with text due to their lack of being able to annotate the image directly. The problem is investigated from both the designer's and client's perspective, and the solution aims to extend the functionality of what the designer and client's preferred tools are (Photoshop and Email respectively).

Problem

1. Problem Statement: Replace the sharing of mockups over Email – potential miscommunication

- Design has to export mockups and attach them to emails
- Clients responses

2. The designers perspective

- Manually attach mockups
- Changes made from reading email response

4. Current Resolution using existing tools

- Clients cannot annotate mockups in email
- Clients have to describe what they want changed

3. The clients perspective

Context

9. Service Providers
- Stock imagery Warehouse
- Hosting provider
- Domain Registrar
- Merchant provider

5. Design Firm Roles
- Graphic designer
- Front end dev.
- Back end dev.
- Sys admin
- Creative Director

10. Existing Communication Channels

Communication Technology	A	C	C	C	API	Media	Usage/Time
Email	X	X	X	X	X	Text Files	
Skype	X		X	X		Voice Files	
Basecamp	X	X		/	X	Text Files	
Phone			X	X		Voice	
Face to Face	X	X	X	X			

6. Client Roles
- Admin staff
- CEO
- Sales people
- Retail Manager

7. End Users

8. Other Stakeholders
- Shoppers
- Product vendors
- Store staff
- Contractors

11. Location: Suburb A ← → Suburb B

Tool

12. Anticipated solution to the problem: A Photoshop plugin which emails mockups with areas of interest. Client email replies appear in PS as annotations

Supports Communication	X
Supports Collaboration	X
Supports Coordination	

14. Most similar communication technologies: Email

| Replace | X | Extend |

Designer 100%   Client 0%
15. New Communication Channels

Primary Users (from 5, 6, 7, 8, 9): Clients, stakeholders, any relevant designers (front and graphic)

13. Category

16. Usage/Time

17. Integration with other communication channels: Email

Awareness: Same as email
Privacy: Same as Email

Media: Photoshop Files
Archive: (annotated) Mockup exports

18. Tool attributes

19. Methods for adoption: Client only has to use Email, designer only uses Photoshop (with plugin)

Figure 56: Canvas example of extending existing communication tools

Example based on awareness of stakeholder activity (UQMarkup)

During the UQMarkup case study (Chapter 3.5), one of the largest issues was keeping track of the various stakeholders who were involved in the process. In particular, stakeholders who managed the system but were not involved as clients would send design requests to the UQMarkup team based on their use of the website in testing. In particular, the design of the manage submission section became cumbersome when a large number of students were enrolled. Although email was used to solve the problem, this required a large amount of back and forth between the designers and the users, often through an intermediary client who was unsure of the issue. These requests would most commonly occur from a variety of stakeholders at the same time, with no awareness of each-others request.

Figure 57: Canvas example of UQMarkup context

Example based on client configuration issues (the Newscube)

Based on the interviews with both the client and designer around the Newscube project (Chapter 3.6), there were a number of times where the client had problems with the configuration of services. The designer resolved these issues immediately by providing the client a screen-recorded video of the designer performing the action. Despite the client using this video, issues would appear that the client was unable to solve, and the client would contact the designer through either email or phone.

Problem

1. Problem Statement: Resolve client configuration issues when using software

2. The designers perspective: -Developer has to guide client remotely -Happens many times, different issue each time

4. Current Resolution using existing tools: -Designer video records them fixing the issue and emails the file after talking on phone/skype

3. The clients perspective: -Client has difficulties in setting up third party software -Frustrated

Context

9. Service Providers: -3rd Party Software developers

5. Design Firm Roles: -Designer -Developer -Project Manager

10. Existing Communication Channels

Communication Technology	A	C	C	C	API	Media	Usage/Time
Skype	X		X	X		Video Voice	⋀⋀
Email			X	X	X	Text Files	⋀/⋀⋀
Phone			X	X			⋀⋀
Face to Face	X		X	X			⋀⋀

6. Client Roles: -Primary client -New contractors -Research students

7. End Users: -News organisation -News consumers

8. Other Stakeholders: -Other researchers -Content creators

Location: Sydney ←——→ Brisbane

11. Location

Tool

12. Anticipated solution to the problem: Tutorial plugin to skype/video so the developer/designer can teach the user in real time (and record)

Supports Communication	X
Supports Collaboration	X
Supports Coordination	

14. Most similar communication technologies: Skype

Replace	Extend ✓

17. Integration with other communication channels: Skype, Email

Primary Users (from 5, 6, 7, 8, 9): Designer, primary client

15. New Communication Channels: Designer 50% / Client 50%

Awareness: Shared

Privacy: Builds on top of existing skype privacy

13. Category

16. Usage/Time

Media: Video + Voice + Screen

Archive: Video recording

18. Tool attributes

19. Methods for adoption: Used in unison by designer and client

Figure 58: Canvas example of NewsCube context

Example based on Communication Browser

The aim of the Communication Browser (Chapter 7.2) was to solve the issue of reflecting on the communication aspect of the design process across an entire project. In particular, designers are, for the most part, unable to reflect on the design process and visualise high and low intensity conversations to understand how they occurred and how they were resolved.

Figure 59: Canvas example of Communications Browser

Example based on Contacts

The Contacts application (Chapter 7.3) investigates the issue of keeping track of many clients across many projects using a number of different accounts across various communication channels. Designers are required to memorise a number of potentially unrelated accounts across various communication channels. In addition, designers when searching for specific information received from the clients are required to search across a number of channels or memorise which channel the information was sent.

Figure 60: Canvas example of Contacts application

Example based on Progress

Progress (Chapter 7.4) examines ways in which a project's progress can be tracked over time. This has many potential benefits for internal communication and awareness, but also has the potential to solve the problem of awareness between the designer and client. In this scenario, the client currently has no way to actively see the progress of a project without either explicit communication or the designer providing an area where the client can look at the project as it develops and comment on progress.

Figure 61: Canvas example of Progress

The examples shown above are a test of the flexibility of the Canvas in approaching specific problems found in certain contexts. Each of the problems and contexts are unique; however, the Canvas gives insight into the cause of the problem (from both perspectives), how the problem is solved currently and a description of the existing communication ecosystem and how it used. The tool solution area does not provide

information as to what the solution is in detail, instead it provides information related to how it will co-existing in the existing context. From these examples, the Canvas was then tested with industry web designers through a design workshop (Chapter 8.6). To see the Canvases that were completed by participants during the workshop see Appendix 4: Canvas Workshop.

8.6 - Canvas Workshop

8.6.1 Workshop Design

Based on the organisation and categorisation of issues outlined in the Canvas, a workshop session was run with 12 web designers. The purpose of evaluating the canvas with designers was twofold. Firstly, it is a means of evaluating the elements and relationships outlined in the canvas by getting designers to attempt to apply it to their own web design communication experiences. This is a means of testing its general applicability to serve as a framework that models the elements of the web design communication process above and beyond the studies that informed its construction. Secondly, it is evaluated as a design tool that can be used to inform the development of new communication tools/platforms to support the designer/client communication process.

The workshop was conducted over three hours, and it was structured in a way that followed through the steps of the canvas. The schedule for the workshop is listed in Table 11.

Table 11: Workshop schedule

Step	Time	Task
1.	20 minutes	Introduction and welcome
2.	20 minutes	Group discussion around client communication issues
3.	20 minutes	Writing up the Problem section of the Canvas (each participant choosing their own issue)
	Break	Coffee break
4.	20 minutes	Group discussion of the web design context
5.	20 minutes	Writing up the context (each participant writing up their own understanding of the context based on their experience)
	Break	Lunch Break
6.	30 minutes	Writing up the solution of the participants own Canvas
7.	30 minutes	Discussion of the problems and solutions discovered, the use of the

Canvas

8.   20 minutes   Wrap-up discussion

The demographics of the participants were:

- All participants had client interaction in their day-to-day work.
- The role of the participant varied between web designer, project manager, web developer and front-end developer.
- The average web design client interaction experience of the participants was 7 years (6.95), from early career web designers (1 year experience) to senior designers (over 10 years experience).
- The Gender distribution of participants was 3 women and 9 men.

Analysis of the workshop was conducted using a number of sources of data, gathered from observing the process taken by the web designers, analysing the Canvases that were generated, audio recording the participants and through group discussions with the participants. The questions that the workshop aimed to answer were:

1. How does the Canvas help the participant in explaining the problem from the perspective of the designers and the clients?
2. What is the range of problems that the participants highlight?
3. What is the range of contexts discussed, and how does the Canvas represent the context?
4. How does the Canvas represent the proposed solution to a tool designer?
5. How do the participants interpret the considerations?
6. Are the considerations new or unexpected to the participants?

8.6.2 Workshop Process

Participants were split across 3 separate tables in groups of four (Figure 62), with each table providing pens, Canvas templates and spare sheets of writing paper for each participant (Figure 63).

Figure 62: Workshop setting

The workshop began with participants being introduced to each other and an informal discussion about how the group works with clients. The group was then introduced to the workshop, told that they would be tasked to think about problems that they experience when communicating with clients and would be required to develop initial solutions for those problems. Participants were then introduced to the Canvas, which was presented as a tool aimed to assist them in coming up with their solutions, and that the workshop aim was to evaluate the Canvas. Participants were reminded that their performance in the task was not being directly evaluated, and the focus was on the design of the Canvas and how it assisted them.

Figure 63: Workshop participant seating

Participants were first asked to think about their current work and how they communicate with their clients. Participants were asked to think about the problems that they had encountered recently during this communication, and to think about those problems that could have been avoided given the correct technology. Once the participant had chosen their example problem, they were asked to write it down on the Canvas (Q1) and also explain why the situation was a problem for them (Q2). Participants were then asked to think about the situation from the client's perspective and what the impact of the problem was for the client (Q3). Finally, participants wrote down how the situation was resolved currently (Q4). Figure 64 is one of the problem spaces that was explored by participants.

Figure 64: Workshop Canvas - Problem

After a break, participants were asked to think about the context in which the situation had occurred. Rather than focusing directly on the problem, participants

were asked to think about the larger business context, in particular the people who were involved in the communication. Participants were asked to write down the web design roles involved (Q5), as well as the roles of the clients (Q6). Once this was done, participants were asked to think about the larger communication context and who else was involved (Q7-9).

After establishing the roles involved in the context, participants were asked to list all communication channels that were used in the context (Q10). Additionally, each communication channel was flagged as to whether it was used for Awareness, Coordination, Communication and/or Collaboration. Participants were then asked to note if the communication channels had an Application Programming Interface (API), identify what kinds of media the channel was used for, and to provide a sparkline of how the channel was used over the course of a project. Lastly, participants were asked to write down the locations in which the designers and clients collaborated. Figure 65 presents a context written by a participant.

Figure 65: Workshop Canvas - Context

Following a break for lunch, participants were asked to start thinking through an initial solution based on reflecting on their identified problem. Participants were first asked to write down their anticipated solution (Q12) and think through their solution with regards to the context that they had listed out. Similar to Q10, participants were asked to categorise their solution (Q13) - whether it would aim to support Coordination, Communication and Collaboration, as well as who the primary users would be.

Participants were then asked to reflect upon their categorisation and look for similar channels from Q10. Participants then listed the most similar and wrote down whether their tool would replace or extend the existing channel (Q14). Participants were then asked how heavily designers and clients would use the tool over the course of a project (Q15-16), and what integration with other communication channels would be useful (Q17). Finally, the attributes of the solution were detailed, highlighting what kind of awareness it would provide, how privacy would be managed, what kinds of media would be supported and how this information would be archived (Q18). Figure 66 shows one of the solutions written up by a participant.

Figure 66: Workshop Canvas – solution

Participants were then asked to discuss their solution with the group and ask questions about their solution. Once the participants had gained feedback from the group, they were asked to fill out how they imagined their tool would be adopted by both clients and designers within their business.

8.6.3 Workshop Results

The workshop ran to plan and no major obstacles were encountered during the process. The speed at which participants went through the Canvas was quicker than anticipated, with only two participants needing more time than was given. Overall participants chose a variety of problem spaces; however, most focused on issues of miscommunication between designers and clients rather than focusing on the fault of a single technology. Table 12 outlines the problems and initial solutions that participants wrote in their Canvas.

295

Table 12: Workshop participant problems and solutions

Problem	Solution
Defining scope of app/website as a solution, have both parties agree on the solution	Early prototyping tools to demonstrate functionality in regards to objectives with resources for design decisions
Clients have a bevvy of ideas but don't actually think about what they want or need	A grant program for design agencies to spend months in-situ with clients
Getting to understand clients needs requires them to understand what's possible to make	Feature tracker that explains to clients what they can and cannot add to their projects by showing how much money a decision is going to cost them
UI/UX common problems - locking clients into their decision, reminding their motivation for why they decided	A timeline based system that shows client decisions in a talk bubble and if they add alterations the time and cost on the timeline increases for the visualisation, providing feedback.
Eliciting client's assumptions about how they expect the final product to work	A wire-framing or wiki or similar tool, editable by the client, that automatically indicates cost or complexity when changes are made or features are added
Assumptions are made about both functionality (designers) and business process (clients & designers) that do not align. Doesn't become evident until unknown time in the project.	A tool that documents shared understanding and learning and allows constant review of understanding (clients and designers walking through the design process)
Managing varying scope and costs on complex large projects	Build an artefact tracking system with costing, scoping, sharing, documentation generation and mapping historical record
Managing scope changes and financial impacts is difficult and can create tension between clients and designers	Dynamic project specification that allows revisions, shows changes over time and impact on budget.
Difficulty communicating time, cost, feasibility of implementation of features to non-technical users	A code analytics platform (which finds similar features from a large collection of projects and provides statistics on effort, time and complexity)
Changing requirements well into the build stage	A fast mock-up tool that incorporates functionality then captures it so it can be viewed by others and defines

	requirements.
Difficulty getting feedback on specific features when other aspects of project aren't finished. Getting 30% complete feedback from clients instead of 90% complete.	A tool that facilitates the face-to-face communication, makes it easier to focus people and record feedback (screen recording). But still allows designers and clients to brainstorm solutions on the spot.
Communication in regards to visual and behavioural (interactive materials)	Customisable package according to project requirements, the client type, timeframe etc. Built in analytics that adjusts the systems preferences according to use.

As noted, the majority of problems presented involve miscommunication between designers and clients, either in the scope and functionality throughout the design process or the initial design concept. Although many of these problem statements are similar, the solutions are different and depend on the context of the roles involved. The solutions proposed by participants also highlight needs that they believe are important problems with existing communication tools. In particular, tools regarding code changes and making transparent costing are not currently provided to clients through existing communication channels.

Regarding the problem context, participants gave detailed descriptions of the roles and communication channels which were in use. The average number of design roles involved was 4, while the average number of clients was 3. Additionally, stakeholders, end user groups and service provider's averages were 3, 2 and 4 respectively. As expected (from Chapter 3), the range of designer and client roles is diverse, and the description of the designers is more detailed than the descriptions of clients. Table 13 shows the range of roles that were written down by participants.

Table 13: Workshop - participant roles

Designer	Client
Designer	Founder
Developer	Developer

Account Manager	Marketing
Junior Developer	Sales Person
System Administrator	Project Liaison
Project Manager	Manager
Researchers	Researcher
Management	Business Contact
Sole Trader	Domain Expert
Finance	Academic Advisors
Content Supplier	Project Contact
UX Consultant	Communication Officer
Graphic Designer	Finance Controller
Quality Assurance	Relationship Manager
Analytics	Business Development Manager
Programmer	Content Writer
Web Developer	Sole Trader
Creative Director	CEO
Producer	Lawyer
Backend content engineer	HR Representative
Content Authors	
Design Lead	
Front-end Developer	

Analysing the communication channels in use, each participant listed a large number of tools, and were often limited by space within the Canvas. In these situations, participants were asked to focus on those that were most widely used and relevant given the problem space. Overall, Email, Skype and Face-to-Face were universally used by participants, with more traditional technologies such as FTP and Phone calls being less prominent. Tools that have been designed specifically for supporting this kind of communication (Asana, Basecamp, Slack) are rarely used in these contexts, and social networking tools such as Facebook are not used. Table 14 provides a list of the communication channels, as well as their frequency and usage patterns.

Table 14: Workshop - participant use of tools

Tool	Aware.	Coord.	Comm.	Collab.	API	Canvases used in
Email	9	11	12	5	4	12
Face to Face	6	6	9	7	0	9
Skype	5	4	9	3	1	9
Dropbox	7	3	2	8	4	9
Google Docs	4	3	5	7	1	7
Git	3	2	2	4	3	5
Phone	3	3	3	1	0	4
FTP File Sharing	1	0	0	1	2	2
Annotated PDFs	1	1	1	3	0	3
Pinterest	0	0	1	0	0	1
Word Track Changes	0	0	1	0	0	1
Instant Messenger	1	1	1	1	0	1
Asana	1	0	0	0	1	1
Wiki	1	1	1	1	0	1
Google Hangouts	0	1	1	1	0	1
Microsoft Project	1	1	0	0	0	1
Invision	1	0	1	1	0	1
Evernote	1	1	1	1	0	1
Slack	1	0	0	1	1	1
Basecamp	0	1	1	1	0	1
SMS	0	1	1	1	0	1

Participants were asked which communication channels their anticipated solution would replace or extend, and which communication channels their tool would integrate with. Solutions were more likely to extend existing communication channels rather than replace them, and most solutions aimed to integrate with a number of services. All solutions aimed to support communication, while only some supported coordination and collaboration (8 and 7 respectively), this may be biased, as the focus of the workshop was communication. Table 15 outlines which tools were being aimed to be replaced or extended, and which tools would be integrated with. One solution is not included here as it is a governmental solution rather than a tool based solution.

Table 15: Workshop - participant tools to replace or extend

Similar	Replace or Extend	Coord.	Comm.	Collab.	Integrate With
Annotated PDFs	Replace	1	1	1	Git, Email, Google Docs
Git and Evernote	Extend	1	1	-	To-do Lists and Slack
Email	Extend	1	1	-	Skype, Invision, Basecamp
Google Docs	Replace	1	1	1	Email, Dropbox
Wiki, Google Docs, Dashboards	Replace & Extend	-		1	1	Email, Meetings, Physical Installations
Basecamp	Extend	1	1	1	Email, Calendar, Skype, Adobe Suite
Annotated Word Document	Replace & Extend	1	1	-	Email
Face to Face	Extend	-		1	-	GitHub, Email, Face to Face
Face to Face	Replace	1	1	1	Email, Dropbox, Skype, Face to Face
Face to Face	Extend	-		1	1	Email, Skype
GitHub, Annotated PDF	Extend & Replace	1	1	1	Calendar, Email

Finally, the methods of adoption indicate how designers thought about how these tools would be adopted. Three solutions were not client facing and would instead be interacted with through existing communication channels, while two solutions were to be adopted only during face-to-face meetings. However, six of the solutions proposed that clients would be asked to use the tools at the initial stage of the process. One solution was to be adopted at a larger scope (governmental) due to the nature of the solution. Although participants acknowledged the difficulty of getting clients to adopt new methods of communication, many were confident in their ability to get client adoption directly by introducing the tool early in the design process.

The completed Canvases from the workshop can be found in Appendix 4: Canvas Workshop.

8.6.4 Canvas Reflections

The workshop set out to answer a number of questions related to the design and use of the Canvas in assisting in the design of new designer-client communication tools:

1. Does the Canvas help the participant in explaining the problem from the perspective of the designers and the clients?

The Canvas was successful in providing enough guidance and detail for the participant to convey the problem as well as the current solution in practice. Participants were initially confused about the client's perspective, however once they acknowledged that the client may also consider this a problem, they appeared excited to reflect on the problem from the client's perspective.

> *I think so. I think having the structure of the canvas helps you think about aspects of your idea that you would normally not think about. (Participant 4)*
>
> *Yes. The canvas was a good way of ensuring that both perspectives [designer and client] were considered and provided a good framework to analyse the current situation [context]. It*

also maintained focus on important considerations - like the solution, addressing factors such as awareness, coordination, collaboration etc.
(Participant 7)

2. What is the range of problems that the participants highlight?

Most participants focused on miscommunication between clients and designers regarding the scope and functionality of the product being designed. The generality of these issues was larger than the original vision of the Canvas (which aimed for specific problems), however it did give insight into the issues which participants were most concerned with. One unexpected problem was that one of the problem contexts was concerned with the industry as a whole (from a methodological perspective of how designers understand the client's context), which could imply that the Canvas may be useful at a larger scale of issue than originally anticipated.

3. What is the range of contexts discussed and how does the Canvas represent the context?

The Canvas is successful in portraying the designer-client context in that each participant's context is unique, but follows similar patterns. The roles that are presented help understand the unique context of the involvement of clients and also the breadth of roles which are involved in the communication process. Examining the participants Canvas provides specific details as to the problem that occurs as well as the context in which the problem occurs. Most insightful is the list of communication channels, which show what they are used for when communicating with clients and where they are used within the timeline of the design process. One problem with the portrayal of the context was in finding the relevance of, and describing the location of the designers and clients, due to how it changes over time.

4. How does the Canvas represent the proposed solution to a tool designer?

On analysis when examining the created Canvases, there is significant detail provided to have a clear understanding of both the type of solution the participant

was suggesting. More importantly, the categorisation of the tool provides an insight in to how the participant anticipates the tool to be used and how it will be used in conjunction with the pre-existing communication ecosystem. The sparkline and usage (Q15-16) prove to be useful in understanding which phases of the design process the participants were targeting.

5. How do the participants interpret the considerations?

In discussions during the workshop with participants, certain sections of the Canvas were difficult to comprehend. Question 3 (client's perspective) was initially confusing for the participants, with participants stating that the issue didn't affect the client. To respond to this, I suggested that they think about the underlying cause of the problem and whether it was initiated by the client (which turned out to be the case). Question 8 and 9 (Stakeholders and Service Providers) were difficult for participants, as they weren't sure whether some roles should be included. For example, a domain name provider is a Service Provider which requires communication interaction; however, the service is fully automated (automatic emails), and is only one directional. Additionally Question 11 (Location) was not clearly understood by participants, and was purposefully vague to allow for interpretation; however, it did not effectively present the changing context. In contrast, Question 15 (new communication channels) was also vague to allow for interpretation, which allowed participants to creatively draw the relationship between client and designer use.

6. Are the considerations new or unexpected to the participants?

Participants stated during the discussion that Question 3 (client perspective) provided new insights into the problem context, and participants stated they had not before thought of the problem from the client's perspective. "I always just assumed that the client was the cause of the problem." Additionally, by breaking down the existing communication ecosystem into categories of use, participants were able to more easily decide which tools to extend or replace. "I could see that my tool was performing the same action as what we use Annotated PDFs for, so it was easy to

decide whether to replace or extend it." Participants also stated that the use of the sparklines made it easy to see how other participants used different forms of communication throughout the design process.

> [Questions] 3, 4 and 14. I think it helps to think about the client's perspective, since they are often seen as 'the problem'. I also think reflecting on existing tools, and why they work/don't work is a good idea, too.
> (Participant 5)

> [I found new insights from]:
> - Client's perspective on the problem
> - Factors like supporting Awareness, Communication, Collaboration, Coordination
> - Methods for adoption
> (Participant 7)

Overall, the use of the Canvas allowed the participants to effectively and succinctly communicate the problem which they were attempting to solve, as well as detail the existing communication context. The problems that the participants highlighted are relatable to those identified during Chapter 3, in particular around miscommunication between designers and clients. There was some confusion in the relationship of the client to the problem, specifically that the issue impacted the client. However, many of the issues arose due to a lack of common ground (Convertino et al., 2008).

As discovered in Chapter 4, the most common forms of communication by designers were generalised tools such as Email and Skype, with more tailored tools such as Basecamp being uncommon. In discussion with the participants, each participant knew of these tools, and many had tried them without success. Some participants mentioned that these tools were in use but only for internal design firm communication and were not used with clients.

As stated by Grudin (1988) the design of new communication tools heavily depends on the intuition of the designers. In the solutions presented by the participants, every solution relied on some level of integration with pre-existing communication channels, and many were based on extending a channel rather than replacing it as

Adams (2010) suggests. This gives promise to platforms similar to enSense that aim to build upon existing methods of communication. However not all participants regarded adoption as a major concern, with many stating that they would approach clients directly as the method for adoption, acting as shepherds (Quinones, 2014). This is in contrast to the conclusions made in Chapter 5 with regards to the difficulty of adoption by clients. Participants who chose to directly engage clients also stated that the integration with other tools would act as a fall-back method in case of adoption failure. Other participants focused their solution so that it would be entirely transparent to the clients and instead rely entirely on existing communication methods.

On reflection, the Canvas provided interesting insights into the issues that the participants encountered in their daily activities and provided enough detail to provide an understanding of the problem. Although participants were guided through the Canvas, they did not require an explanation to understanding why the types of questions were being asked, aside from the client's perspective. However, once explained, they agreed that the client's perspective made the problem space more objective, and often contained specific details that were neither in the problem statement nor the designer's perspective.

Some aspects of the context section were not well used (location) and there were some issues with knowledge of the stakeholders involved. This is in part due to the nature of the problem and the context being explored (e.g. Canvas K). However, in a similar manner to the Lean Canvas (Maurya, 2012) the DCCT Canvas could be iterated upon over time to establish a more holistic view of the context. An initial idea to promote this would be to make each section modular so that they could be versioned over time and stuck over the top. This would also enable a problem and solution to be examined across multiple contexts.

The solution section worked well in highlighting the designer's initial ideas; however, the details after the proposed solution aided in the designer rethinking the solution, which made the proposed solution less relevant. Some aspects of the solution,

primarily Step 15 and Step 16 did not provide enough detail as to how they were to be filled in and requires changes in labelling for comprehension.

As discussed in Chapter 8.1, the aim of the canvas has been to (a) operate as an encapsulation of the designer-client communication issues identified in the literature and field studies, and (b) serve as a prospective design tool that can aid designers of communication support tools for web design practice. Regarding (a), the fact that each of the practicing web designers were able to, with only a little guidance at certain points, map their own unique and diverse problems and experiences onto the canvas gives some indication of the general applicability of the categories and relationships that are represented on the canvas. As a general framework for mapping relevant issues in the designer-client communication process, the canvas has been moderately successful. Regarding (b), it is clear that the designers who engaged with the canvas were able to generate feasible ideas for applications that could provide support for the problems they have experienced, and they reported finding the canvas potentially useful. However, the workshop has only examined the tool as a simulation of the initial stages of a design process. For that reason, the extent in which the canvas would effectively function as a tool for the design and development of communication support applications throughout each stage of the process cannot yet be shown from the workshop.

8.7 - Evaluation: Findings

Throughout this thesis, there have been five areas of investigation, each exploring an aspect of technologies to support designer-client communication:

- The analysis of the client designer communication within the web design context (Chapter 3),
- The analysis of designer-client communication observations within web design projects (Sections 3.5 and 3.6),
- The analysis of communication tools and technologies which are currently in use within web design firms to support designer-client communication (Chapter 4),
- The analysis of the enSense platform in relation to its use in prototyping applications that build on existing communication channels which are already universally used in designer-client communication (Chapter 7 and Section 8.2), and
- The analysis of the DCCT Canvas in a workshop study with web designers to examine how the Canvas can assist designers in understanding the pre-existing communication ecosystem (Chapter 8).

This section is concerned with reflecting on each of these studies in relation to the evaluation of Chapter 8, to evaluate the current state and creation of new designer-client communication within web design. In particular, the evaluation is concerned with how new tools that build upon existing methods of communication provide new means of communication to designer-client communication. These tools are specifically designed to mitigate concerns and challenges associated with adoption of new methods of communication into pre-existing designer-client communication contexts where the client communication is uncontrolled, that is they already have methods of communication which they are familiar with and are more likely to use.

As seen from the studies investigating designer-client communication (Chapter 3 and 4), a major aspect of the day-to-day job of web designers is communicating with clients. Although designers often prefer face-to-face contact, the availability and location of the client means that much of the communication is reliant on digital technologies. This communication is a vital aspect of the web design process, as establishing common ground between the designer and client is essential to carry out web design. Communication is not usually a one to one relationship between a single client and single designer, rather there are most often multiple designers and clients involved, as well as stakeholders, service providers and end users who are involved in the design process during certain phases.

The social complexity of designer-client communication is at odds with the communication tools that web design firms tend to use. Often, communication technologies are limited to those that are in pre-existing use by both designers and clients. For the most part, this means that communication is limited to universal methods of communication, in particular Email, Phone, Skype and Dropbox. These tools are designed for generic communication and are not tailored to the knowledge sharing and collaborative aspects of web design. Although tools that are web browser based may be considered in universal use (as all stakeholders have web browser access), the habitual use is not at a website level. Of particular interest is popular social networking services like Facebook, which are well known by the general population, but are not actively used by web designers to communicate with clients.

On investigation of tools that are available that may be appropriate (Chapter 4.5), it was found that most bespoke tools aim to replace these pre-existing channels, rather than integrate and extend them. While some integration exists with universal channels (such as Email), they use (and abuse) these methods of communication as methods of notification. In many situations, these tools are used by designers for communication internally within firms; however, designers are wary of introducing these tools to clients - due to the issues with clients adopting them successfully.

This adoption is the central issue for new communication technologies being introduced into designer-client communication (Chapter 5.2).

enSense was a platform designed to bridge the gap between existing universally used communication channels, and new communication tools that are better tailored for designer-client communication. Although the study of enSense *in situ* was unfeasible for a number of reasons, three tools were developed that leveraged existing communication data. Each of these tools was more focused on pulling information from existing channels, rather than sending communication back to clients. The case studies showed that by leveraging these existing channels, much greater awareness and knowledge could be given to designers when compared with traditional means (Chapter 8.2). Additionally, the collation of knowledge across many communication channels has benefits of contextualising the entire communication narrative between designers and clients.

An output of this research was the development of the Design Client Communication Tool Canvas, a framework for representing a spectrum of issues and relationships that have been shown to be recurrent and relevant to the designer-client communication process that also functions as a lightweight guide for tool designers. The Canvas focuses on getting designers to reflect on the problem and the context in which is situated. From the workshop conducted (Chapter 8.6), designers noted that the canvas was useful in helping them flesh out the problem space, and better understand the existing communication ecosystem. From this, designers were able to understand how a new tool could be created which would extend and enhance their existing methods of communication. This could be used either to select an existing tool on the market or to start the creation of a new tool to solve the problem. Designers stated that they had been frustrated about the current communication tools on the market and had, at many times, strongly considered creating new methods of communication in-house. Although there were some issues identified with the Canvas, the lightweight and iterative nature of the tool provides a quick way for designers to highlight issues within a particular context and refine their thoughts over time.

A future direction of the Canvas would be to evaluate it in the design of specific communication tools, and to understand how the Canvas influences the design of these tools over many iterations. This is outside the scope of this thesis, as it requires many iterations of a product development cycle to understand how the Canvas should be iterated upon. In the scope of this thesis, the Canvas is presented as an output, which represents a series of considerations as opposed to an artefact that has been designed as part of the evaluated process.

Chapter 9 - Conclusions: Discussion and Future Work

9.1 - Introduction

This thesis has examined the design of existing tools and the creation of new tools to support designer-client communication within the context of web design, through a number of studies and investigations:

- The background literature (Chapter 2) survey shows that the design of tools to support designer-clients communication heavily relies of the intuition of designers and needs to be designed for the context in which it will be used (Grudin, 1988). Awareness is an important consideration when designing new tools (Fitzpatrick et al., 1996), and the design needs to be sensitive to privacy concerns of awareness within the context (Abowd et. al., 1999). Communication is not isolated and is instead part of a larger communication context (Turner et. al., 2010). While there is literature (both published online and in research) centred on the web design context, it is primarily focused on either the technical aspects of web design (Newman & Landay, 2000) or earlier stage design in face-to-face settings (Ames, 2001).
- The research methodology (Chapter 2.7) goes through the methods that were carried out to meet these aims through the use of an interaction design approach.
- Chapter 3 explores the web design context and presents two case studies of designer-client communication situations: one from a participatory perspective and the other through observations.

- Chapter 4 investigates the current problems of designer-client communication from the perspective of web designers. Additionally, a survey of the current state of communication tools is presented to investigate how they can support the web design context.

- From Chapter 3 and Chapter 4, a series of challenges for the design of designer-client communication tools is presented in Chapter 5. The major challenge that is identified is how to get new methods of communication successfully adopted, especially with clients.

- enSense is a prototype platform that has been designed to support the creation of new designer-client communication tools. Chapter 6 discusses the design of the prototype and how it evolved in response to the limitations that were encountered.

- Chapter 7 presents a number of new tools to assist designers with communication that build on top of the existing communication ecosystem.

- Chapter 8 reflects on the design of enSense and considers how similar platforms can assist in the creation of new tools to support the web design context. Chapter 8 then presents a study of a lightweight tool to assist the designers of communication tools in evaluating and understand the existing communication ecosystem they are designing for.

This chapter reflects on these studies and, in particular reflects on the original aims of this thesis, that is, how communication tools to support designer-client communication within web design can be better designed. Based on these reflections a number of contributions are described in relation to the current literature within the area of Computer Mediated Communication. A number of limitations of this thesis are discussed, and from these limitations future areas of exploration are identified and presented. Finally, this chapter reflects on the central motivations of the thesis, and re-explores the importance of having effective support for designer-client communication.

9.2 - Contributions

The focus of this thesis was to understand the existing designer-client communication process; specifically how new digital tools can be designed to better support designer-client communication. This thesis makes five main contributions to the fields of HCI and CSCW:

A deeper understanding of the designer-client relationship within web design
Throughout a review of the literature in both CSCW and HCI, there is little research conducted on how designers and clients communicate within the web design field. Although there are many studies conducted to examine the web design process (Bauer, 2005; Duyne et. al., 2002; Lin et. al., 2000; Newman & Landay, 2000), these studies are focused on the technical process of web design, as opposed to the methods of communication between various stakeholders within the web design process.

Through interviews and later discussions with designers, I found that from their perspective, communicating with clients was far more challenging and time-consuming than the technical web design process itself. Effective communication amongst the designers and clients is a vital aspect of the design process due to the nature of the collaborative design process and due to clients providing much of the required knowledge and expertise (through their understanding of the market). In many design firms, the organisational structure of the designers emphasise this, where roles are specifically created to support the designer-client communication, such as the project manager, account manager and, in extreme cases, the email manager.

The intricacies of designer-client communication are similar to other design disciplines (in terms of gaining common ground); however, there is a much heavier focus on digital communication compared with face-to-face communication.

Because of this remote collaboration, as well as the short nature of the collaboration, many problems that web designers face are due to their communication practices.

A broad review of the tools that are designed to support designer-client communication within web design and the categorisation of these tools

A large component of CSCW focuses on the design and evaluation of groupware - that is tools to support communication, collaboration and coordination across groups of individuals all working together to complete common goals. The context of designer-client communication is one where the study of groupware and its impacts are relevant. However, much of the groupware research has been conducted prior to the popularity of Social Software which are wide reaching and are becoming more popular for assisting in work related tasks. In the study of designers and clients, the use of Social Software within the web design context was exceedingly rare - primarily due to the designer's perspective that Social Software was not appropriate for working relationships. Instead, designers rely on a series of generalised tools that are popular for the general public (such as Email and Skype), but not those that are designed for enterprises.

A number of tools are available which provide a range of functionality well suited to designer-client communication; however, these tools have not been strongly adopted by the web design industry. It was discovered through categorisation of these tools, based on the methods suggested by Johanson (1988) and Penichet et. al. (2007) that many tools aimed to support designer-client communication are available for the range of categories. However, these tools were discovered to provide little integration with existing methods of communication and rather presented themselves as a replacement to existing communication channels. Additionally, these tools rarely discussed the pragmatic issues related to changing and adopting new technologies.

The issues that were found with current communication tools to support this work are similar issues to those described in the seminal article on Groupware and Social

Dynamics: Eight Challenges for developers (Grudin, 1994b). The challenges identified through this thesis were:

- Competing with existing methods of communication
- Seamless adoption
- Providing project insight
- Support to documenting and search the narrative
- Support for knowledge transfer and awareness
- Support for both internal and external communication
- Support for rich media

The thesis details the range of communication technologies which have been designed for designer-client communication (Basecamp, Asana, Slack etc.), as well as identifying a number of limitations in existing tools for supporting the context (the lack of support for design artefacts, the challenges of adoption with clients, the problems with awareness etc.).

The identification of lack of integration being a large challenge to new tool adoption and the importance of having a collated narrative of communication
Although many limitations were discovered in existing methods of communication (including collaboration around artefacts and annotations of documents - Chapter 5.2), the primary issue with new tools is their ability to integrate with the existing designer-client communication process, as well as the fragility of users using other tools to communicate. Communication tools, which did provide integration with existing methods of communication (such as Basecamp), were much more likely to be adopted by designers, primarily due to their ability to retrieve and send information through Email. As designers mentioned; however, the fragility of the technology meant that it was common for communication to be missed by the system, and communication to break down and resort to traditional technologies.

An exploration of how integration with other communication technologies can be addressed

enSense is a prototype research tool that was designed to better understand the challenges of integrating with existing methods of communication. The focus of this platform was to investigate the challenges associated with integrating existing communication channels with new communication tools. enSense is a platform which provides a REST API (Application Programming Interface) that allows tool designers to retrieve, collate and insert new knowledge into the existing narrative at a systems level. In addition, enSense allows new tools to use existing communication channels to interact with clients, while allowing designers to use the functionality provided by the new tool. enSense is not intended as a platform which is a product; instead it is an illustration and exploration of the types of platforms and tools that can be developed to work alongside other communication technologies.

Due to the complexity of such a platform, various aspects are detailed. In particular, the construction and design of the API and the method of storage and filtering the various forms of communication messages as well as the mapping of their relationships (Chapter 6). There are a number of challenges that were found through the design of enSense, in particular scalability and the misuse of existing communication channels; however, this technique of integration shows one way of avoiding the problems that current tools present when addressing the challenge of client adoption.

Categorisation of the challenges for tool creators designing for designer-client communication within the web design context

Based on the investigations of the web design practice, tools to support web designers in communicating with clients and the ways in which these tools can be designed to better support the existing context, a series of considerations were developed to assist tools creators in designing tools for this context. These considerations are presented as a guide, visualised as a Canvas. The design of the Canvas is to help tool designers investigate the problem space, as well as the

existing context, to make more informed decisions when considering how the tools they design will integrate with the existing collection of communication technologies.

This set of considerations is based on the research conducted throughout the thesis, and an initial evaluation (Chapter 8) demonstrates the challenge of adopting new tools to support designer-client communication (as described in Chapter 5) are understood by designers. However, the framework is still at an initial state and requires longitudinal evaluation in the future to understand what impact these considerations have on the design of new communication tools.

In addition to the outlined research contributions, this thesis also provides a practical contribution that may be beneficial to the web design community:

DCCT Canvas Output

The aim of the DCCT Canvas is to provide creators of communication tools with a method of understanding a communication problem space and the context in which it exists. The Canvas is a lightweight tool to capture this information and reflect on the context when exploring solutions. The Canvas requires creators of new tools to examine the existing communication ecosystem and describe how the new tool will exist within the ecosystem. Tool creators are more likely to create new communication tools that can co-exist with the current communication ecosystem, and thus creating tools that have a higher chance of being successfully adopted. The evaluation showed that by using the Canvas, designers were less likely to simply design a technical solution, and instead think through the context in which the problem they are aiming to solve. Therefore, tools are more commonly designed as sociotechnical solutions, rather than simply new technologies.

9.3 - Reflection on Research Aims

In the opening chapter of this thesis (Chapter 1.3), four key research aims were outlined. These research aims focused on identifying and understanding the current challenges of designing tools to support designer-client communication, and how to mitigate these challenges. This section reiterates these research aims, and reflects on how these were investigated throughout the thesis.

Research Aim 1: *Show the existing designer-client communication process with a focus on the tools and methods that they employ.*

Based on my initial understanding of the designer-client communication process, I had a number of assumptions regarding the methods that designers employ to effectively communicate with clients. I had originally assumed that the communication between the design firm and client was complicated; however, I had not anticipated the breadth of stakeholders who were involved in the web design process. Instead of a specific and well defined "designer-client communication" process, there are instead many different processes, tools and stakeholders that co-evolve depending on the size and nature of the project and the existing communication ecosystem shared between the designer and client. During discussions, designers would first discuss the core interaction with the clients, but throughout the discussion more stakeholders would be referred to. In addition, the roles and categories given to each person within the design team changed for each design firm. Categories such as product managers, product designers, digital directors, account managers and content producers were roles which acted as designers, but were specialised to a specific aspect of the web design process - and most commonly these roles were created to streamline the designer-client process.

The challenges that I observed and discovered through interviews were common across many of the different design firms, and the solutions that they put in place were not unique. The relationship between designers and clients is one that grows over time, through establishing a common ground. However, this builds an inherent

knowledge in the best methods to interact with clients, and one not documented outside of the communication narrative that is generated by digital communication technologies. Additionally, while designers prefer face-to-face meetings with clients, in practice a majority of communication is conducted through digital means.

For more information on the designer-client communication process, see Chapter 3 and Chapter 4.

Research Aim 2: *Identify current issues with designer-client communication; specifically how existing tools in practice contribute to these issues, and the challenges that the use of these tools introduce.*

The initial research aim was to investigate the current issues with communication technologies, which aim to support external communication with clients in the web design process. There are a number of tools designed to explicitly support communication, collaboration and coordination between designers and clients. However, these tools are not highly regarded amongst web designers. Rather, there are a number of tools that are general communication tools but have been adopted in designer-client communication, mainly through pre-adoption of the technology by both users and designers.

Through discussion with participants, a number of issues were highlighted with the current tools to support communication. In particular, tools that were designed to provide rich collaboration between stakeholders were hard to adopt, and difficult to use in the context of designer client communication. Tools that aimed to replace, rather than augment, existing methods of communication had limited success within the context. Moreover, tools that did provide integration with existing methods of communication do not fully utilise the potential of this interconnectivity. For example, tools which build on top of email require clients to use specific email address and any emails sent to other addresses are not captured. In addition, tools that leverage email to notify or make clients aware of information often do so without regard for the socially norms in how Email is used.

For more information on current issues, see Chapters 4 and 5.

Research Aim 3: *Demonstrate how a middleware platform can be designed, deployed and evaluated for the purposes of assisting in the creation of new tools that support designer-client communication by web designers*

This research aim is focused on the ways in which tool designers can create technologies to assist in supporting the unique challenges that arise in designer-client communication. Unlike designers or enterprise systems, tool designers are unable to assume that communication technologies will be adopted from top-down emphasis from managers within a closed system. Instead, tool designers need to focus more on ways they can design tools in a similar manner to existing public communication technologies, in that they have a low level of adoption for clients. However, these communication tools need to provide support, particularly around design artefacts, which are specific to the web design context.

Instead of suggesting that tool designers create isolated tools that can be adopted by a general audience (which requires the tool to find that to large public issues of communications), the aim was to create a prototype platform that builds on the existing infrastructure of universal communication channels already in use within the web design context. enSense provides an example of how a platform can be conceptualised and designed, building on top of existing methods of communication without limiting the type of tool that can be developed.

While tools exist that accomplish this (to a certain extent), they individually integrate with specific communication channels and generally do not leverage the narrative within the communication ecosystem to understand the existing context. enSense demonstrates a number of concepts around the ways in which integration with other technologies can reduce the challenge of adoption, providing a pick-up and use adoption approach as opposed to requiring designers (and, through them, clients) to

change from already familiar tools to new tools, which may have unanticipated consequences.

For more information on enSense, and its applications, see Chapters 6, 7 and 8.

Research Aim 4: *Categorise the issues with creating new communication technologies for supporting designer-client communication within web design. Develop these categories into a guide which can assist designers in being aware and mitigating these challenges.*

The purpose of this research aim was to synthesise the issues and challenges discovered that tool designers face when designing communication technologies for the web design context. Based on the previous research aims, a number of challenges became apparent when designing for this context. However, rather than focusing on all the possible challenges, I chose to focus specifically on the challenge associated with developing new communication tools, which could be easily adopted by both designers and clients (from a pragmatic perspective). Based on investigation, I found that the easiest way to accomplish this is to build upon and extend the existing technologies that have already been adopted by designers and clients. Email is an example of this; however, other communication tools may be more appropriate to build upon. These challenges are made visible through the use of the Designer-Client Communication Tool (DCCT) Canvas, which is a guide for tool designers to identify problems within a given context. The Canvas assists designers in examining a web design context, categorising the communication tools currently in use and presenting ideas for solutions, which build upon this existing communication ecosystem. For more information on the Design Client Communication Tool Canvas, see Chapter 8.

From the results of these studies, a set of contributions to the fields of HCI and CSCW are presented in Chapter 9.2.

9.4 - Limitations and Future Work

9.4.1 Limitations

There are a number of limitations that must be considered when building upon this research. As highlighted in Section 1.4 (Research Scope), this thesis is focused primarily on tools and technologies to support communication between designers and clients. In addition, this work is primarily concerned with designers within the web design industry, rather than design as an over-arching discipline.

The focus of the studies conducted in this thesis focused primarily on a limited set of designers, with similar cultural backgrounds (western culture, mostly within Australia). Additionally, this research focused on the designer's perspective, rather than investigating web design communication from a client's perspective, due to the diversity of clients. The case studies presented in Chapter 3 are limited in their scope in how they may be generalised to web design.

Regarding enSense, the studies that were completed were smaller prototype studies, rather than longitudinal *in situ* studies, so the long-term impact of these technologies are yet to be fully understood. Additionally, the observations and results from the enSense evaluation stem from design of the platform, invoking the wicked problem scenario. As the prototype was designed as a platform, rather than a distinct solution, the focus of the evaluation is centred on the over-arching platform design for communication tools, rather than for improving specific methods of communication. An alternative to the platform approach would be to build a number of grounded solutions to specific problems encountered by web designers.

The development of the Canvas provides tool designers with a way to think on the context that they are designing for and help identify challenges early on regarding the existing ecosystem. However, the long-term effects of these design considerations are yet to be seen in terms of adoption and the evolution of the communication ecosystem within the web design context.

9.4.2 Future Work

The nature of this work bought together multiple areas of research, and as a result there are a diverse areas of future work warranting attention. There are three significant areas of research that can directly draw on this work: a) understanding how web designers work, b) uncovering ways to evolve the existing communication ecosystem of specific contexts to support new products and technologies and c) ways to extend the underlying platforms of these systems to create more opportunities for new methods of communication. These areas are either core to following this work or are in related disciplines that have been highlighted through this work:

A comprehensive understanding of designer-client relationships

This thesis focuses on specifically understanding the ways in which designers and clients communicate through a variety of digital communication channels. However, based on background research there is little longitudinal ethnographic research on how designers collaborate with clients across the entire design process. Current research focuses primarily on the technical design practice of web designers within their context, rather than studying the designer-client relationship throughout the lifecycle of the project. A more focused and longitudinal study on the evolving relationship between clients and designers will bring further insight into new tools and practices which can better support the web design industry.

Design new kinds tools and infrastructure that support designer-client communication around artefacts

This research highlights the need for new kinds of tools to support the nature of designer-client relationships by focusing on the ability to communicate effectively through digital communication around design artefacts. There needs to be no disconnect between the artefacts (such as design tools and websites) and the methods of communication that discuss them. Communicating around artefacts should be fluid and not require the designer to consider whether the client will be willing or able to communicate using the tool that they use. Similarly, clients should

not be required to install design or developer oriented tools to be able to effectively communicate with designers, and instead should have access to easy to use (and easy to remember) forms of communication and annotation with design artefacts.

Currently, both designers and clients use *ad hoc* solutions to support communication around artefacts. There is a large potential for research into methods in which communication around an artefact could be attached to the artefact itself (and as the artefact is iterated upon), similar to the functionality provided by developer-oriented version control systems. This thesis provides a starting point for the design of such new tools, and more research is needed to understand how such tools play out over a long period of time.

Adapting existing communication infrastructure to enable a distributed communication graph

A major problem that this thesis highlights is the need to build upon existing universal communication channels to ensure success within the design client communication context. Clients are transient in the web designer relationship, and thus are unlikely and often unwilling to adopt new methods of communication. While the enSense prototype allows for the augmentation of existing communication channels to provide new methods of interaction, a more streamlined and prevalent approach would be to augment the infrastructure that underlies the most common communication channels. While some methods of communication (such as Skype) are proprietary, Email in particular is distributed and allows inter-operability between various venders.

The vision of the future communication tools is to explore how popular Email protocols (in particular IMAP and SMTP) could be extended to provide enSense-like functionality and features without requiring centralised servers. The email protocol allows for custom headers to be added to messages, which would allow enabled servers to monitor, track, augment and report the richness of meta-data of communication between designers and clients (with the potential of a much broader context of use). A significant limitation with enSense is that it is a centralised system

that requires users to store their communication information within a central location. Building upon the existing SMTP standard for sending email and providing a more user-controlled architecture helps in managing privacy and issues of ownership that are handled in a business level peer-to-peer architecture (Merle, Bénel, Doyen & Gaïti, 2012). Through this method, each business can control how their communication information is shared and with whom.

There are many considerations required in this area of research, in particular the well established standards of email communication, as well as privacy and awareness of using these types of services. However, as services such as Apple's iMessage has demonstrated by extending SMS, there is potential to augment established and ingrained communication channels with new features to provide better levels of awareness amongst users.

The introduction of application usage and context-aware computing into the meta-data of communications

A missing aspect of the current established communication channels is the lack of contextual understanding of the situation surrounding messages and communication. While some contextual information is highlighted explicitly within the message and its associated meta-data, little else is known about the context in which the communication occurs. Capturing the larger context in which communication occurs has the ability to create a better understanding of the communication (by both human and digital readers), as well as allowing for better reporting and documentation of the life of the relationship between the users. Better integration between applications that designers use and communication channels between designer and client would allow for more effective and productive communication to take place. In addition, understanding the context of clients (such as when they are busy) would provide designers with a much better awareness of the most appropriate times to work with clients, to aid in providing a better working relationship.

The enSense prototype platform examines the concept of an API that allows designers to build on top of existing communication methods. The platform was

used to explore the challenges of building upon existing methods of communication and there is significant potential for future work on the platform to implement a version that can be embedded within web design firms for long term studies. Platforms that can be used to study this context needs to take into account many considerations that were beyond the scope of this enSense prototype:

- Security concerns related to storing commercial in confidence information,
- Scalability for large scale testing across a number of users,
- Quick query access to large scale data, and
- Connectivity with other services that have limited API access, such as Skype and Phone calls through license agreements.

The design of Application Programming Interfaces (APIs) for end user usage

An unexpected outcome of this thesis was the discovery of a lack of research regarding the design of Application Programming Interfaces from a human centred perspective. While industry best practice has improved the usability and learnability of these APIs, empirical and experimental research on the methods by which this information is learnt and interacted with is still to be effectively conducted. This leads to a broader area of research that involves the potential for end users to effectively utilise their own communication information, a much broader area than web-designer-client communication. While some progress has been made in this area through end-user programming research (Wong & Hong, 2007), current research work is focused on the accessibility of situated and physically contextual information, rather than the accumulating levels of communication information being stored online. There are many practical applications for this research beyond privacy and control of one's own data, such as being able to both report and reflect on the individuals own work, providing end users insight into their actions and ways to better explore their data at an group or organisational level.

9.5 - Conclusions

This thesis has described an investigation that was undertaken to understand the issues around technology support for design client communication within the web design context. In particular, the thesis provides insight into how tool designers can create new design client communication tools that lessen the challenge of adoption by designers and clients without requiring a significant amount of work on the part of the designers to drive client use of the technology.

The thesis proposes that instead of creating new communication technologies that require the adoption by clients, tool designers can build upon existing communication technologies in a way that does not require clients to necessarily use the tool for it to remain useful. By leveraging the existing communication ecosystem, tool designers can primarily focus on the problems encountered by web designers, rather than on how the tool will be adopted by clients. Two-way integration between communication tools allows new tools to be designed contextually on the web design process to benefit the designer, while at the same time allowing the clients to communicate through channels which they are already familiar with. An added benefit of this approach is that newly developed tools can leverage the existing knowledge contained within the already-in-use technologies and add contextualised meta-data to this knowledge as the context becomes apparent.

The thesis presents a series of studies that investigate current designer-client communication practice, as well as the categorisation of communication tools which are currently available to support this. From these studies, a series of challenges are identified, in particular the problems associated with introducing new communication technologies into the pre-existing web design context.

A prototype, enSense is presented as a middleware platform that enables new tools to build directly on existing methods of communication in a two-way integration. The platform provides a heavily documented REST API that allows designers a quick

education into how to use the platform. From the study of the prototype through a series of applications, along with the previous studies, a guide (the DCCT Canvas, Chapter 8.3) has been created which organises the discovered concerns to assist in guiding tool designers through the planning phases of designing new communication tools.

The purpose of the Canvas is to bring to light the challenges that tool creators will face when designing communication tools for this context, and ways in which they can address some of these challenges by building on top of existing (and already adopted) methods of communication. Although the Canvas was not evaluated in how it informs the creation of new tools (Chapter 8.6), it has proved to be an effective tool for giving insight to designers in how to consider the existing communication ecosystem, and how existing channels of communication may be extended and built upon rather than being replaced.

Successful communication tools of the future that aim to support designer-client communication either need to become used universally in the general population on their own or leverage the existing communication ecosystem of existing universal channels. By building on top of these channels, tool designers may focus directly on the problems which web designers face, rather than focusing on the issues of client adoption.

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Appendix 1: Review of Existing Designer-Client Communication Tools

A quantitative study was conducted to examine the current range of applications and services which focus on supporting business communication. This study was conducted to understand the direction and focus of existing communication tools, and identify what features they provided. A total of 122 communication tools were identified and examined. The analysis of tools in this study was based on the classification system provided by Penichet et. al. (2007).

Communication tools were discovered through a variety of methods, including informal recommendations, interviews with Web Developers (see Appendix F), as well as CSCW and Social Software literature. 60 tools provided collaborative functionality (providing shared areas for collaborating around content), 82 provided communication support (both synchronous and asynchronous), and 75 focused on the coordination of projects and teams. 53 of tools were required to be deployed within a business, while 89 tools were offered as Software as a Service (SaaS).

Each communication tool was given a single keyword to describe its primary focus. The majority of tools examined focused on supporting conversations between workers, and providing organisational support (Table 16).

Table 16: Examined communication tools

Classification	Tool	Company Name	Collaborate	Communicate	Coordinate	Synchronous	Asynchronous	Collocated	Remote	Focus	API	Deployment	2 way Integration
	TOTAL		**80**	**100**	**89**	**57**	**134**	**97**	**149**				
A-05	Backpack	37 Signals	0	0	1	0	1	0	1	Knowledge	Yes	Online	No
A-05	Google Calendar	Google	0	0	1	0	1	0	1	Organisation	Yes	Online	No
A-05	Metastorm SBW	Metastorm inc.	0	0	1	0	1	0	1	Knowledge	Yes	Local	No
A-05	Mingle	ThoughtWorks	0	0	1	0	1	0	1	Project	Yes	Online	No
A-05	Pmrealworld	Windsong	0	0	1	0	1	0	1	Project	No	Online	No
A-05	Sites	Google	0	0	1	0	1	0	1	Documents	Yes	Online	No
A-05	Sortfolio	37 Signals	0	0	1	0	1	0	1	Introductions	No	Online	No
A-07	Collanos Workspace	Collanos Software	0	0	1	0	1	1	1	Files	No	Local	No
A-07	Exoplatform	eXo Platform SAS	0	0	1	0	1	1	1	Middleware	Yes	Local	Database

A-07	HubWoo	SAP	0	0	1	0	1	1	1	Project	No	Local	No
A-07	Huddle	Ninian Solutions	0	0	1	0	1	1	1	Project	Yes	Online	No
A-07	Presto	Inmagic	0	0	1	0	1	1	1	Knowledge	Yes	Local	Sharepoint
A-07	Social Network Analyser	SAP	0	0	1	0	1	1	1	Analysis	Yes	Local	Database
B-05	Flickr	Yahoo	0	1	0	0	1	0	1	Files	Yes	Online	No
B-05	Usenet	Open	0	1	0	0	1	0	1	Communication	Yes	Both	No
B-05	Sidewiki	Google	0	1	0	0	1	0	1	Bookmarking	Yes	Online	Browser
B-05	Wordpress	Wordpress	0	1	0	0	1	0	1	Communication	Yes	Online	Email
B-07	Buzz	Google	0	1	0	0	1	1	1	Conversations	Yes	Online	Twitter
B-07	Inbox2	Inbox2	0	1	0	0	1	1	1	Organisation	Yes	Local	Email, SN
B-07	phpBB	phpBB Group	0	1	0	0	1	1	1	Conversations	Yes	Both	No
B-07	Twitter	Twitter	0	1	0	0	1	1	1	Conversations	Yes	Online	No
B-11	Google Talk	Google	0	1	0	1	0	1	1	Conversations	No	Online	No

B-11	IRC	Open	0	1	0	1	0	1	1	Conversations	Yes	Both	No
B-11	Jabber	Open	0	1	0	1	0	1	1	Conversations	Yes	Both	No
B-11	Skype	Skype Limited	0	1	0	1	0	1	1	Conversations	No	Online	Telephony
B-13	Unified Communications	Open	0	1	0	1	1	0	1	Communication	Yes	Local	Phone, Digital
B-15	Vulcan Project	IBM	0	1	0	1	1	1	1	Communication	Yes	Local	Lotus
C-05	Activecollab	AS1	0	1	1	0	1	0	1	Project	Yes	Online	No
C-05	Bantam	Bantam Networks	0	1	1	0	1	0	1	Project	Yes	Online	No
C-05	Basecamp	37 Signals	0	1	1	0	1	0	1	Project	Yes	Online	Email
C-05	Box.net	Box.net	0	1	1	0	1	0	1	Files	Yes	Online	No
C-05	CoBooCo	CoBooCo	0	1	1	0	1	0	1	Project	No	Online	No
C-05	CoTweet	ExactTarget	0	1	1	0	1	0	1	Conversations	No	Online	Twitter
C-05	Exchange	Microsoft	0	1	1	0	1	0	1	Communication	Yes	Both	Email
C-05	Get Satisfaction	Get Satisfaction	0	1	1	0	1	0	1	Project	Yes	Online	Salesforce
C-05	Highrise	37 Signals	0	1	1	0	1	0	1	Conversations	Yes	Online	No

C-05	Moodle	Moodle Trust	0	1	1	0	1	0	1	Education	Yes	Local	No
C-05	Onehub	Onehub	0	1	1	0	1	0	1	Project	No	Online	Email
C-05	Outlook Social Connector	Microsoft	0	1	1	0	1	0	1	Conversations	Yes	Online	Email
C-05	The Coordinator	Winograd, Flores	0	1	1	0	1	0	1	Conversations	No	Local	Email
C-06	Social Sites Enterprise	Newsgator	0	1	1	0	1	1	0	Enterprise 2.0	Yes	Local	Sharepoint
C-06	Socialcast	Socialcast	0	1	1	0	1	1	0	Enterprise 2.0	Yes	Both	Email, Sharepoint
C-07	ConcourseConnect	Concursive	0	1	1	0	1	1	1	Project	Yes	Both	No
C-07	CubeTree	CubeTree	0	1	1	0	1	1	1	Enterprise 2.0	Yes	Online	No
C-07	GroupTweet	GroupTweet	0	1	1	0	1	1	1	Conversations	No	Online	Twitter
C-07	ELAvate	INgage Networks	0	1	1	0	1	1	1	Enterprise 2.0	No	Local	No
C-07	Hyperoffice	HyperOffice	0	1	1	0	1	1	1	Communication	No	Online	Email
C-07	Memberhub	Five Points	0	1	1	0	1	1	1	Project	No	Online	No
C-07	Ning	Ning	0	1	1	0	1	1	1	Conversation	Yes	Online	No

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C-07	Office Medium	OfficeMedium	0	1	1	0	1	1	1	Communication	No	Online	No
C-07	Trac	Edgewall	0	1	1	0	1	1	1	Source Code	Yes	Both	SVN
C-07	WizeHive	PivotPoint	0	1	1	0	1	1	1	Conversations	Yes	Online	Email
C-07	Yammer	Yammer	0	1	1	0	1	1	1	Conversations	Yes	Online	No
C-13	Campfire	37 Signals	0	1	1	1	1	0	1	Conversations	Yes	Online	No
C-15	Beehive	Oracle	0	1	1	1	1	1	1	Communication	Yes	Local	No
C-15	Comindwork	NewtonIdeas	0	1	1	1	1	1	1	Project	Yes	Online	No
C-15	Flock	Flock	0	1	1	1	1	1	1	Conversations	Yes	Local	Browser
C-15	omCollab	Open	0	1	1	1	1	1	1	Enterprise 2.0	Yes	Local	Office
C-15	Quad	Cisco	0	1	1	1	1	1	1	Conversations	No	Local	No
C-15	Socialwok	Voiceroute	0	1	1	1	1	1	1	Conversations	No	Online	Email, IM
C-15	Streamwork	SAP	0	1	1	1	1	1	1	Project	Yes	Online	Email
C-15	Threadbox	Threadbox	0	1	1	1	1	1	1	Conversation	Yes	Online	Email

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D-05	Delicious	Yahoo	1	0	0	0	1	0	1	Bookmarking	Yes	Online	No
D-05	Spurl	Spurl	1	0	0	0	1	0	1	Bookmarking	Yes	Online	No
D-05	Wridea	Octeth	1	0	0	0	1	0	1	Idea Generation	Yes	Online	No
D-07	Confluence	Atlassian	1	0	0	0	1	1	1	Documents	Yes	Both	Office
D-07	Jumper 2.0	Jumper Networks	1	0	0	0	1	1	1	Bookmarking	No	Local	Browser
D-07	Lotus 1-2-3	IBM	1	0	0	0	1	1	1	Documents	No	Local	Office
D-07	Lotus Quickr	IBM	1	0	0	0	1	1	1	Files	Yes	Local	Email, Lotus
D-07	Lotus Symphony 3.0	IBM	1	0	0	0	1	1	1	Documents	Yes	Local	Office, Lotus
D-07	MediaWiki	Wikimedia	1	0	0	0	1	1	1	Knowledge	Yes	Both	No
D-07	Mindmeister	MeisterLabs	1	0	0	0	1	1	1	Idea Generation	Yes	Online	No
D-07	SVN	CollabNet	1	0	0	0	1	1	1	Source Code	Yes	Both	No
D-07	TikiWiki	TikiWiki	1	0	0	0	1	1	1	Knowledge	Yes	Local	No
D-09	Mikogo	Mikogo	1	0	0	1	0	0	1	Screensharing	No	Online	No
D-15	Axure RP	Axure	1	0	0	1	1	1	1	Idea Generation	Yes	Online	No

D-15	Buzzword	Adobe	1	0	0	1	1	1	1	Documents	No	Online	No
D-15	Google Docs	Google	1	0	0	1	1	1	1	Documents	Yes	Online	Office
E-05	BSCW	Fraunhofer FIT	1	0	1	0	1	0	1	Files	Yes	Online	No
E-05	Connectbeam	Connectbeam	1	0	1	0	1	0	1	Enterprise 2.0	Yes	Local	Office, Browsers
E-05	eGroupware	EGroupware.org	1	0	1	0	1	0	1	Project	Yes	Both	Email
E-07	Cynin	Cynapse	1	0	1	0	1	1	1	Knowledge	Yes	Both	No
E-07	Groove	Microsoft	1	0	1	0	1	1	1	Files	Yes	Both	Office
E-07	Jira	Atlassian	1	0	1	0	1	1	1	Project	Yes	Both	No
E-07	Lyza	Lyzasoft	1	0	1	0	1	1	1	Documents	No	Online	Office
E-07	MindTouch	MindTouch	1	0	1	0	1	1	1	Documents	Yes	Online	No
E-07	Onenote	Microsoft	1	0	1	0	1	1	1	Documents	Yes	Both	Office
E-07	Dropbox	Dropbox	1	0	1	0	1	1	1	Files	Yes	Online	No
E-15	Sharepoint	Microsoft	1	0	1	1	1	1	1	Project	Yes	Both	Office
F-09	Gotomeeting	Citrix	1	1	0	1	0	0	1	Meetings	Yes	Online	No
F-09	LiveLOOK Cobrowsing	LiveLOOK	1	1	0	1	0	0	1	Screensharing	No	Online	No
F-09	Remote Desktop	Microsoft	1	1	0	1	0	0	1	Screensharing	No	Local	No
F-09	Sharedview	Microsoft	1	1	0	1	0	0	1	Screensharing	No	Local	Office

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F-09	Telepresence	Cisco	1	1	0	1	0	0	1	Conversations	No	Local	No
F-09	VNC / Screen Sharing	Open	1	1	0	1	0	0	1	Screensharing	No	Both	No
F-09	WebEx	Cisco	1	1	0	1	0	0	1	Screensharing	Yes	Online	No
F-11	Hive	IBM	1	1	0	1	0	1	1	Conversations	No	Local	No
F-11	Xen	Citrix	1	1	0	1	0	1	1	Screensharing	Yes	Local	Computers
F-13	Central Desktop	Central Desktop	1	1	0	1	1	0	1	Communication	Yes	Online	IM
F-13	CS Review	Adobe	1	1	0	1	1	0	1	Communication	No	Online	Adobe CS
F-13	Kablink	Novell	1	1	0	1	1	0	1	Communication	Yes	Local	No
F-13	Lotus Sametime	IBM	1	1	0	1	1	0	1	Communication	No	Local	Telephony
F-14	Qontext	Qontext	1	1	0	1	1	1	0	Communication	No	Online	Salesforce
F-15	Colaab	Storm Ideas	1	1	0	1	1	1	1	Annotation	No	Online	No
F-15	Twiddle	Twiddla	1	1	0	1	1	1	1	Idea	Yes	Online	No

										Generation			
F-15	Wave	Google	1	1	0	1	1	1	1	Communication	Yes	Both	No
G-05	Clearvale	BroadVision	1	1	1	0	1	0	1	Communication	Yes	Online	No
G-05	Teambox	Teambox	1	1	1	0	1	0	1	Project	Yes	Online	Email
G-06	Socialtext Workspace	Socialtext	1	1	1	0	1	1	0	Enterprise 2.0	Yes	Online	No
G-07	GitHub	GitHub	1	1	1	0	1	1	1	Source Code	Yes	Online	Git
G-07	Humanedj	Role Modellers	1	1	1	0	1	1	1	Enterprise 2.0	Yes	Both	Office
G-07	Jive SBS	Jive Software	1	1	1	0	1	1	1	Enterprise 2.0	Yes	Local	Sharepoint
G-07	Lotus Connections	IBM	1	1	1	0	1	1	1	Enterprise 2.0	Yes	Online	No
G-07	Redliner	Redliner	1	1	1	0	1	1	1	Documents	No	Online	No
G-07	Wrike	Wrike	1	1	1	0	1	1	1	Project	No	Online	Email
G-09	Venuegen	VenueGen	1	1	1	1	0	0	1	Meetings	No	Online	No
G-15	Engage	MangoSpring	1	1	1	1	1	1	1	Enterprise 2.0	Yes	Online	No
G-15	Mind Manager	Mindjet	1	1	1	1	1	1	1	Idea Generation	Yes	Local	Office

G-15	PBWorks	PBwiki	1	1	1	1	1	1	1	Enterprise 2.0	Yes	Online	No
G-15	Pulse	Novell	1	1	1	1	1	1	1	Enterprise 2.0	Yes	Local	Wave
G-15	Chatter	Salesforce	1	1	1	1	1	1	1	Enterprise 2.0	Yes	Online	Office, SocSof
G-15	Zoho Projects	ZOHO Corperation	1	1	1	1	1	1	1	Documents	Yes	Online	No
F-11	Etherpad	Etherpad Foundation	1	1	0	1	0	1	1	Documents	Yes	Local	No
D-07	Evernote	Evernote	1	0	0	0	1	1	1	Documents	Yes	Local	Email
A-05	Senduit	Davidville	0	0	1	0	1	0	1	Files	No	Online	No
A-15	Remember the Milk	Remember the Milk	0	0	1	1	1	1	1	Project	Yes	Both	Email, SocSof
A-05	Harvest	Harvest	0	0	1	0	1	0	1	Project	Yes	Online	Email
D-07	ConceptShare	ConceptShare	1	0	0	0	1	1	1	Idea Generation	Yes	Online	No
G-15	Fluxiom	wollzelle	1	1	1	1	1	1	1	Files	Yes	Online	No
C-15	Asana	Asana	0	1	1	1	1	1	1	Project	Yes	Online	Email
B-11	Google Hangouts	Google	0	1	0	1	0	1	1	Conversations	Yes	Online	Telephony
B-11	Anymeeting	Anymeeting	0	1	0	1	0	1	1	Conversations	Yes	Online	Telephony

F-11	Fuze	Fuzebox	1	1	0	1	0	1	1	Conversations	Yes	Online	Telephony
F-07	Trello	Trello	1	1	0	0	1	1	1	Project	Yes	Online	Email
A-05	Doodle	Doodle	0	0	1	0	1	0	1	Project	Yes	Online	No
D-07	creately	Cinergix	1	0	0	0	1	1	1	Idea Generation	Yes	Online	No
D-07	GroupZap	Paleosoft	1	0	0	0	1	1	1	Idea Generation	Yes	Online	No
C-15	Slack	Slack Technologies	0	1	1	1	1	1	1	Communication	Yes	Both	Social Software
E-07	Huddle	Ninian Solutions	1	0	1	0	1	1	1	Files	Yes	Online	No
B-13	Hipchat	Atlassian	0	1	0	1	1	0	1	Communication	Yes	Online	No
D-07	Ninjamock	Ninjamock	1	0	0	0	1	1	1	Idea Generation	No	Online	No
D-07	Realtime Board	Realtime Board	1	0	0	0	1	1	1	Idea Generation	Yes	Online	No
G-07	Govisually	ClockworkStudio	1	1	1	0	1	1	1	Conversations	No	Online	No
G-15	Open Atrium	Phase2	1	1	1	1	1	1	1	Conversations	Yes	Both	Yes
G-13	Cage	Cageapp	1	1	1	1	1	0	1	Project	No	Online	No

C-07	Binfire	Binfire	0	1	1	0	1	1	1	Project	No	Online	No
F-05	Marqueed	Marqueed	1	1	0	0	1	0	1	Idea Generation	No	Online	No
G-15	Concept Inbox	Concept Inbox	1	1	1	1	1	1	1	Idea Generation	Yes	Online	No
A-07	Proof Hub	Proof Hub	0	0	1	0	1	1	1	Project	Yes	Online	No
F-05	InVision	InVision	1	1	0	0	1	0	1	Idea Generation	No	Online	No
F-15	Scribblar	Scribblar	1	1	0	1	1	1	1	Conversations	Yes	Online	No
F-05	redpen	Pistachio Collective	1	1	0	0	1	0	1	Idea Generation	No	Online	No
D-05	flatsi.es	Alasdair Monk	1	0	0	0	1	0	1	Idea Generation	No	Online	No

Table A1.1 - Existing communication tools

The classification of tools (Table A1.1) is based on a tally of Type (Collaboration, Communication and Coordination (A-G)), and Time/Space (Synchronous, Asynchronous, Co-located and Remote (1-15)).

Appendix 2: Grudin's Eight Challenges

Grudin (1994b) outlines eight challenges that designers of Groupware must take into consideration. Although these challenges are over fifteen years old, the problems discussed are still relevant to the design of Groupware and Social Software (Duysburgh & Jacobs, 2010; Shah, 2009; Shih, 2009). These challenges are not concerned with the technical implementation of Groupware; rather the concern is focused on the conceptual design of communication tools and their introduction into the workplace:

1.0 Disparity in work and benefit: Groupware inherently requires some users to do more work than others. Additionally, the rewards for using Groupware are not equally distributed

2.0 Critical Mass and Prisoners dilemma: Groupware requires mass adoption within the workplace to become successful. Groupware cannot effectively support a task if not everyone involved is using the system. Markus & Connolly (Markus & Connolly, 1990) further define this as Groupware is built on a need of interdependence – that a success of a Groupware application for a single user is dependent on its usage from other users.

3.0 Disruption of social processes: Tacit and implicit information is not made explicit within Groupware. Designers must understand the existing social processes within the workplace, and the system must be able to adapt to them, and support users as they adapt to situations.

4.0 Exception handling: Predefined work processes define how "the work should be done", however workers will often adapt processes to better fit the situation. Groupware should be designed so that is does not enforce predefined work processes, instead guiding users but offer flexibility where necessary.

5.0   Unobtrusive accessibility: Designing Groupware that takes into account all possible situations is not feasible. However task specific applications need to account for unanticipated features. Grudin suggests that Groupware should augment existing successful applications, rather than attempt to replace them.

6.0   Difficulty of evaluation: Groupware is difficult to evaluate, more so than single user applications. Groupware cannot be evaluated immediately; it requires observation over time to evaluate how the system affects work efficiency and effectiveness over time. Social, political and work factors must be taken into account when evaluating Groupware.

7.0   Failure of intuition: Groupware is often designed around the requirements of management rather than the direct users of a system. Groupware applications should be designed with direct user involvement, rather than generalising user work patterns through discussions with management.

8.0   Adoption process: The success of Groupware has a high dependence on its initial acceptance within the work environment. Groupware must be introduced in a way that its benefits are directly noticeable, and does not require a large amount of initial work by users to become usable. Grudin suggests that by augmenting existing applications with Groupware specific features, these adoption issues can be negated.

Grudin analyses the success of email in regards to these eight challenges. Email is successful due to its flexibility within any situation as well as its easy to adopt nature. Email provides a communication channel that does not force users to engage in particular process; rather it puts the emphasis on social protocols to enforce its usage. Rodden (1991) identifies that another common characteristic of Groupware is the role of Control, and how it defines the usage within groups. This is important within businesses where a strict hierarchy manages the social relationships.

362

Grudin suggests that by building on top of already in use applications, many of the adoption and critical mass challenges can be avoided, allowing designers to focus more on novel methods of supporting group interaction. Grudin (1994b) and Rouncefield, Hughes, Rodden & Viller (1994) emphasise that communication technologies are likely to change existing organisational and communication methods, and this phenomenon should be considered throughout the design process to reduce the risks associated with successful adoption. The 1990 CHI panel (Ensor, 1990) discussed the practicalities of Groupware, with Gail Rein stating, "If Groupware is to realise its full potential as an enhancer of human interaction, it must be well integrated into existing organisations and their software environments. Practical Groupware applications must provide viable connections to the single-user application world".

Appendix 3: Designer-Client Meeting

One of the most important aspects of the designer-client relationship is defined by the first meeting. We conducted an ethnographically inspired observational study on the initial meeting between a design firm and their client. While we had familiarity with both the designers and clients, the client invited myself to the meeting. The focus for the initial design meeting is for the designers to get an understanding of the clients needs; the clients target audience, and the vision for the product/service being developed. However this is also a vital step for the designers to gain an understanding of how the client works and thinks, and to understand what is are design needs versus design wants. While our initial thoughts were that it was an important meeting comparative to other meetings, we found that on reflection it in fact a vital part of the design process in general, as it establishes the roles of the parties, as well as the social norms of the relationship. It is also begins to develop the design language - in the sense of the language that it used to discuss concepts.

In the meeting that I observed, there was a lot to take out of the meeting process:

1. The designers were less interested in the end user than they were the clients needs
2. The users were imagined through the eyes of the client
3. The client, while not being of a design discipline, had a clear vision that the designers needed to gain
4. While having a vision, the client did not think through some of the options available
5. A lot of the discussion was around understanding, rather than semantics
6. Props were used extensively in the meeting to represent the vision/ideas
7. Printouts of information were used as reference, not much time spent examining the data "this kind of information"

8. The designers would speak aloud ideas or thoughts, and then watch intently on how the client reacted - exploration into the ideas

9. The client would regularly draw on their own experiences, using storytelling as a mechanism for explanation

10. Common terms of reference, such as popular news stories would be used to frame an idea/workflow

11. The client appeared confident in their understanding of what the users would and would not appreciate

12. The communication of the concept from the client to the designer is an iterative process

13. The entire concept as a workflow is essential, not just isolated pieces of the idea

We also identified a number of roles, both for people within the meeting, and others discussed within the meeting:

- The client - the person who needs something achieved
- The expert - the person who has the domain knowledge
- The mediator - the person reiterating what someone has said
- The designer - the person proposing ideas
- The developer - the person concerned about implementation
- The storyteller - the person who has prior experience in a specific situation based on domain knowledge

Below is a retelling of the meeting, based on our observations and reflections. We later interview both the client and designers about this first meeting, to discover what they took away and what they disregarded in the meeting. Our focus here is not on the specifics on the design concept itself, but rather the flow of the narrative within the meeting, and what kinds of information were focused on. The thought is that by understanding this initial meeting, we will have a better handle on the established context/relationship when examining digital communication data, and gain an understanding of how information disseminated in F2F meetings can be extracted

through later communications. As opposed to progress meetings, or meetings within organisations where structure is set, the initial designer/client meeting is quite open, and can have dramatic impacts on the direction that a project may take. This re-telling of the meeting is being recounted prior to analysing digital communication to ensure no bias towards the perspective of the narrative.

Meeting, 10:00AM

The initial meeting between the client and the designers took place in the client's office, located on level 3 of the building. Formal introductions were done, although brief (due to the initial contact being already done on Skype). We the researchers were also present in the meeting, sitting around the table with the client and the designers. We stated initially that we were primarily there to observe the meeting, but our presence was more there to take notes as opposed to treating them as research subjects.

The focus for the initial project was to outline the project vision and purpose, so that the designers could plan the conceptual design of the work. In this case, the client had already developed some material that was used in the meeting:

- Light-weight physical prototype presenting the concept
- Table based information that would serve as the structure of the data

From the design side, two members were present. One presented themselves as the project manager, and the other a designer/developer. Both of these people were there to ensure that all information was captured from the meeting.

The client established the focus for the design - the design is to develop a user interface that presented different themes or views on a particular news story. This was to be presented in the skeuomorphic form of a cube. Thus, each of the 6 sides of the cube (which could be manipulated) would have material related to its theme. The design firm for this project dealt primarily with iOS design, so therefore the cube

would be presented either on an iPhone or iPad, and would be interacted with through direct manipulation. The purpose of this design was to break away from traditional forms of journalism where there is a single narrative, to a more digital form of storytelling, where end users could link through to varying perspectives and themes on a single topic.

The project manager started with the first question, who was the end user. The client came from a journalism background, so the question was related to whether the application would be designed for end-users, or for journalists. This made the client reflect, as in their own mind they were both a journalist and an end-user. After some discussion and self-reflection by the client (talking through informally the use cases of the system), it was decided by all participants that the interface would be first-most designed to be used by journalists, and later by end users.

The project manager then asked about the current state of journalism (attempting to get some insight into the clients perspective on the area). The client described the current state of journalism, in that the business models were eroding, mainly due to the problems with self-sustainable journalism, and its reliance on advertising. The client discussed that currently journalism has not changed for the most part, and that stories are just "stuck on the web". Additionally, the client went into how the format of journalism doesn't tend to promote reflection by the journalist. Providing more insight for the designers, the client went into (using a whiteboard) the process that goes into the writing of an article by journalists. The client referred to this as a "triangular form", where by the most important information of a news story sits at the top, and decreases downwards, with each piece of information being rated with a "news value". The client then discusses that the medium of the web has potential to provide much more to journalists, with journalists being able to package stories together. However, the traditional methods employed by journalists lead to a single narrative, all written from a single perspective, and that new methods of interaction such as hyperlinking are not effectively exploited by journalists. The concept behind the cube was to provide a new way for journalists to think about, and structure their narrative (Figure 67).
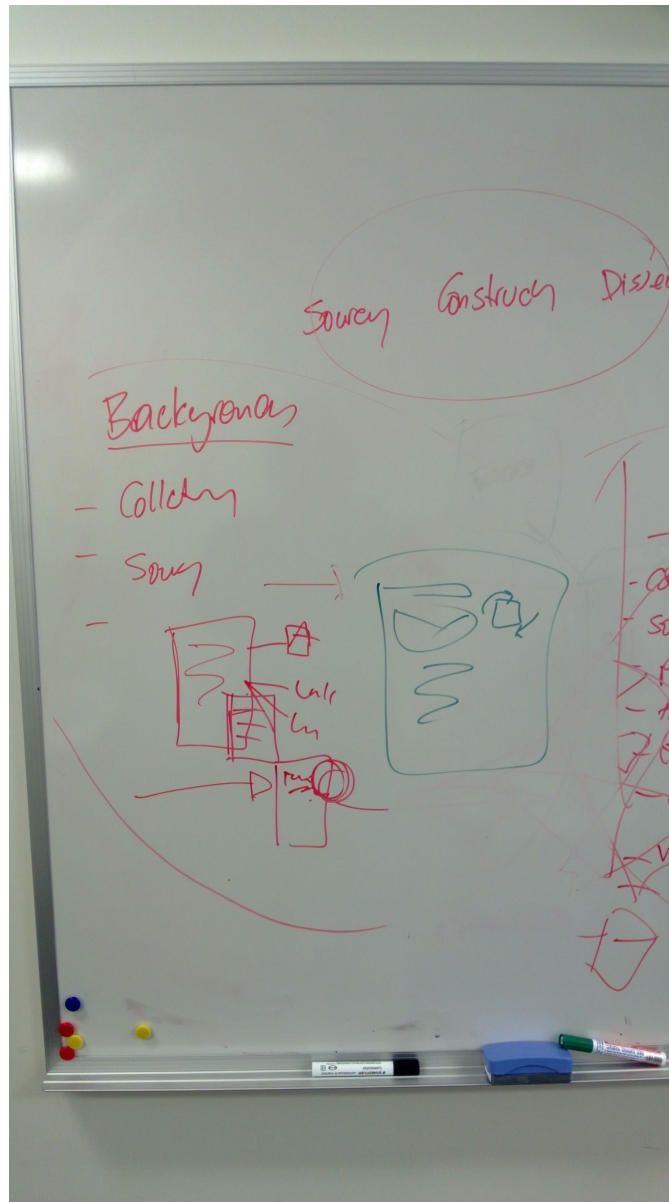
Figure 67: NewsCube - explaining concepts

The next question (again by the project manager) was to ask how the cube was specifically going to address these issues, at least in the clients mind. From these observations, we could tell that the objective for this meeting from the designers perspective was as much to do with understanding the clients viewpoint as it was getting specific requirements. This was the question where the client began to highlight how they envisioned the cube to work. The client referred to (and continued to throughout the discussion) a story on soil erosion, and how it is a complex story with many intertwining themes. The main emphasis was on the thought that hypertext was not effectively used by journalists, and that the cube should enforce a

structure which encouraged hyperlinking content. Each side of the cube would be related to a theme, and that links would be created across the cube to relate articles of different themes together. In the case of the soil erosion story, the example themes were economic, environmental, business, politics, security and social impact. There was also a discussion, whether it would be possible to tag content, similar to how flickr and other websites work. As the client and designers discussed the context of hyperlinking, the client pulled out some example lightweight prototypes that they had created to explore the idea (Figure 68). This led to all three people to talk around the cube.

Figure 68: NewsCube - physical prototypes

At this point the discussion turned to each person grabbing the cube and gesturing to how links would be formed. Would the cube become transparent and show a web inside, or would it form links around the cube that could be clicked. Through the physical medium, the client and designers were able to brainstorm how the cube

would both function and be interacted with. Another cube, which was yet another prototype created by the client initially, showed a more concrete example of the different themes. This began another discussion into the idea of tagging content, to understand how it relates together. The client suggested that all content should be tagged, in a way that it is organic. The client asked whether this tagging could be done automatically? The client then mentioned that tagging is done in two ways for journalists, categories, and also keywords. The PM responded that this may have further implications down the line, where things like social media do not make this distinction. There were also issues raised between the PM and the designer about the use of tags. The PM highlighted the potential concerns between too many and too few tags, and the importance of finding the correct number of tags. The designer/developer suggested that there were no technical limitations to this, and that it could be refined at a later point.

The designer then asked whether cubes were isolated, or whether multiple cubes link together. The client did not have a concrete response to this, and instead sketched up the possibilities on the whiteboard. The client stated that they were unsure, because of how complex and narrative the news and world were. There was a discussion on the potential of having nested cubes, and how multiple people become involved. At the end of the discussion, it was mutually decided that multiple cubes and users became messy and complex, and should be left alone until further along in the process. While the PM was happy with this, the designer appeared to have some concerns, stating that it "sort of answers the question".

Once the people had a clear vision of the project, then more questions were raised on the scope of what fitted into a cube. The PM asked whether the cube was best suited to complex stories, or whether simple stories worked as well. The client responded that journalists could easily find angles/themes to simple news stories. The client gave the example of a car accident incident, in that it was an open/shut story. However, in the story it may include a theme around road safety, which may involve police or politics. However the client admitted there was more scope for themes within larger and more complex narratives.

The designer/developer then asked about the structure of information - is there a clear hierarchy, and what are the most important points to the story. The client responded with drawing on the whiteboard (Figure 69).
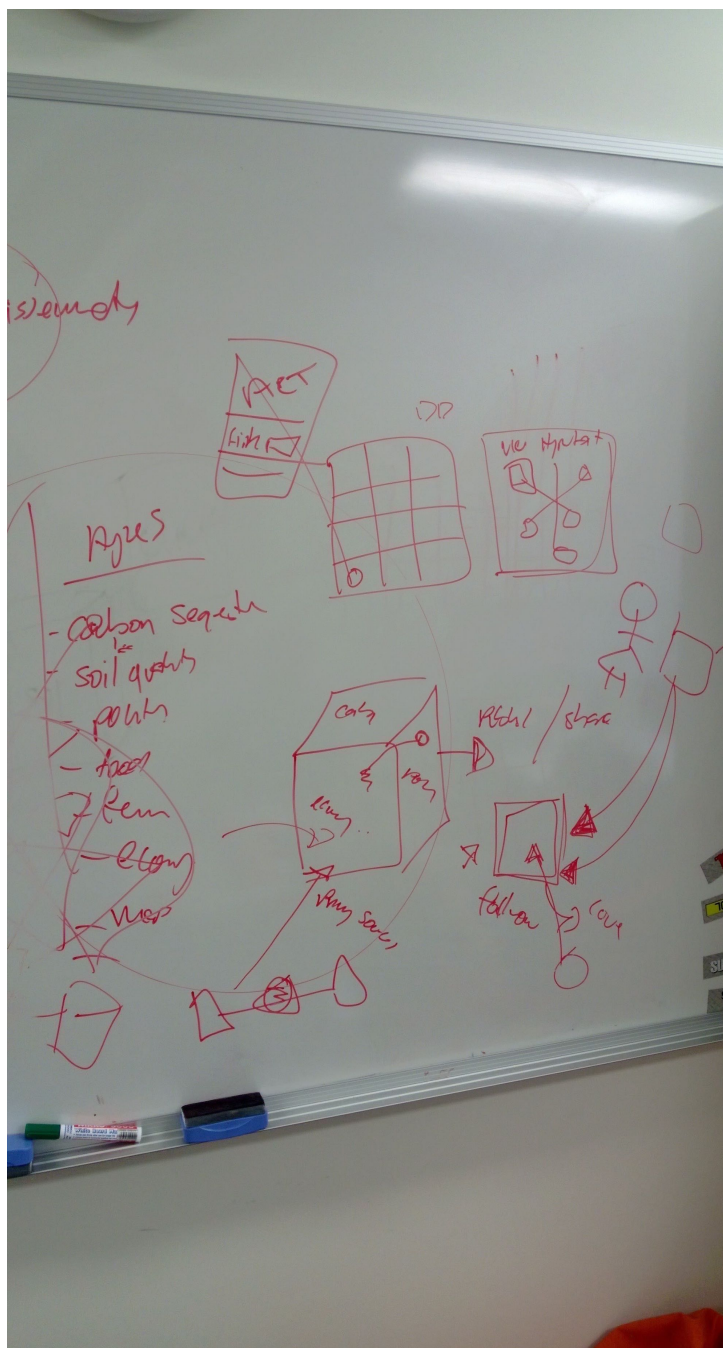
Figure 69: NewsCube - client details

The client discussed the idea of there being a grid structure on each side of the cube. The more important information would rise to the top of the grid, and the

journalist would have the ability to pin specific information to one or more parts of the grid. This would allow journalists to manipulate the cube manually, reordering information on a side of the cube. The journalist then asked whether it would be possible to automate some aspects of this, for instance having the latest information sit at the top - similar to a blog, or to the Facebook timeline.

At this point we noticed that there was a change in dialogue, as the designers now had enough information to understand the clients perspective. At this point, the designers asked to do a run through of a story to get a better handle on how the client envisioned the workflow of a journalist working through a story with the cube - and also to validate their understanding.   "Can we take an end to end discussion, what is the workflow you imagine?" (PM) This was done primarily through the client drawing on the whiteboard, the PM engaged in the conversation, and the designer taking notes. The client broke the process of a news story into three phases: Sources, Construction, and Dissemination (Figure 70). The client also suggested that while this process is traditionally a once through, that digital in their mind had the potential to be more iterative, especially through reader's contributions.
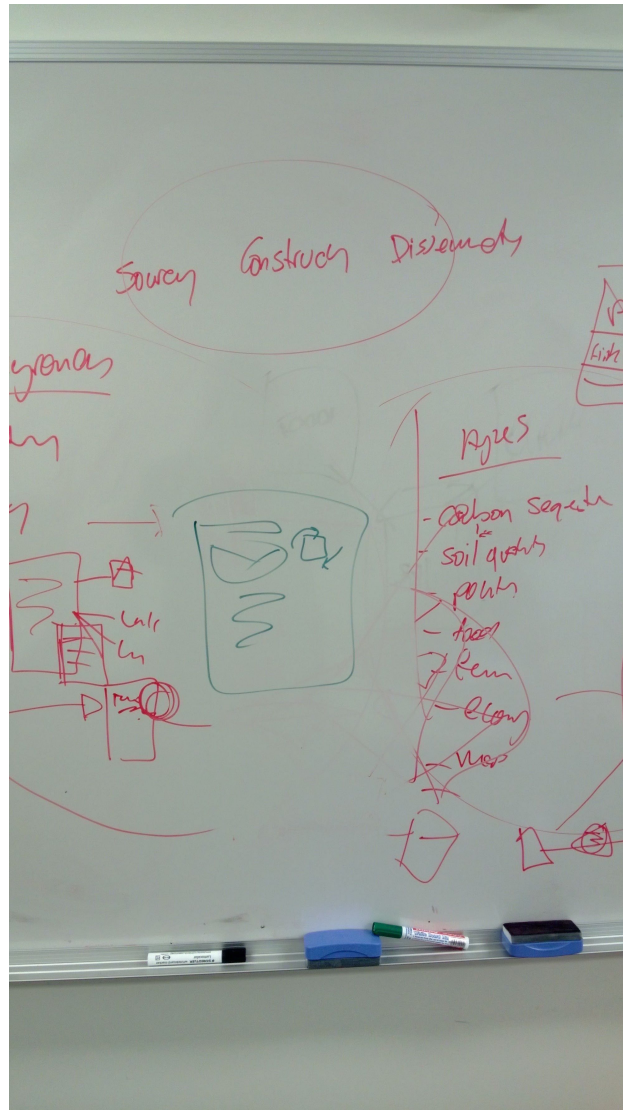
Figure 70: NewsCube - client domain concepts

The client introduced that a news story happens with an event that the journalist begins to investigate. They start with preparing through collecting information, and making a large list of all the relevant information. The information is then categorised (and the client shows an Excel spread sheet) into "blocks". This information is then collated, known as "backgrounding" where information is sourced. The client mentions that the cube could be an excellent way to facilitate research, acting as a tool that helps the journalist categorise and order information.

The client then discusses "reporting", where from the blocks of information, the journalist will go and gather new information. This may be from interviews, observations, videos, or other material. This information will sometimes be published as the journalist progresses, or left for a larger story. We noticed here that

while the client had previously given insight into their vision into the cube, by having the client retell the entire news workflow a much greater depth of the process was uncovered.

Once a variety of "reporting" is conducted, the journalist will then look for angles within the information. The client states that often there will be multiple stories within the mass of information, and the journalist needs to choose one or more of those stories, finding multiple angles (referencing back to the cube).

From this point, the client envisions that the sides of the cube would then be constructed, focusing primarily on themes (the examples given being carbon, politics). These themes link back to the "reporting" that has been captured or sourced. Secondly relationships between the themes would be identified. This in the clients mind was the main aspect of constructing the cube.

As the cube is made whole, it would then be made public, and allow for commenting on the cube. Cubes may be shared, or followed (using social media terms), engaging with the public. Unlike more traditional media, the cube would then be updatable over time, allowing the journalist to work on a living story, in which readers could continue to follow (as opposed to read once). The client suggested that there may also be an opportunity for users to contribute, and began to question how users could feed back into the cube. The main emphasis that the client reiterated at this point was that traditional journalism was deadline based, and that the hope was the cube would encourage a more iterative model of the sources, constructing, decimating model (circling on the whiteboard).

The conversation then moved back towards the tagging of this information, with regards to how people share the Cube, or themes within the cube. There was discussion on animation that could be used to relate items within the cube, transitioning between sides of the cube. The PM made an offer of two solutions at this point (trying to create some structure) for categorising data: 6 core categories, and unlimited sub-categories, or a more flexible model of tagging. The client stated

that the purpose of the Cube was to scope the story. At this point the PM suggested that 6 core categories would assist in this, and that the journalist would decide on what those are. At this point we noticed that the client was not sold on this, and suggested that news stories often evolve over time in their themes, and that flexible was good. At this point the designer/developer intervened, suggesting that Cubes could be "stamped" (versioned), to allow for both types. At this point all parties decided to come back to this later.

An interesting observation that we made that while the client made a number of references back to existing work, the designers decided to (for the most part) listen rather than trying to suggest associations with existing services (for instance, Storify tends to follow a similar structure, although more social than news-worthy).

The PM decided that this would be a good time to reiterate the clients requirements (to validate their thoughts), suggesting that reconstructing and re-disseminating the story would be beneficial. The client states, "lets look at what happens at the moment". The participants start with the idea of a finished cube. "Someone has to have control of the cube" - or ownership. "Ownership is on the creator". The client then discusses the idea of user-created data on a cube. Concepts of moderation and commenting are raised, how the readers can feedback into the journalistic process. We observe some confusion between the parties "we need to be able to turn it off though". "turn off comments?" "nah, turn off moderation". After some back and forth, the PM interjects "can we think through how the moderation would work?". This was an interesting discussion, as the client definitely played a number of roles, both wanting more user involvement, but also understanding the importance of having reliable information. The client decided that it would be best initially to offer commenting, that could be moderated by the journalist if wanted.

The PM then started to present some of the decisions that were important to get formalised initially. A piece of information would serve as the main data, and would belong to a category, as well as a number of user-definable sub-categories. The client interjected and asked whether the main categories were changeable. The

client suggested that changeable would be important, as it would be able to help the user make categories not visible, and also allow for editorial/judgement - where control is given to how the story is presented at a later stage. After some discussion, all parties agreed that the ability to change categories after the initial setup was an important feature.

The client then went into how data could be annotated by the journalist, as opposed to an unedited copy of the source information. In particular, the ability to link information together. The client outlined a number of process that were important to the user workflow: "firstly, to aggregate and organise", but also the ability to "synthesise and categorise", and that annotation was an important aspect to this. The client then discussed the soil erosion example, and then used the cube prototype to explain how the different sides were linked, but extra detail was needed to explain the link. This discussion bought to light the importance of linking information, and started a discussion on how links would "be made visible to the user".

At this point the discussion turned to brainstorming different ways of designing the links between information. We observed that the main focus of this was linking between information on different sides. Initially the designer suggested having a part of each side of the cube dedicated to links. The client suggested it would be good to have a visual representation of the links, "like a web" referencing the visual styles commonly used for demonstrating Internet infrastructure. The client emphasised that the links should work in the same context as hyperlinks where the link was embedded with the content. The client referenced a piece of software that they had previously seen, in where police visualise crime networks. The PM then explained a piece of software that they had used in the past, which was used by accountants to examine financials between people. We observed here that the client and the PM were trying to establish a common understanding of what they meant in terms of network diagrams. The client described it as the cube having inside it a web of strings tying the sides together. The designer/developer then intervened to highlight the issues that would arise with a focus on drawing these linked in 3 dimensions.

The client re-emphasised that visualising these links was important. The designer responded with ideas about how to better represent the links, suggesting colour could be used as a way to tie sides together. The client had concerns with this, suggesting that it may result information missed by the reader, or at least an increase in learning curve. This discussion continued, with the PM also asking questions around the idea of a single article being linked to multiple other sides. The designer suggested that this causes extra issues, in particular when considering the screen size of a mobile device. The designer suggested that the most usable option may be to simply include a list view of all links to other cubes. The client was still adamant that it was important to contextualise the links, but was flexible: "it would be good to have a semi-transparent link to see inside the cube, but in lieu of a better idea, go with where you are thinking". The PM responded with "we'll try a couple of options and see how we go".

The meeting then moved onto the final stages of the workflow, "ending or closing a Cube". In response to this question from the PM, the client responded that Cube may live on forever, or the owner may wish to close the story. In both scenarios, the owner of the Cube would be the person to make that decision. The PM then asked about situations in which a news story would be stopped. The client noted that in some situations (such as legal), the story would be withdrawn, but for the most part stories keep living on forever, but are archived. Therefore it was decided that Cubes as well should be able to be archived. In our observations the method to which Cubes would be archived was not explored in depth, rather left as a feature to be explored later on.

The PM then reiterated the requirement of moderated and unmoderated comments within cubes, and also suggested that there would be both private and public Cubes (with the ability to make a private cube public). At this point the PM suggested that the discussion move to more granular aspects of the concept. "How does a user discover a Cube?" We noticed that the client appeared to be a little surprised with this before reflecting. The client said that in traditional journalism, an organisation already has an existing readership with readers. The client then moved to the

whiteboard, suggesting an initial thought that had been previously discussed, of having a small spinning cube next to a web based news article, which would link through to the Cube. The client also asked whether there was the ability to do internal promotion, or to share a Cube with another user. The PM responded that a lot of these decisions depend on the underlying business model. The designer interjected with an example they had seen previously by another company that supplied presentations. The company provided two tools, an embedded tool that allowed presentations to be presented for free, while users who wanted to download the presentations could at a fee. The client suggested this might work, in terms of charging for the creation of a Cube. The client then reflected on how that fitted into existing branding strategies. The client suggested that customers could purchase branded Cubes that applied an organisations style guide. The PM proposed that this could either be a flat fee, or subscription based. The client suggested that there might be two audiences, one for personal use, and one for enterprise. We observed during this dialog that all parties were moving towards a single solution. The PM added "free to use for the average Joe, pay for business". "I can imagine enterprise wanting custom, lump sum arrangements". The PM concluded this discussion, stating that "it shouldn't impact us over the next few weeks, but its something to think about".

The PM then bought the discussion back to the idea of linking Cubes together. The client suggested that its something to keep in mind, but not to worry about it for the moment. We observed this was interesting, as there was definite interest initially, but in this later discussion was dismissed as future work. The PM suggested that social media could be an excellent way to share cubes, and the client interjected with a story about a Fox Media executive explaining their strategy. In response to this, the designer suggested that there might be benefits in having a web based front-page for each Cube, with a link to download the app for more information.

The discussion then reverted back to the initial source information that would populate the Cube. The client was very specific on the information that should be collected in this phase. "Headline, description, link/source, the content, the date,

date added, excerpt, format, keywords, news value". The client asked whether it would be possible to store not only the date of the information, but also when the information was added to the cube. The designer responded with "yes we normally store a lot of dates, this isn't a problem". The client then asked about excerpts, suggesting that while it is generally the first part of a piece of information, stating, "it doesn't necessarily show the relation, or the insight". The client felt that the user of the Cube may also "want to craft their own excerpts". The client also suggested that there may also be copyright issues, stating that previously there had been a number of issues in the past with relation to copying information. The client suggested that the best method would be to automatically ingest information, but also provide the user a way to edit the information once it had been added. The PM then briefly restated the earlier conversation about the grid style of the cube, stating that they would initially work with a grid of 16, with the ability for the user to drag particular information bigger. The client and PM then discussed the spreadsheet that the client had earlier provided, in the context of the 16 squares.

As the meeting began to wrap up, the PM asked how the client would like to communicate digitally. A number of tools were mentioned by the PM, in particular Dropbox, Evernote and Email. The PM asked which tools the client was familiar with. The client stated that although they had accounts on all of them, they rarely used them. The client said that "I'll find what my accounts are for them and let you know". There was a discussion about which tools were most useful, with the PM suggesting that for this work Dropbox and Email would be the best starting point. Interesting we noticed that no tools that were built to support this kind of collaboration were mentioned. While Evernote was initially suggested by the PM, we noted that the conversation drifted towards what Evernote was actually good for (we the researchers were also asked our opinions on Evernote and whether we used it). At this point, the meeting concluded, and we asked the designers to fill in some paperwork with regards to ethical clearance.

Appendix 4: Canvas Workshop

Based on the organisation and categorisation of issues outlined in the Canvas, a workshop session was run with 12 web designers to understand how the Canvas may assist designers in reflecting about the problem space and the pre-existing communication context. The workshop was conducted over three hours, and was structured in a way followed through the steps of the canvas.

For question 10 (Existing Communication Channels), the workshop used the order Coordination, Communication, Collaboration for the three C sections. Below is the Canvases which were developed by participants during the workshop, along with additional notes taken by the designers (Figure *71* to Figure *87*):

Participant A:

Figure 71: Canvas - Participant A

Participant B:

Figure 72: Canvas - Participant B

problem: ① changing requirements after build started.

② knowledge gap - what is possible/have - what is required.

③ 30% feedback

?what is consequence

Figure 73: Canvas - Participant B back page

Participant C:

Figure 74: Canvas - Participant C

Participant D:
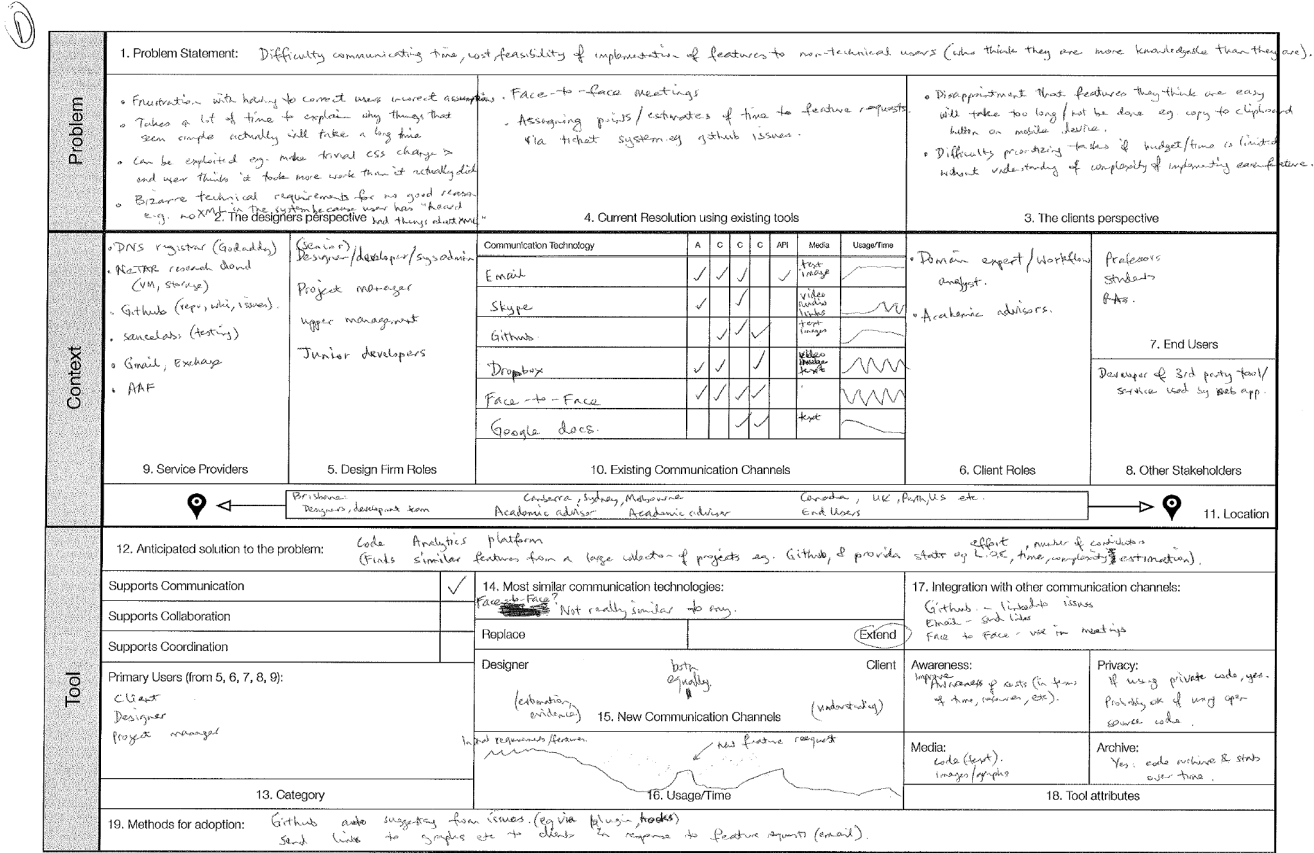
Figure 75: Canvas - Participant D

in knowledge Scope — simple things
vs — complex things
pretty technical end user ; because requirements

sig other packages

+ understanding workflows / requirements.

changing requirements

30% feedback

developer communicate — clients seeing the same channel.
— knowing clients to involve sm'one else.

products that require sign of / marketing.

Awareness
Co-ordination
Communication
Collaboration

Figure 76: Canvas - Participant D back page

Participant E:
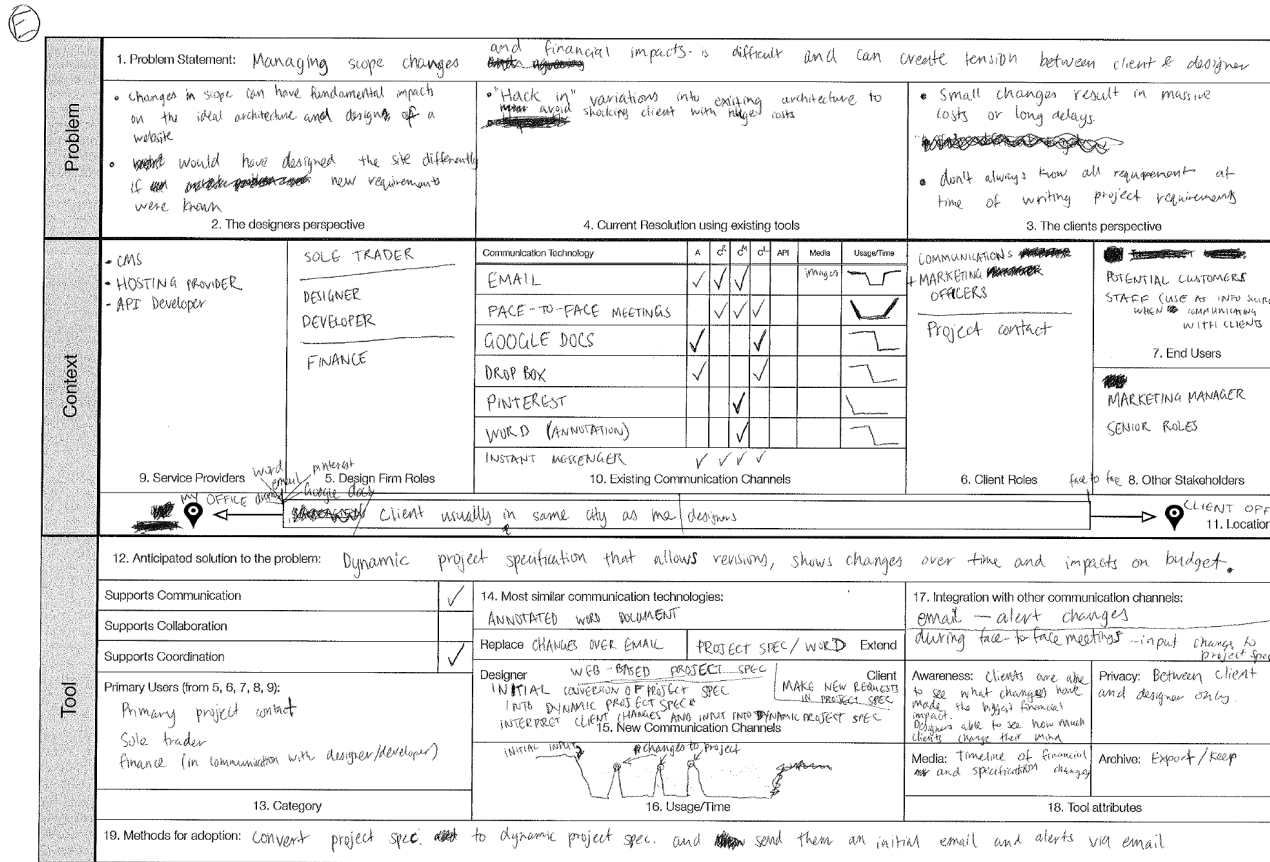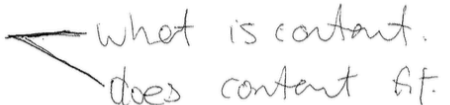
Figure 77: Canvas - Participant E

Participant F:

Figure 78: Canvas - Participant F

→ Getting Content ⟵ what is content.
                     does content fit. ⟶ writer

→ Assumptions ⟵ Can requirements be defined
                 what happens when goals shift
                 we only kind of know how to describe.
                 Inability to explain complex requirements.
                 Fundamental changes that don't hold over large
                     projects.

→ Fixed price:
      renegotiations ⟹ due to changes.

→ Not understanding the technology.

→ Undefined end dates   ⟶   It looks like a project, it's costed like
                             a project, behaviour is like a service.

Figure 79: Canvas - Participant F back page

389

Participant G:

Figure 80: Canvas - Participant G

Participant H:

Figure 81: Canvas - Participant H

ENT'S REQUIREMENTS (ASSUMPTIONS ABOUT HOW WEB WORKS

LICITATION -HSE COPYWRITER

LEONE ELSE'S BUSINESS IN ORDER TO
- OWN (EG WEB DEVELOPMENT)
CLIENT - COULD UNDERMINE PROJECT,
STRUCTURE, WHO WHATS THE COST,
WORE TIME RESEARCH/TESTING

S   THE END OF A PROJECT

SUMPTIONS
NON ALITY
SIMPLE OR COMPLEX SOMETHING IS
IT SHOULD LOOK (SOMETHING ELSE THEY HAVE SEEN)
EASY (IT SHOULD BE TO ADD SOMETHING
HANGE SOMETHING

THINKS THE HARD WORK IS DONE ALREADY
THEY'VE MADE THE DECISION THAT THEY WANT

LING THE CLIENT, SPEND A LOT OF WORK
THEIR BUSINESS, SCOPING WHAT THEY WANT,
MIGHT TAKE THESE IDEAS SOMEWHERE
THINK THEY ARE THE ONES WHO HAVE DONE

IDEAS → MIND MAP, EXAMPLES IDEAS, DETAILED
CENARIOS OF USE
DESCRIPTION IN SOFTWARE TERMS

+ EXPLAIN THE MORE COMPLEX FUNCTIONAL
  - WHY ITS COMPLEX
  - WHAT'S THE COST
            OR HAVE A SET OF
            TEMPLATES + TOOLS THAT
            CAN BE (BLUEPRINT) TO
            ANY SOFTWARE

E ZONES
LARGE TRANSLATION
- BIG AMOUNT OF DATA

AS TO CREATE SOME CONCRETE REPRESENTATION
BUSINESS IDEA / PROCESS AND ALL AGREE ON
UNDERSTANDING.

ANY BETWEEN CODE + FINAL PRODUCT
WS. CLIENT OF THE IMPLICATIONS OF A
THAT THEY WANT BIG HIGHLIGHT THE
OR VARIABLE THATS AFFECTED.

CAN'T QUANTIFY LOOKING WORK
ON TIME

IN APPEAR BIG ON EVERY ELEMENT
EFFECTED BY THE CHANGE

3 GET CONNECTED TO INFOGRAPHIC OR
NTS FOR CLIENT

Figure 82: Canvas - Participant H notes

Participant I:

Figure 83: Canvas - Participant I
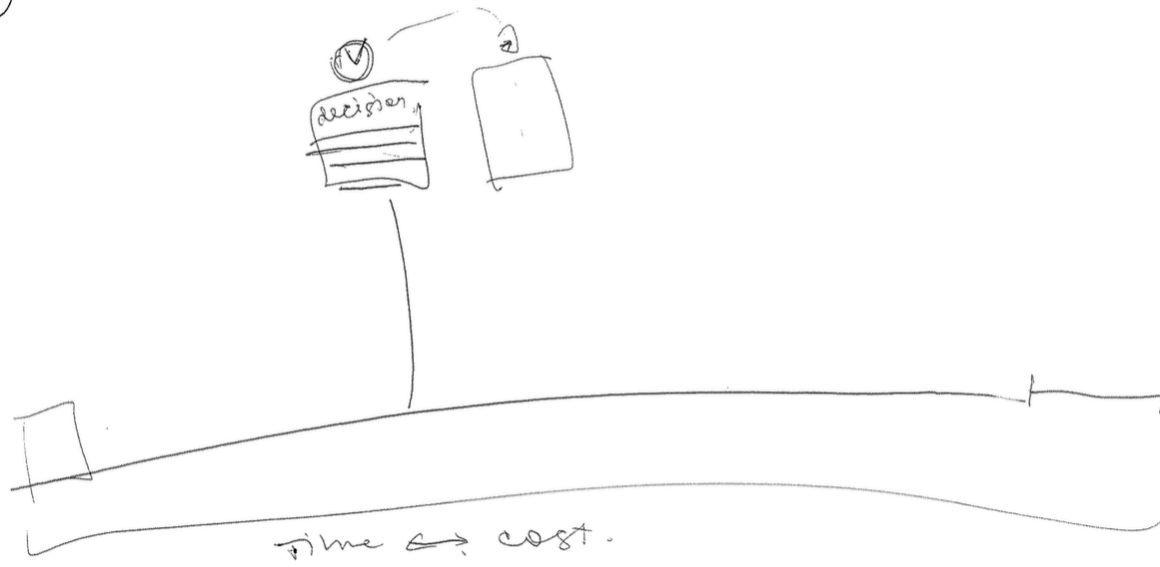
Figure 84: Canvas - Participant I back page

Participant J:
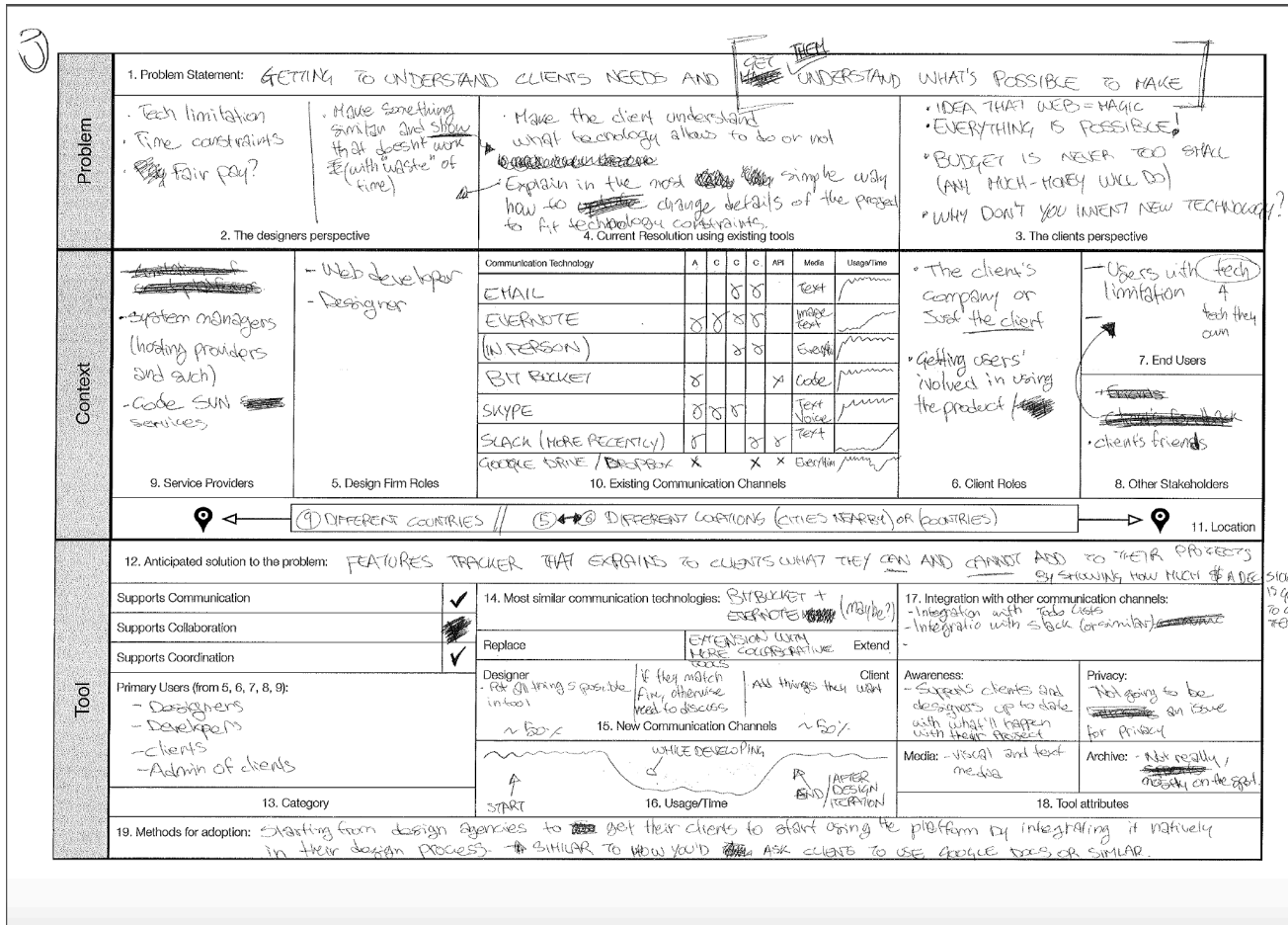
Figure 85*: Canvas - Participant J*

Participant K:

Figure 86: Canvas - Participant K

Participant L:

Figure 87 : Canvas - Participant L