Approaching interaction design, or designing a better way to record personal time use.

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This dissertation is submitted in partial fulfilment of the requirements for the degree of Bachelor of Multimedia with Honours at Murdoch University 2006.

Declaration

I declare that this dissertation is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary educational institution.

Christopher Andrew McLay

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Colophon

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Abstract

This thesis explores the role of designers in the field of human-computer interaction as well as the emerging field of interaction design. More traditional approaches to human-computer interaction such as usability, human-centred, ergonomic and cognitive theories are contrasted to more recent approaches involving phenomenology, semiotics, design theory and holistic design. This is further explored through the design of a digital artefact, the Time Notepad, for the recording of personal time use.

The results of this research suggest that design needs to be better understood within both industry and research environments. Further, design processes need to be fully integrated into the development of interactive artefacts and into the domain of human-computer interaction. Designers themselves need to be more engaged with their own methodologies, as well as the contexts and experiences of those using the artefacts they are designing. Phenomenology, embodied interaction and semiotics are areas of exploration that may aid designers in their efforts to create successful interactive artefacts.

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Introduction

> *The old computing is about what computers could do;*
> *the new computing is about what users can do.*
> – Ben Shneiderman, Leonardo's Laptop (2)

Our reliance on the artefacts we use in everyday life has increased dramatically over the last few hundred years. They have become essential for getting around, staying in touch, working with others, being entertained, winding down and generally getting things done. With increases in electronic and digital technology we have sandwiched more and more functionality into more and smaller artefacts.

The design of these increasingly complex artefacts, and in particular our interactions with them, has fascinated me for many years – in fact for most of my design career. As a designer, I have designed interfaces for several pieces of software, some web applications, and a lot of web sites, but my primary experience is as a visual designer. Despite this experience, trying to make a serious move towards interaction design has been frustrating. Both formal and independent study in the field of human-computer interaction has developed my general understanding of the domain and provided me with a range of knowledge: one or two design methodologies; lots of guidelines, recommendations and laws; a good understanding of usability, human cognition and ergonomics; a range of well documented interaction styles; and a variety of evaluation techniques. I could use this knowledge and come up with a reasonable design. However, I didn't feel that I had the whole picture – something was missing that made me less than confident in my ability to make use of this knowledge to successfully design a good artefact.

Initially I thought I would find confidence in new and different methodologies and approaches to interaction design – perhaps what I had found so far simply didn't suit *me*. During my further research I did find several good approaches and methodologies which I

felt confident with, but I also started to find something else. The more I worked, the more I read, the more I came to realise that what seemed to be missing wasn't a methodology or approach, but *the act of design* and a role for designers in the broader human-computer interaction universe. The design of artefacts and their interfaces is often discussed, but design is rarely explored in its own right. Design seems to be something that just "happens" during of the development process, and a lot of effort seems to have gone into trying to avoid *the act of design* through the use of laws, rules and guidelines to be applied by analysts and engineers as they develop artefacts.

A significant part of my research and exploration has been done through the process of designing of a digital artefact, the Time Notepad. This artefact is for the recording of personal time use, or filling in time sheets, something that is an ongoing frustration to me and many other workers. Workers record their time use for many reasons. Some use the information to bill clients for freelance or consulting work; some use it for tracking the progress and budget of a project; some employers use it as part of performance management and evaluation of their staff; some individuals use it to reflect on their work practices and to look for ways to improve their time management. Additionally, during my research, the Australian Government introduced the new Workplace Relations Act requiring all employers to keep records of hours worked for all of their employees (Commonwealth of Australia).

Designing a digital artefact for recording time use provided a good platform to look at the processes, methodologies and approaches to interaction design for a number of reasons. While it is a relatively simple task and is done by a lot of people everyday, it appears to be done poorly by many systems. As such, improving the recording of time use could have a very positive impact on the many people who hate having to do it – including myself.

In this thesis I have tackled some of these issues. The first chapter, *Approaching interaction design*, looks at what design and interaction design are. It goes on to look at traditional approaches to improving interaction such as usability and human-centred design, and then contrasts these with newer approaches that have a broader focus. The chapter finishes with an examination of design methodologies and outlines the two main methodologies used for the design of the Time Notepad artefact.

The second chapter, *Designing a better way to record personal time use*, works through the design of the Time Notepad artefact. This chapter outlines some of the more specific approaches and methods used, details key points from the user research and design processes, and ends with a quick review of the research with some areas for further exploration.

A note on terminology

I would like to clarify some of the terminology I have used throughout this thesis. Rather than talk about software, computers, devices, objects, appliances, tools etc., I am using the term *artefact* to represent all of these things. Typically an artefact is any object made by a human being, and this is very useful in this discussion, as many of the boundaries between our other descriptors have been blurred or are irrelevant to the concept of interaction design.

Another term I have used frequently is *user*. This use of this term has come under some heavy criticism (Norman "Human-centred"), and *user* even been called a four-letter-word in some discussions. The problem with this is that no other term exists to properly replace it, and much of the criticism relates to negative meanings that have been applied to, or associated with the term. I would prefer to focus on properly defining and reclaiming the term, rather then trying to invent a new word or confusing the issues by using terminology that is inappropriate or too broad.

This thesis has been referenced using the MLA style (Gibaldi).

Chapter One.
Approaching interaction design

> *Design is by nature both holistic and ruthlessly simplifying. A designed artifact, whether it is a piece of communications software or a city park, must address the complex mixture of human needs, embodied in a weave of physical and social interaction. But the design itself cannot embody all of the complexities if it is to be constructible and understandable. The design must embody a simplification, leaving room for the texture of the world to be filled in by the interpretation and practices of those who use it.*
> – Terry Winograd, Designing a New Foundation for Design (72)

Design and *the act of design* are often misunderstood and variously defined. Since they are key topics throughout this thesis, I will start with a discussion on what *design* is and what I mean by *the act of design*.

Put simply, everything made by humans has been designed. Every time something new is created, someone has made decisions about its function, content and medium of expression. Decisions to include, exclude, modify or to seek out new ideas are what make the something that has been created. These decisions – conscious or unconscious – are at the heart of the design process.

Design is often described in terms of problem solving – here is a problem, design a solution. This is a useful way of trying to understand the design process, especially as it takes the focus off the visual and aesthetic outcomes of design. However, it needs to be acknowledged that design problems can not ever be fully understood and that there is no single solution to a design problem. Design takes place within a complex context which the designer is continually exploring and seeking to further understand – a context which is always liable to change, if it is not already in continual flux. As designers work to create and refine solutions, their understanding of the problem and context is increased, allowing them to further refine

their solutions, and so on. Under these circumstances it is not possible to establish if a solution is right or wrong – if it *is a solution* in the logical sense (Löwgren & Stolterman).

Additionally, designers must communicate their design solutions to others – to other designers so they can share, discuss and collaborate; and to their clients, users and the general population, in order to increase their understanding and evaluate the effectiveness of their solutions. Without effective communication *the act of design* becomes very difficult and can very quickly lose its value.

Design is an activity to be undertaken deliberately, knowingly and with eyes wide open. With the previous points in mind, we can say that to design is:

- to seek to understand a problem and its context;
- to seek and create solutions to the problem, or at least parts of the problem;
- to evaluate and decide on the effectiveness and appropriateness of the solutions; and,
- to communicate these design solutions to others.

These points are not linear nor definitive. They are repeated many times over, in many different orders. In this way, they make up the activity of designers: *the act of design*.

I have included an illustration from Jonas Löwgren & Erik Stolterman (Figure 1) that beautifully illustrates the reality and lack of linearity in the design process. The diagram shows the designer moving through various levels of abstraction over time, from the initial vision to final specification. The dark diagonal line shows the general, or averaged progress, but as we can see from the lighter line the actual design process is in no way linear or straight forward.

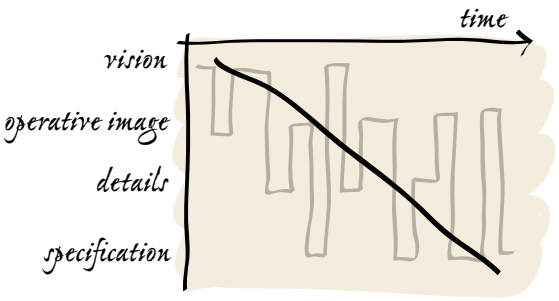


Figure 1. The design process moves from vision to specification, but the path is not straight and linear. Source: Löwgren & Stolterman (25)

Interaction Design

> *Interaction design… illuminates the relationship between people and the interactive products they use… its focus is on defining the complex dialogues that occur between people and interactive devices… Interaction design defines: the structure and behaviors of interactive products and services; user interactions with those products and services.* – Interaction Designers Association

> *Interaction design refers to the process that is arranged within existing resource constraints to create, shape, and decide all use-oriented qualities (structural, functional, ethical, and aesthetic) of a digital artifact for one or many clients.*
> – Jonas Löwgren & Erik Stolterman (5)

> *Interaction design is the art of facilitating interactions between humans through products and services. …interaction design isn't about interaction with computers (that's the discipline of human-computer interaction) or interaction with machines (that's industrial design). It's about making connections between people through these products, not connecting to the product itself.* – Dan Saffer (4, 6)

Interaction design is still a relatively new term and there are significant differences of opinion as to its exact definition. Older design disciplines, such as graphic design, fashion design, architecture and industrial design, are reasonably well defined and understood. This is perhaps because of the fairly tangible nature of their outputs when compared to interaction design – graphic design produces graphics, fashion design produces clothing, but interaction design does not produce interactions.

Interaction itself is a very broad term. Interaction takes place when any two *things* have a reciprocal effect on each other, these could be subatomic particles, weather systems or people. We can't predictably influence all of these types of interactions, so we need to better define what types of interaction we are interested in.

Dan Saffer's definition, quoted above, tries to draw a line between interaction design, human-computer interaction and industrial design. He limits interaction design to interactions between people through the use of artefacts. Someone programming a video cassette recorder to record a television show is outside this definition, as there is no connection between people involved. Someone using a digital video recorder with an electronic program guide is inside the definition, because they got the programme guide as a result of some sort of connection with the people who made the programme guide. As will be discussed later, it can be argued that someone using a video recorder is connecting with the designers of that video recorder and is therefore inside the definition after all. Although helping people make connections and communicate with each other is an important and integral part of interaction design, it does not help to define the discipline well.

Jonas Löwgren & Erik Stolterman's definition of interaction design, quoted above, focuses on interactions with digital artefacts that can be used. This is a much more straightforward way of separating the interactions we are interested in. As there are many non-digital artefacts

which have and could benefit from the application of good interaction design I would remove the digital part of their definition and look at interactions with artefacts that can be used.

The definition from the Interaction Design Association, above, is very similar to Löwgren & Stolterman's definition, but perhaps not as concise and clear. It does use some slightly simpler and more accessible language though, which can be an advantage. To bring all of this together I would suggest the following definition: *Interaction design is a process focused on improving the interaction between people and the artefacts they use. This process creates, shapes and decides the functional, behavioural, structural, aesthetic and ethical qualities of these artefacts.*

Approaches to Designing Interactive Artefacts

In response to the difficulty many people have using interactive artefacts, a number of approaches to producing better products have evolved over recent decades. These include usability, humans' cognitive and ergonomic abilities, and human-centred design.

Usability is the study of how *usable* an artefact is - the more usable the artefact the better it is to use. Nielsen & Loranger suggest that 'Usability is a quality attribute relating to how easy something is to use. More specifically, it refers to how quickly people can learn to use something, how efficient they are while using it, how memorable it is, how error-prone it is, and how much users like using it. If people can't or won't use a feature, it might as well not exist' (xvi). Usability metrics come from extensive qualitative studies of products, usually conducted in usability labs. They are useful for finding specific issues with a product, or for comparing the usability of different solutions. Over time general design guidelines have evolved from usability studies, but these need to be used carefully and with considerable attention to the contexts of the studies, and the components of the designs, that lead to these guidelines.

Another approach common in human-computer interaction, is to work from cognitive and ergonomic understandings of human ability. In *The Humane Interface*, Jef Raskin argues that by starting from an understanding of human cognition, striving for simplicity and focusing on *uniformity among individuals*, we can build completely modeless and monotonous interfaces that improve productivity and lead to less time spent doing a task. An interface is modeless if the interface responds consistently to a single gesture for the current state of the interface, and if the user is aware of the current state of the interface. Raskin suggests that a modeless interface provides greater consistency and *trust*, is less confusing to users, and allows them to work faster. A monotonous interface is one where any desired action can only be invoked via a single gesture. e.g. being able to perform an action via a menu or a keyboard shortcut is an

example of a non-monotonous interface. Raskin suggests that non-monotonous interfaces provide increased choice for users, are therefore more confusing and will slow users down.

There are several laws and guidelines for interfaces that come from a similar cognitive and ergonomic understandings of humans' abilities and limitations. These include:

- Hick's Law, the time it takes someone to make a choice from a list increases exponentially with increases in the size of the list;
- Fitt's Law, the time it takes to move to a target increases as the distance to the target increases and as the size of the target decreases; and
- memory chunking, people are generally only capable of accurately remembering between five and nine (7 ± 2) chunks of information in short term memory.

An understanding of humans' cognitive and ergonomic capacities is valuable in helping to decide between different interface options, and in attempting to understand why people have problems working with certain interfaces in certain contexts.

Human-centred design, or user-centred design, is widely accepted as the basic standard for developing and designing good interactive products. This approach was developed in response to a range of bad software designs, and focuses on the needs and abilities of the users of the software. Users drive the design process, and they are often involved in every stage, providing input and inspiration (Preece et al. 285-287; Norman "Human-centred"). Human-centred design has been very valuable in focusing the attention of developers and designers on the actual needs and limitations of the users, rather than on what developers and designers perceive their target users to want or to be capable of.

Even though these approaches have been around for many decades, and they have been very useful in improving the quality of interfaces and artefacts, there are still a lot of people who have considerable trouble using the artefacts being produced. When considered in the context of design and the act of design, an interesting pattern emerges from these approaches. All three seek consistent, definitive and quantifiable results from either quantifiable user testing, cognitive and ergonomic laws and limits, or from the users themselves. These results all come from outside the product development team. With such definitive results the product development team no longer needs to make a decision, thereby absolving itself from, or reducing its role in, the design process.

The evolution of these approaches in an engineering or business environment is perhaps understandable. As we have already discussed, design is a very flexible activity, and the results

of design can rarely be classified as right or wrong. Within a scientific and engineering environment, like most software and technology companies, this must be a difficult concept to fully accept. Within a business or corporate environment, it must sound very risky, if not potentially suicidal. In this context it makes sense that such approaches have evolved in order to try and reduce the perceived risk, and seemingly avoiding the whole *design issue*.

The problem with not being actively involved in the decision making or design process and simply relying on the results of these approaches, is that it is impossible to know if the results are accurate, or if they point to a successful outcome, or not. This lack of engagement and simple acceptance of results is likely to lead to small refinements to the current design concept. It does not encourage creativity, or the development of new design concepts that may be better suited to the activity or context. Additionally there is a strong risk that the results of these approaches will become concrete limitations or boundaries in the minds of the developers, rather then being considered desirable or probable in the context from which they were derived. These types of approaches are simply not sufficient to fulfil or to replace the act of design in the development of interactive artefacts – they are not bad or wrong, but they need the benefit and application of experienced designers in a good design process.

This apparent avoidance of the act of design is raised by William Buxton as a key factor in the failure of software companies to deliver successful products. In *Performance by Design: The Role of Design in Software Product Development* he compares the software development industry to the film production and industrial design industries, and laments the lack of any design in the upfront processes of the software industry. A key point made by Buxton is that the software industry will typically approve the engineering and production of a product before they fully understand the product they are setting out to build (Figure 2). By comparison, the film industry typically spends a considerable amount of time in preproduction (writing, scripting, gathering key production staff and cast members, budgeting, release plans etc.) before a product is to be considered for production. A similar process takes place in the automotive industry – full production of a vehicle will be considered only after a full scale model has been built, and detailed plans for the manufacture and marketing of the vehicle have been completed (Figure 3). In the software industry, without the proper design processes in place, the products that ship, if they do ship, are often very different from the product intended at the start of the engineering process and may not end up meeting any real needs or goals of the market place.

Buxton goes on to point out that simply adding designers to the beginning of the process is not going to result in better products at the end. A more ideal situation is for all interested

parties and stake-holders to be involved in the development process on an ongoing basis (Figure 4). Susanne Bødker & Jacob Buur's *Design Collaboratorium* provides an interesting starting point for integrating development teams. The Design Collaboratorium is a place and a way of working in which all parties involved in the design and development of a product can work, or at the very least come together. Designers, engineers, marketers, users and other stake-holders can work and share the same time and place in order to facilitate an improved design process.

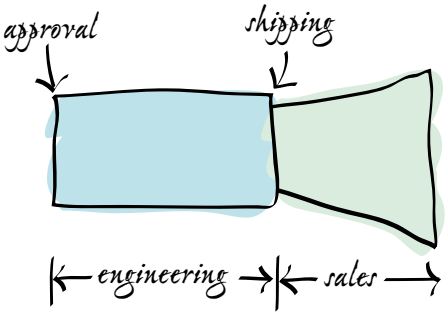


Figure 2. The status quo in software development today. Source: Buxton "Performance" (6)

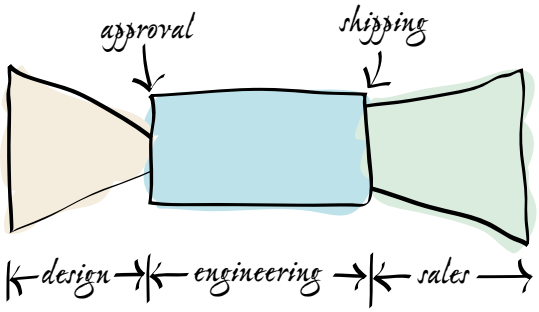


Figure 3. Inserting a design phase at the start of the process. Source: Buxton "Performance" (8)

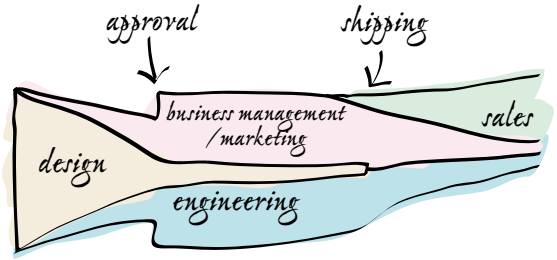


Figure 4. Removing the boundaries to demonstrate on-going responsibility. Source: Buxton "Performance" (11)

Including designers in the development of interactive products, and providing for suitable design practices will improve our interactive artefacts, but designers will need to use more appropriate approaches than those previously outlined. In *Designing Interaction, Not Interfaces,* Michel Beaudouin-Lafon compares the 1984 Macintosh computer with the 2003 model iMac. Somewhat surprisingly, even with the massive growth in computing capability, the basic interaction is still the same. In this time, new methods of interaction have been developed and *proven in testing*, but they have rarely been adopted. To improve this situation Beaudouin-Lafon argues that we need to move away from task analysis and interface designs, to a more holistic approach, considering the broader implications of interaction beyond just that of the user and the computer. By arguing for a better understanding of the context of use, and the development of stronger theories around the *phenomenon* of interaction, Beaudouin-Lafon is in essence arguing for a shift from human-computer interaction and the design of interfaces toward interaction design as defined earlier. That is, improving the interaction between people and the artefacts they use, not just designing the interfaces of these artefacts.

In line with Beaudouin-Lafon's argument for less focus on tasks, and for an understanding of the broader context in which interaction takes place, Ben Shneiderman wants to see a move away from machine-centred automation, which aims to replicate or replace human tasks, towards user-centred tools, which aim to assist humans to do their tasks better, faster and more accurately. This is Shneiderman's second shift towards what he calls *the new computing*. The first, and most important shift, is in the way users perceive and value the experience of using computers. Instead of being concerned with gigahertz, bandwidth, and megabytes, Shneiderman wants users to value how much work they got done, how creative they were, what their computer usage allowed them to contribute to themselves and to their various broader communities. This shift in value by users, and therefore consumers, should put increased pressure on developers and designers to improve their artefacts to meet the desires of these consumers.

Both Shneiderman and Beaudouin-Lafon argue that the increasing creative workload of most modern computer users is not well supported by the interfaces currently in place. Given that artefact design and engineering can be considered as a creative activity, it would make sense to build interfaces and artefacts for designers, developers and engineers that better support their creative work. This would then hopefully provide positive flow-on effects as these workers build the interfaces and artefacts for the rest of the world to use.

In comparison to usability, cognitive and ergonomic understandings, and human-centred design, the approaches of both Shneiderman and Beaudouin-Lafon promote a broader understanding of the development, purpose and use of interactive artefacts. These approaches ask us to step back, to examine and to question even the motivation and purpose of the artefact being developed. Jonas Löwgren & Erik Stolterman take this even further, arguing that the design of interactive artefacts is so complex, so constantly changing, and so fraught with contradictions that it requires something more than new methods and approaches to design, it requires a *thoughtful designer*. This is a designer who not only understands design and can design, but a designer who consistently examines the role of design, their own role in the design process and the benefits and pitfalls of the different methods and tools available to them. 'A thoughtful designer is someone who takes on design as a serious and important task and who tries to become a designer with the ability to create fascinating, authentic, and useful digital artifacts' (2).

In his book *Shaping Things*, Bruce Stirling presents designers with an even greater challenge – design with everything in mind, because your users (collectively) will have everything in mind when it comes to using (or choosing to use) the artefacts you design. This type of collective

knowledge is already in existence through Amazon and various other online stores, and the world wide web in general. You can easily find many different reviews of a product you may be interested in purchasing. If you look a bit harder, you can find other people who have used the product talking about the problems they have had, or how great the product is. This level of knowledge is only going to increase until the collective users know more about an artefact and how it works than the designers, engineers and marketers who made it in the first place. With this level of knowledge it is going to be much harder to sell products that are of a poor or substandard quality, and that is going to be a major challenge for many companies over the next few decades.

In addition to these arguments for broader thinking in the design process there are a number of more specific approaches designers may choose to use in examining and understanding the interactions that take place around an artefact. In *The Semiotic Engineering of Human-Computer Interaction*, Clarisse Sieckenius de Souza presents a model for interaction design which brings the designers of artefacts up to the same level of recognition and importance as the users of these artefacts. Following general semiotic principals, the theory of semiotic engineering explores the communication between designers and users which takes place through the built artefact. Semiotics is the study of signs, exploring how signs are created, how they are interpreted and how they participate in communication. Following the theory of semiotic engineering, designers examine the users, the role of the user and the context in which the user operates. The designers must then put forward a design for the artefact which responds to the users desire for change, and communicates the designer's vision for how this change might occur. Through interacting with the designed artefact, the users explore the designer's vision until they fully understand it and are capable of making use of the design within their own context. This is a significant change from the separate design model, system model and user's model often found in human-centred design methods (Figure 5). Semiotic engineering places a greater burden on the designer to better understand users and communicate with them, effectively bringing the different models together into a shared vision.

My early research led me to a methodology for interaction design from the Utrecht School of Art based around the philosophy of phenomenology. Phenomenology considers experience and embodiment – being in the world – central to the creation of meaning, rather than meaning being created by objective abstract thought. The methodology, which I'll explain in more detail shortly, uses phenomenology to help designers to understand the user, the experience of the user, and the context they are designing for (Barfield et. al.). The idea of phenomenology as a design tool made considerable sense to me, so I followed this further in

the work of Paul Dourish and his book *Where the Action Is: The Foundations of Embodied Interaction*. Dourish builds on the work of philosophers Martin Heidegger, Alfred Schutz, Maurice Merleau-Ponty and others to establish a theory of *embodied interaction*, a perspective on the relationship between people and systems. According to Dourish, 'Embodied Interaction is the creation, manipulation, and sharing of meaning through engaged interaction with artifacts' (126).

Through the theory of embodied interaction Dourish defines interaction design as needing to encompass three qualities of an artefact: its *holistic* qualities – an artefact is part of an environment and must be designed as such; its *expressive* qualities – artefacts express values and meanings and this expression needs to be considered as part of the design; and, its *aesthetic* qualities. Though it may appear that the theories of Dourish and de Souza are irreconcilable – phenomenology places embodiment at the origin of meaning, while semiology holds signs and texts as primary – Dourish and de Souza reach similar conclusions. The following quote from Dourish, could almost be word-for-word from de Souza: 'The designer must somehow communicate to a user a set of constraints and expectations about how the design should be used. The system can be thought of as the medium through which a designer and a user communicate' (132).

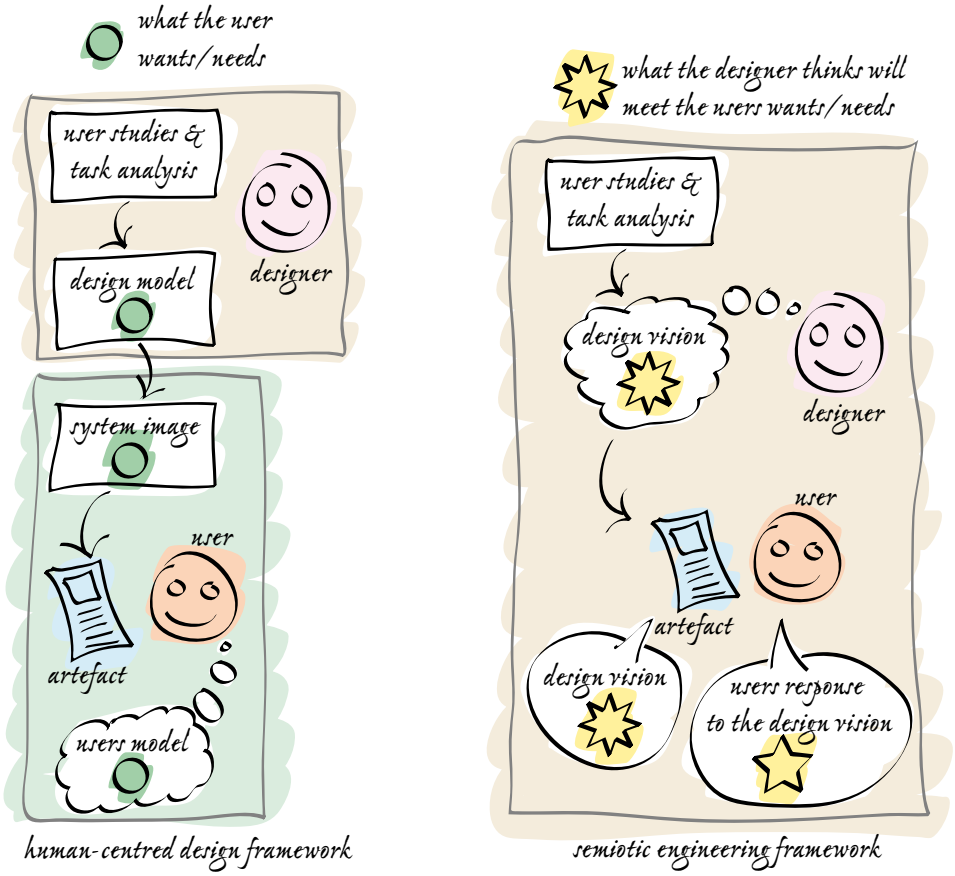


Figure 5. Human-centred design compared to semiotic engineering. Source: de Souza (8)

That both Dourish and de Souza have reached similar conclusions from different points is both exciting and broadly beneficial. Semiotics and phenomenology can be seen to appeal to very different types of thinking, and rather than take one as better than the other, designers, developers and engineers can work from the perspective that best suits them, or draw from both as the situation requires.

Design Methodologies

As this point, I would like to move on from approaches to interaction design and discuss the design methodologies I chose to work with for the empirical part of my research. As I have already suggested, design is a broad and flexible process. This in itself seems opposed to the application of a specific methodology to design. Some people see methods as being a set of instructions to be followed, and at the end of following the instructions you will get your result. In design this specificity of process is not what makes methodologies useful. Designers need to understand, adapt and mix methodologies to best suit the projects they work on.

The successful understanding and adaptation of methodologies is a key part of the success of any design process. It is rare that a designer can successfully design anything without following some sort of methodology – usually, successful practice uses a mix of several they have found and modified to suit their personal strengths and weaknesses over time. In this sense design methodologies can be seen to support designers in their internal processes: they help to ensure designers have researched and thought through all aspects of the design; they help designers to avoid common pitfalls; and, they direct designers to greater levels of understanding and research.

Design methodologies also provide significant value in enabling designers to work together with engineers, clients and other participants on a project. Many people don't understand design or the act of design. Some think it is all just made-up, creative mumbo-jumbo. Some think it is purely interested in surface and aesthetic qualities. Others simply see design as a black box where you send something in one end and it comes out the other end as a finished product (Löwgren & Stolterman 64). Design methodologies can help designers explain how they work, why they ask the questions they do, and the potential value in following through with a full design process.

For the empirical part of my research I worked from two methodologies for interaction design, the LUCID methodology and the Utrecht methodology, both of which are described in more detail below. At the start of this research, my decision to use these methodologies was

as much based on intuition and experience as it was from academic rigour. Now, having had the experience of using them throughout a design process and having completed significantly more research into interaction design, I feel that the decision to use these two methodologies was the right one for this project. Further, I believe they would provide a good base for a wide range of interaction design projects.

The Logical User Centred Interactive Design methodology, or the LUCID methodology, was developed by Charles Kreitzburg and Cognetics Corporation. It was originally called the Cognetics Quality Usability Engineering Design Methodology and was developed to integrate usability engineering practices into existing software development methods and procedures (71). The version outlined here is from Ben Shneiderman & Catherine Plaisant who describe it as a widely used and well tested methodology (119-122).

The LUCID methodology has six phases – Envision, Discovery, Design Foundation, Design Detail, Build, and Release (Figure 6). The first stage, Envision, is probably the most important stage of the process. It aims to reach agreement between all of the projects stake-holders on what the artefact is going to do or going to be for. Without all parties agreeing to clear and well defined goals, the project is almost certain to fail as different people and groups head off in different directions, or unknowingly change direction as problems or new opportunities arise.

Stage two, Discovery, is focused on researching and understanding all the different users of the artefact, the tasks they perform and what they need the artefact to provide. This information is then used to create a user requirements document for the artefact.

Stage three, Design Foundation, takes the information gathered from the previous stages and uses it to form the basis of the artefact design. Key to the LUCID methodology is the development of key visuals and a key prototype. Presenting users and stake-holders with the key visuals of the artefact generates significant interest in the design, and encourages significant levels of feedback from many different people.

Stage four, Design Detail, builds the design concepts and policies into a fully detailed specification. At this stage the detailed visuals and work-flows can start to be taken through a full usability evaluation process with users, making use of either paper-based, or simple computer-based, prototyping methods.

Stage five, Build, occurs when the design for the artefact is completed and can be handed over to the development and engineering teams. However this handover is not the end of the designer's involvement in the artefact. To ensure the artefact continues to meet its goals and requirements the designers need to assist development teams to work through problems as

they come up, and to be involved in further and more detailed user testing as the artefact progresses towards release.

Stage six, Release, sees a managed release of the artefact to the market or to the customer's site, ensuring a positive reception from users and customers.

From my own experience, and research, the LUCID methodology appears to have been developed to address many of the common design issues that arise when working on larger projects in a commercial environment. One of the key appeals of this methodology for me is the establishment of a shared vision, which is built on, returned to, and revised as required. This one key point of ensuring that everyone is talking about and working towards a clearly defined and documented objective is something that many methods, and projects, simply assume to be the case, often to their detriment.

STAGE 1: Envision	• Align the agendas of all stake-holders, balancing the needs to meet business objectives, manage technical constraints and support users' needs for a highly usable product. • Develop a clear, shared product vision among the stake-holders. • Identify and deal with potential problems that could impair the development team ability to collaborate effectively. • Begin the design process at a concept sketch level.
STAGE 2: Discovery	• Develop a clear understanding of the characteristics of each distinct segment of the product's users. • Understand the tasks users perform, the information they need, the terminology they use, their priorities and their mental models. • Analyse the data gathered and create the products user requirements.
STAGE 3: Design Foundation	• Develop and validate the basic conceptual design of the product. • Develop a visual look for the product. • Present the completed design as a key screen prototype.
STAGE 4: Design Detail	• Complete a style guide containing the graphic design and UI policy decision. • Flesh out the high-level design into a complete specification. • Conduct usability evaluations of specific screens or work-flows. • Create detailed layouts for each screen and detailed specifications for each element of each screen.
STAGE 5: Build	• Answer questions and support developers, redesigning screens if needed. • Conduct usability evaluation of critical screens, if necessary. • Support the build process through review and late-stage change management.
STAGE 6: Release	• Develop a rollout plan to support the new product • Conduct usability evaluation of the "out of the box" or installation experience. • Measure user satisfaction

Figure 6. Logical User-Centred Interaction Design Methodology. Source: Shneiderman & Plaisant (120)

The LUCID methodology should be familiar to many designers, as it reflects the way many designers work, through creating a cycle of research, design, and evaluation. At the same time, it is a methodology which reads well and should appeal to non-designers, engineers and business minded people through its well structured and staged approach.

The last important factor in the appeal of the LUCID methodology is its flexibility. There is plenty of room to absorb other methodologies, techniques and approaches within it. LUCID provides a firm foundation which can be modified, built on, and built into to suit a variety of projects and situations.

To compliment the structure of the LUCID methodology, and to build on its user-centred base, I decided to incorporate a second more intuitive and analytical methodology which I'll refer to as the Utrecht methodology, as it was developed at the Utrecht School of the Arts . The Utrecht methodology is based on an approach to design by architect Christopher Alexander, and the theories of phenomenology from the work of Edmund Husserl and Maurice Merleau-Ponty (Barfield et al. 70-79). The Utrecht methodology is an interactive methodology with five stages (Figure 7).

When working with the methodology, the designer cycles through the five stages as follows:

- the designer describes the *experiences* of the users, attempting to set aside, or at least make explicit, any prejudices they may have;
- using *intuitive judgements* the designer attempts to identify the good experiences from the bad experiences, and to then identify the invariant elements that make them good or bad;

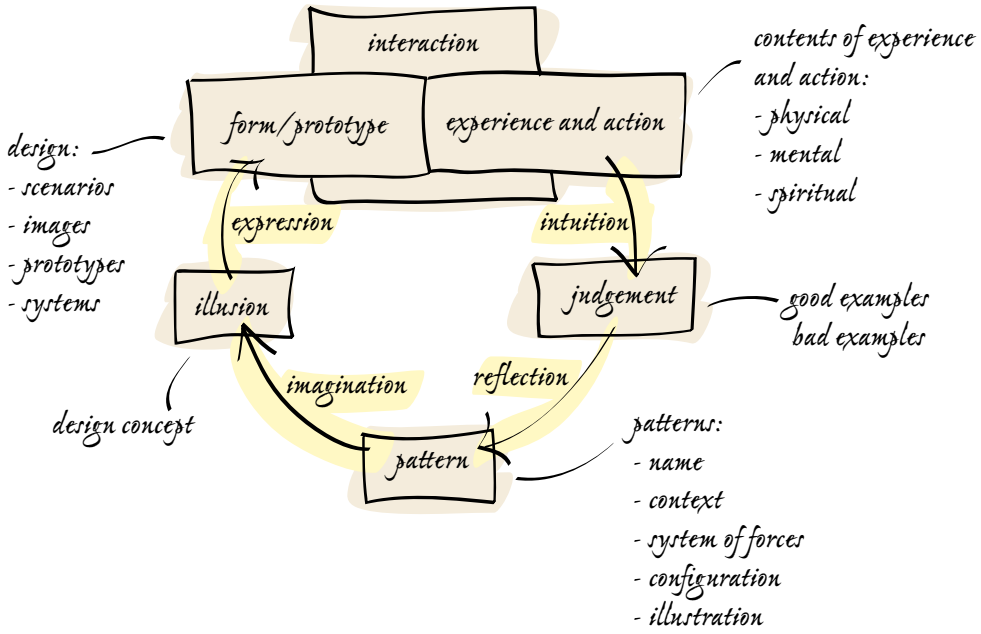


Figure 7. A method for experienced-based design. Source: Barfield et al. (75)

- using *patterns* the designer represents their analysis as a system of constant forces, a context, and which elements resolve the forces in the context;
- using *imagination* and the awareness of the forces from the pattern, the designer outlines an *illusion* to function as a design concept;
- the designer then *expresses* these ideas as a form or prototype that can be *experienced* by the users, and these *experiences* can then be used to restart the process.

The use of phenomenological analysis to understand the essential experiences of the users performing the tasks brings the designer much closer to the users. This has the potential to provide the designer with a much larger level of understanding of the users' tasks, context and interpretation, than more typical approaches to user-centred design or task-based analysis would.

The following chapter describes how I used the LUCID and Utrecht methodologies, and the range of approaches to interaction design previously discussed, in the context of the design of a new artefact for the recording of personal time use.

Chapter Two.
Designing a better way to record personal time use

> *Our actions can not be separated from the meanings we and others ascribe to them. Embodiment is about engaged action rather than disembodied cognition; it is about the particular rather than the abstract, practice rather than theory, directness rather than disconnection.*
> – Paul Dourish, Where the Action Is (189)

Any search for a methodology for interaction design needs to be balanced in both theoretical and empirical research. Despite the masses of theory surrounding interaction and design, both are founded in practice and any theoretical examination would benefit from an empirical perspective. On a more personal level, I was looking for methodologies and approaches that suited me – how could I know they suited me without at least trying to use them? In addition incorporating an empirical approach stimulated my research – had I not had the interest in applying these methodologies and approaches in a practical, real world context, a number of theories may not have been explored in as significant detail.

When looking for *something* to design, an activity which seemed likely to provide fertile ground for research was the recording of personal time use, or filling out time sheets. Many different types of workers have to record their time use on a regular basis. This information is used to help keep track of projects, to bill clients, to pay the workers, to track efficiency and for personal time management.

I felt that designing a digital artefact for recording personal time use would provide a good platform for empirical research into the methodologies and approaches to interaction design for a number of reasons:

- it is a *relatively simple* activity which is done everyday by a large number of people with a broad range of experience and backgrounds;

- it is an activity that was done before the introduction of computers into the workplace;
- it appears to be done poorly in many circumstances; and,
- even slightly improving it could have a very positive impact on many, if not all of the people who don't like having to do it everyday.

Undertaking the design of an artefact in the context of this honours research project, required that I took on the roles of client, designer, user and to a limited, extent developer. In a more realistic environment all of these roles would be performed by separate people, and I would have had a team of designers to work with. Whilst this was not possible in the context of this research, there were a number of things I was able to do to help overcome this issue. As mentioned previously, the recording of personal time use is a common activity done in many and varied organisations. This provided the opportunity to find potential "clients" – individual organisations – with which to establish the artefact's requirements. Each of these clients had a number of "users" – workers from within the organisations – from which to establish user requirements and conduct the various participatory processes and evaluations. Going out to the wider community removed the need for me to be client and user, and allowed me to focus on being a designer.

As I already had a good idea of the activity and tasks involved in recording time use through my own personal experience, my main goal in finding and selecting volunteers to participate in the research was to find individuals whose use of and experience with existing time recording systems varied from my own. In the end I was able to work with ten users, from a range of industries including marketing & public relations, financial & accounting services and software development, from both the private and public sectors. The users involved were a mix of managers, employees, contractors and freelance workers.

While many more people expressed interest and agreed to take part in the research, many of these were unable to make the time, about half an hour, to meet with me for an initial discussion. It was difficult in this context to offer anything of real value or to be able to encourage participation, and I expect this would be similar in a more realistic context. Educating potential volunteers to the personal benefits of participation needs to be a strong part of the recruiting process in order to try and increase the participation rate.

Another issue also arose at this point which I would expect to be just as relevant in a more realistic context. With two organisations I had to rely on other people to select potential volunteers for me. Despite explaining the user-focused nature of the research, and the need for me to speak with end users, the volunteers selected for me were from middle and senior

management who were not required to use the time recording systems as frequently or as rigourously as more junior staff. In further exploration of this issue there appeared to be a general belief that there was no advantage in speaking to users further down the line as the managers understood everything. Again, educating clients and careful communication would be needed to overcome this issue in future.

User Research

Before going out to my participants to discover their needs, I had a number of goals for the artefact already in mind. It is common for designers to establish initial ideas for a design from the moment they learn of a project, but as the owner of the project I had more of a say than I might otherwise have had. For me the main goal of the artefact was to enable and assist workers to quickly generate accurate records of how they use their time. I also always intended that the artefact would require an active involvement from the worker and would not monitor or automatically collect information from the worker's general activities. There were a number of reasons for this including the personal and privacy concerns of the workers, and the logistics of translating monitored data into useful and accurate records without significant user involvement. I also hoped that by actively involving users, it would increase their awareness of their time use, which could potentially provide benefits to their time management and productivity.

With this in mind, my objective for the first interview was to work through the Envision stage of LUCID with my participants, and to gather information on their work practices and requirements to complete the Discovery stage, as well as to start on building an understanding of the participants experiences as part of the Utrecht methodology. This may seem like a lot to achieve in a single meeting but, as recording time use is a common activity with which everyone involved was familiar, it seemed reasonable. Additionally, participants were sent a one page letter (Appendix A) explaining the subject and objectives of the research prior to the interview. As a result many came to the interviews with ideas and design concepts ready to talk about.

As an experienced designer, my client communication skills are one of my key assets, however the style of interview and degree of exploration were outside my typical experience. To this end Brenda Laurel's *Design Research* proved to be an excellent reference, presenting a range of articles and experiences from a wide range of designers and researchers. In preparing for the initial interviews, the advice from Christopher Ireland on conducting one-on-one and dyad interviews, and from Stacey Purpura about talking to the

right people and "feature-testing", provided very useful in setting out to do this type of qualitative research.

I designed the initial interview worksheets (Appendix B) with a number of things in mind: I needed to ensure that I covered all the necessary topics and details; I wanted to avoid a linear line of questioning by allowing the conversations to follow their own course; and I wanted to have everything in one place on one page to avoid having to search for things during the interview. The resulting worksheets were based on a simple grid, with points for me to check off, and room for small notes if I wanted to return to a topic to cover more detail later. To free me up to focus on facilitating the interview, audio and video of all the interviews were recorded directly to a laptop computer for later review. This made my role much simpler, and the small size of the camera was unimposing.

Even though the interviews went well, after reviewing the interviews there were a couple of recurring issues which could have helped make the whole process a bit smoother and enhanced the level of feedback and participation I got from my volunteers. These are fairly common sense, but they are worth mentioning. I was very aware that my interview participants were volunteering their time, and as such I wanted to keep my imposition on their time to a minimum. To this end I was well organised and went straight to the point, trying to get through the interview quickly. Having done that, I think the participants would have felt their time was better used if I had taken longer, and spent more time educating them about the process and their value to the process. Also, as suggested by Christopher Ireland, interviews conducted in pairs were much more useful than the interviews conducted one-on-one. People felt more relaxed and would often draw each other out much more than I could on my own, although some care needs to be taken in pairing interviewees.

Going into the interviews I had a number of expectations of what I might find. Primarily I expected to see a very high level of dissatisfaction with the current systems and current methods of recording time use. This wasn't as consistently present as I had expected, instead many participants seemed to have accepted this activity of recording time use as an annoying but necessary part of their work life.

From several discussions prior to the interviews I was also aware of a situation where some computer based recording systems would require all the details for an entry to be filled in for the system to save the entry. This meant you could not use these systems to record just the start time of an entry, you had to wait until you finished working on a project, and then record an entry. These systems discourage regular use throughout the day because of the level of detail and rigour required to record an entry. While this issue was not explicitly raised during

the interviews, participants who worked with such systems had developed their own personal mini systems to work around the limitations of the main system. In these circumstances these participants only used the main system as required, either weekly, fortnightly or even monthly.

One issue that was a little more present than I had expected was workers who would regularly and deliberately enter false or inaccurate data into the system they used. These workers felt that they would be disadvantaged, penalised or attract unwanted attention if they entered the actual data into the system. This falsification ranged from reducing time spent on a project, to not entering data at all, to entering time against the wrong project. In some cases this was supported, and even encouraged, by their immediate managers. For me this was of concern for two reasons. Firstly, having false data going into the system means that anything done with that data was immediately problematic. Secondly, this represents an environment where workers don't trust the system, or their managers, to the point they have to lie to them, which surely just perpetuates an ongoing cycle of mistrust.

It is unrealistic to expect that interaction design around a small system can solve this problem entirely as it is most likely rooted in the culture of the organisation. However, it is an issue which will have a significant effect on how the worker will use the time recording system – if they don't feel they can trust it then they will be hesitant to use it, and will think before using it rather than using it automatically or habitually.

I was also very interested in seeing what personal mini systems the participants had developed to assist them in recording their time use. I hoped that these personal systems, which potentially had evolved over a long period of time, would provide insight into how participants were comfortable recording their time, and how much data they needed to record throughout their day to enable them to enter complete information into the main system at the end of the day. About half of the participants had some sort of methodical system they used as they worked. These were generally a set of notes in a diary or on a piece of paper which helped them remember what they had done during a day or week, or even a month. Where these notes were inadequate, or where participants did not have such a system, they reverted to relying on their memory and checking diaries, emails, and phone records to help them complete their entries. Those participants who had a personal system felt they had more accurate records than those people who didn't, but most of those interviewed did not feel that their final entries were very accurate. However, they did feel that their data was adequate enough for their needs.

The defence of fairly obvious flaws in existing systems was something I didn't expect from end users of the systems, and I was surprised by the degree to which participants defended

systems, particularly those who had used them for a long time. I had anticipated this from the *owners* of the systems, or those responsible for maintaining them, but in reality those responsible for looking after the systems were more open to discussion of problems and issues, than those who used the systems. This defensiveness was partially a resistance to change, but more strongly it seemed to come from an unwillingness to admit that there were problems in a system that had been relied upon for so long. During one interview I was taken by surprise by this and I think my interview technique would be improved by looking out for this issue in future, and carefully working through it to ensure the participants stay onside.

Design Documentation

There were of course a range of other findings and details that came out of these interviews. Some of these will be discussed below, the rest have been included in the documentation found in Appendices C, D, and E. Appendix C, *Design Documentation*, follows the recommendations of Envision and Discovery stages of the LUCID methodology. Some key points from this documentation that are worth highlighting here include the *High-Level Concept*:

> *Time Pad will support workers who have to keep track of how they spend their time during the day for billing or project management purposes. It will provide simple tools for quickly and accurately tracking work done as it happens, as well as assisting users to complete their records at the end of the day.*

This was the first time that the artefact was named. The name *Time Pad* was chosen to both represent the nature and flexibility of the artefact. *My Time Pad* was also considered for a short period to make the product more personal, but it was felt this cheapened the product in the eyes of some people. The name was eventually changed to *Time Notepad* which clarified the purpose and sounded more balanced.

A couple of other key points from this documentation are worth mentioning. Firstly, the system does not have to report on, or track, start and stop times for individual entries, just the amount of time spent. No individuals or organizations interviewed used or required this information to be tracked. This was a surprise, as I expected at least one organisation would want to track all the details of their employees work. I was sure some organisations might, and with a little further asking around I was only able to identify one organisation out of approximately twenty five which required its systems to track this much detail.

Secondly, the system will run on standard personal laptop and desktop computer systems. Other types of devices, such as mobile phones and PDA's are not required to be supported.

This was something that came out of the interview process, but it's likely I would have made it a requirement anyway in order to keep the scale of the empirical research to a manageable level. It also kept open the possibility of a functional prototype if time allowed.

When it came time to create the user personas (Appendix D), I found it to be a relatively straightforward process. As I went through the two weeks of interviews the three different types of users became clear to me. Abbe Don & Jeff Petrick provided clear guidelines on what to include in the personas, as well as warning about common pitfalls encountered in the process. Their advice was valuable in keeping the personas clear and focused. In particular, the inclusion of a name and a picture was very useful in shaping the final personas and in keeping the personas in mind while I worked through the design process.

The creation of typical experiences (Appendix E), in line with the Utrecht methodology, was much more difficult and required a much higher level of personal involvement and creativity than the personas did. It was hard not to simply retell a participant's story from an interview. Whereas the creation of personas required a breaking down and a simplification, the creation of experiences required finding a simplified core and then fleshing it out to make it personal, realistic and emotive.

What was useful here was Bonnie McDaniel Johnson's article on *informance*. Informance is a process or a set of techniques which aims to give researchers and designers a greater understanding of potential users and their responses to new artefacts through the use of performance and role play. While I didn't actually perform or role play a person or context, I found that these techniques helped me to better consider the user behind the experience, and to bring both my imagination and my analytical skills into play.

At one point while reviewing all the design documentation, notes and interviews, I considered not using the experiences, as I felt they were very close to the personas in the information they provided. In the end, I chose to keep them as they were more open to personal feelings and frustrations than the personas were and, as suggested by the Utrecht methodology, they made it easier to re-consider the experience of such a user going through the same situation with the Time Notepad as I reviewed various design concepts.

The Design Concept

Most of the ideas and concepts for the design were played out by sketching them out in several notebooks. Some of these pages can been seen in Appendix F. Once an idea had advanced past this stage, it was drawn up and refined further, using vector-based illustration

software Adobe Illustrator. Beryl Plimmer & Mark Apperley tested an interface tool which allowed designers to sketch an interface idea, and then *run it* allowing them to better assess its effectiveness – kind of like very-rapid prototyping. The designers who used this tool produced significantly improved concepts to those who use more traditional methods. I didn't have this tool, but was able to use some of the ideas from it to help with testing my ideas and concepts. Being an expert user of Adobe Illustrator allowed me to work very quickly within it to trial concepts. I was also able to use its very flexible layering capability to create and compare multiple versions, as well as create sequences showing different stages of users progress through activities and tasks. While probably not as fast as the tool put forward by Plimmer & Apperley, my methodology was most likely a great deal more flexible in the nature of the interface elements I could use, create and evaluate.

Early on in my research I devoted considerable effort to researching the psychological and cognitive nature of time and memory, hoping to find guidelines and tips to creating an interface that would help people to remember what they had done during their day. Most of what I was able to identify was either too specific or too general to be of use in helping people remember specific times, or recall the order of events more accurately (Hoerl & McCormack; Brown & Chater; Marcus). Interestingly, and in line with the discussion of approaches to interaction design earlier, many of the practical tips and clues to creating the interface for the Time Notepad came from talking with users and understanding the experiences they go through in trying to use their current systems.

In line with the Design Foundation stage of LUCID, a number of different ideas were explored in trying to come up with the basic conceptual design for the Time Notepad. Some ideas based around punch clocks and timers were explored, but these were too problematic. The usefulness of these concepts relied heavily on the worker using them on-time. If they forgot to start a timer, or remembered half an hour into a project, the times recorded would be inaccurate, and a complex or separate interface would be required to allow for changes and corrections.

The concept of a day in a diary was an early one that survived through to the current design. One of the big advantages of the diary concept was its highly visual nature, which provides a very quick view of the day showing what time has been allocated and what has not. This made it very simple to notice projects or entries that had been left out, much more so than a list of times in a table. The diary also made it easy to add entries quickly – you could add an entry by simply dragging from the start time to the stop time, and then typing some text into the entry to describe what you had done. Another advantage of the diary-style interface, in line with the theories of embodied interaction, is that it builds on a level of familiarity both

from existing computer users who may already use such similar calendar systems on their computers, and from other workers who work with paper-based diaries.

Using a diary for the interface requires users to record start and stop times for entries, even though no one interviewed actually required or used this information. Not recording this information would reduce the amount of data collected, and it could be argued that this would improve the usability of the interface. However, from the user research and the experiences created, it is clear that workers use this information to help them remember what they have done during the day. Not including this information in the system significantly reduces the number of cues available to help trigger the worker's memory, and would not provide a visual reference for the worker to check their whole day at a glance.

The main problem to be overcome with a diary-style interface was how make it able to be used regularly as the worker goes through their day. For example, to make an entry you need to click and drag from the time you started to the time you stopped, but at the start of working on a project you don't know when you'll stop. You could simply drag out an hour or two as a guess for how long it would take, but you would then have to remember that it was a guess and fix it later. My initial solutions to this were complex combinations of different types of entries with start and stop timers, none of which seemed to provide a good solution. When I revisited the personas and experiences I had worked on earlier, I realised all that was needed was simply a note on the diary at a single point in time. This note could then be used as a reference later in the day, or could be expanded to become a full entry when the user had finished that time period.

The concept of notes made the whole interface much cleaner and actually opened up the interface to much broader use than had been originally considered. For example, once someone is in the habit of making notes using Time Notepad, they can simply transfer this habit to a diary or piece of paper when they are mobile or away from their desk. This type of notes system could also be adapted to many existing mobile or portable devices beyond the laptop computer originally specified. While the full interface would be too complex to implement on such devices, a note-taking interface would be practical. For example, a mobile phone-based application could be written that would record a note at a point in time during the day. Users could use the small, annoying mobile keypads, or select from a simple short list of pre-written notes – "Started Work", "Stopped Work", "Started Break", "Stopped Break", "Started Travel", "Stopped Travel", etc. This type of simple note-taking could be done quickly with a range of existing portable interfaces on iPods, phones, PDAs, etc., and then synchronised to the worker's main computer when they arrived back at work via wireless or

wired connection. These notes would then appear in the Time Notepad and the worker could expand them to fill in their activities for the day.

In combination, the concepts of a day in a diary and being able to make quick *notes* in such a diary, provided a strong solution to the basic requirements of the Time Notepad. Together they formed the design concept on which I could design the rest of the system. Having come up with this basic design concept, if I was to follow LUCID strictly, I should have created and presented a key screen prototype to my research participants. Ideally this could have been done in one or two quick group meetings, but with my participants variously employed and geographically scattered this was difficult to organise. Instead I discussed the concept informally with colleagues which allowed me to confirm I was on the right track before proceeding to the Design Detail stage of LUCID.

Design Detail

At this point the basic design concept offers all that is required for the system to work as required – workers can make entries or notes in the diary and completely fill them in using a basic form on the right hand side. However, one of the things I noticed, even from my limited sample of workers, was the variation in the types of work they did and in how they recorded this into their time sheets. Some workers had one main project each day with a series of breaks. Other workers often worked on many more projects, or several projects at once. The system would work for these people as is, but some flexibility would improve the interaction.

One level of flexibility added to the basic concept is a feature called *variations* – referred to as "Vary time by" in the interface. The purpose of variations is to allow workers to record actual times in their diary, but make changes to this for whatever reasons they require. For example, a worker may have worked from 10:00 a.m. to 12:00 p.m. on a project, but felt that they had worked slowly and they didn't feel it was worth charging the client for two hours work. They could then choose to vary the time down by one hour. This would mean that the client was only charged for an hour, but their diary would show two hours work on the project, accurately reflecting their work day. Variations can be made up or down as required, and show up visually in the diary. When a variation is made a new field becomes available for the worker to make a note of the reason for the variation.

As well as the flexibility of variations, there is a feature called *interruptions* which allows entries to interrupt other entries. Normally Time Notepad allows two different entries to overlap. This is not seen as an error, and may be necessary for rounding or various other

reasons. The user can set one of these entries to "interrupt other entries", which stops this overlapping of time. A common use for this might be a worker who works from 10:00 a.m. to 3:00 p.m. on a project, taking a lunch break from 12:00 a.m. to 12:30 p.m. They could make two separate entries from 10:00 a.m. to 12:00 p.m. and then 12:30 p.m. to 3:00 p.m., and then enter the same project details for each entry, but this is double entry and a waste of effort. By using an entry for their lunch break the user can interrupt the main project entry. The worker then has one main entry from 10:00 a.m. to 3:00 p.m. with all the project details in it. They then have a lunch break entry from 12:00 a.m. to 12:30 p.m. which is set to "interrupt other entries". This then reduces the time on the main entry from 5 hours to 4.5 hours. Variations and interruptions can be used in combination as required.

Another significant feature of the system is the separation of recording and submitting data. The system is capable of recording a great deal of information about a worker's day. This may be necessary for the organisation, but as discussed it is mostly in place to help users track their own time and see what they themselves have been doing. For example, no organisation interviewed needed to know that a worker worked on a project from 10:00 a.m. to 1:00 p.m., then again from 4:00 p.m. to 5:30 p.m. They simply wanted to know that the worker worked on that project for 4.5 hours on that day. Some needed a description of the work done, others didn't. On the right side of the Time Notepad is a Report panel which provides this summarised data for the worker to see and check over. If they are happy with what they see they can submit or export the data to a larger system they are working with. The level of detail in these reports can be customised to suit the needs of the worker and the organisation, and can cover a day, week, fortnight or month as required.

This separation is in place for a few reasons. It helps to overcome some of the issues of trust and falsified data that came up during the user research. The collection of all this data is most useful to the individual worker, and they should feel comfortable about accurately recording their day, without worrying how it might appear to a manager or supervisor. With the separation of recording and reporting of data workers are able to work quickly and confidently with the Time Notepad without having to think twice before they use it. While this doesn't remove the falsification of data issue entirely, it does leave a more accurate record for the worker of their day, allowing them to trust the system and work efficiently with it.

Additionally, not all of the various back-end systems will support the collection of all this data. Rather than limit the collection of data to what the various systems can cope with, the collected data can be summarised and customised to suit the back-end when exported. Some businesses will want all the details from the system, and this can be done as well, but it is

rarely necessary and in such a case the resulting privacy and accuracy issues are a matter for employees and their managers to work out. The Time Notepad is not intended to force compliance, or enforce an organisation's rules; it is intended to make a worker's life easier, and increase the accuracy of recorded data. I am keen not to incorporate the rules of each individual organisation within the main interface of the system. Some organisations may not want to allow variations, or may require specific rules or notes to be made for them. Implementing this type of compliance into the main interface makes it more complicated and reduces the flexibility of the system. An organisation's rules and compliance issues could be incorporated into the Reporting and Submission parts of the artefact as required. Keeping the main interface free of these types of rules allows workers to find their own patterns and rhythms of working with the Time Notepad.

Prototype Evaluation

Part of both the Design Detail stage of LUCID and the Utrecht methodology is evaluating various versions of the design with the potential users of the artefact. Having detailed the design to a point where a full range of activities could be demonstrated, it was time to show it to my participants to see what they thought. At this stage a non-working prototype would have worked well, but my attempts at low fidelity paper prototypes were not able to show enough detail with out being overly complex or messy. As I had already done some drawings of the interface in a vector illustration program I decided to flesh these out to show all the interface elements, and include a range of sample data for different activities.

As I had a variety of different participants with different levels of computing experience I chose not to use typically styled interface elements from either the Mac OS or Windows operating systems for fear of confusing or alienating participants unfamiliar with one or the other. Instead I drew interface elements that would appear functional and familiar to the full range of participants. Visually the Time Notepad was designed to look clean and somewhat physically like a paper diary, as I wanted to build on the familiarity of a diary, and appeal to the flexibility of taking notes on real paper. In doing this the Time Notepad follows the concepts of *direct manipulation* – where users operate directly on explicitly representative objects – and *affordance* – where an object affords an operation or action – and builds on the users' existing experiences in the world to enable the creation of meaning, all in keeping with Dourish's theory of embodied interaction.

The drawings of the Time Notepad were then pasted into presentation software, where notes and simple animations were added to the sequences in order to demonstrate how a worker

might use the system in various ways (Appendix G). When creating these sequences I returned to the personas and experiences I had created earlier for evaluation and ideas. After a couple of sequences were tried out, I made several small revisions to the design to make some elements or meanings clearer.

In preparing the presentation sessions I was keen to make the sure that the sessions were comfortable and collaborative, and that the participants didn't feel that *they* were being evaluated. The presentations were also structured to allow for the participant to uncover the interface slowly and to give them time to comment and ask questions (Burr & Bagger). The prototype was presented to the participants in the fashion of a paper-prototype, but rather than swapping paper pages around, I controlled a small laptop with the "pages" being presented on the screen. During the presentation the laptop also recorded the presentation session for later review in the same way as for the initial interviews.

For reasons of timing and availability the prototype was shown to half the original participants and all interviews were done one-on-one, rather than in groups of two. While this was not ideal it did allow the participant to view the Time Notepad in their own work space, and to have their existing systems and notes to hand as they reviewed the prototype (Bødker & Madsen). Those who did participate provided a good level of feedback which was relatively consistent across the group.

In the week before seeing the prototype the participants were sent a summary of the design documentation and user personas for them to review and comment on, as well as to refresh their minds and get them thinking about the process again. I went through this documentation with each participant at the beginning of each presentation and these were generally accepted with a few small questions or comments. These documents did prompt two new requirements that needed to be included: firstly to accommodate the new legislation which required all employers to track the start time and number of hours worked for each employee everyday; and secondly, a requirement for repeating events which would help to cover leave arrangements.

Upon being shown the prototype all the participants quickly worked out the basic operation of the software. In one case the sample data used in an example entry was confused for part of the interface as the terminology used in the entry was of a semi-technical nature. As a result I have been more careful and used very generic work terminology in the current examples.

There was also some confusion over the terminology and effect of the variations and interruptions features when people first saw the terms used in the interface, and the

terminology has been revised in the current design to help avoid this. The concepts behind interruptions and variations were not familiar to the participants and it took a few examples for people to understand their value over the basic interface. Once understood most participants appreciated the flexibility and efficiency they offered.

All participants liked the idea of being able to enter notes into the diary, although some took a while to understand why you would bother waiting for an application to open just to make a note. Once they understood the system was intended to be always available from a single keystroke or mouse click, and the very quick time required to make a note, they considered that this may change the way they record their time use.

One participant, a manager, raised a concern that they would not get to see all the information that their staff entered into the Time Notepad, even though their current system did not provide this level of information. This participant felt that all information collected should be theirs to examine and review as required. I explained the trust and accuracy issues behind the separation in the system, and the participant agreed that many people who worked for them did falsify their time sheets, therefore the manager wanted to collect and review every possible detail to rectify this situation. Despite my opinion that this would have the opposite effect, I decided that this debate was not appropriate in this context, and explained that the system could submit every item of collected data if required, but that by default it would not, in order to encourage frequent use and accuracy from the workers who used it.

The presentation also prompted a few ideas from participants about other features that they would like to see in the system. Several suggested an option to import entries from their existing diaries. This was a feature I had considered, and had actually sketched at one point. In working through this concept, I found that as diary entries were usually forecasts, not actuals, most of the information imported (start, duration, description) would need to be changed, saving very little time. The other reason for using data from a diary was to trigger memory of a day's events. While this is useful, it would be simple enough to have the diary open in one window and the Time Notepad open in a second window so that both where visible at the same time. This would achieve the same result without having to complicate the interface of the Time Notepad, so I chose not to include the feature.

The need to track the work day start and duration to match legislative requirements was obviously an important feature that was needed by the system. One way of doing this is to have the worker account for every minute they are at work by making an entry into the system. You can then use the start time for the first entry of the day, and the end time of the last entry to calculate the work day information. I felt that this was an onerous task for

workers and one that is likely to reduce the accuracy of data as workers would likely just match up entries where they would otherwise leave time unaccounted for. After working through a few different concepts, I chose to include a separate set of times for each work day. These times have default values, and can be individually adjusted for each day as required. The interruptions feature now includes an extra option allowing for an entry to interrupt the work day as well as other entries, which allows for the entry of work day breaks, such as regulated lunch breaks, as required. The work day is shown by light and dark shading in the background of the diary.

Having to enter two weeks of daily leave activity entries also seemed to be a fairly onerous task that should be catered for. This was fairly simply integrated by allowing an entry to repeat itself either "Every Day" or "Every Work Day" until a certain date.

One participant wanted to be able to enter a number of hours for a project and have the Time Notepad automatically count down these hours as they were entered, allowing the worker to see how many hours they had left. I initially thought this could be of some value, but with a little exploration it proved highly problematic. My main concern was that without tight integration to the main project management system there was a good chance the count down figure could be wrong, and have dangerous consequences for all involved. With a separate and generic artefact like the proposed Time Notepad, I felt encouraging better communication between project managers and their workers would be a safer and more effective option.

There was also some discussion with participants as to how the project and activity fields were defined and populated. Participants wanted hierarchies and a high level of flexibility with these fields. I had given some consideration to this area, but it was not covered in any great level of detail for the prototype. My idea for both projects and activities was that they would be very flexible to suit the organisation and the individual workers. The name of each field would be variable, so 'Project' could be changed to 'Department' if it suited better. Both fields would have an associated hierarchical list of codes and names. If a project or activity did not already exist in the list, workers could add it by entering the new code or name into the field while filling in an entry. The colour of each entry would come from the activity assigned to it, and activities could also be set to interrupt by default.

The last request made by a participant was for free form entries – these are entries that have no start or stop times just a duration. The reason given for this was that some workers don't want to have to worry about what time they did something, they just want to choose the project and enter some time against it. It was suggested that all the extra data entry would slow workers down who wanted to make such a quick entry. I'm going to admit to a bias here,

in that I don't like this idea at all, partly because I worked hard to ensure making entries was as easy as possible, partly because it breaks the diary concept, and finally I don't believe this would be a real issue in practice. To make such a quick entry in the current design, a worker would click-and-drag an entry of the right length and then choose a project. Using a revised design that included free form entries, a worker would create a new free form entry somehow (most likely a small button click), type in a duration and then choose a project. It would be the same, if not more, work with free form entries, even excluding the extra cognitive load caused by having two different types of entries in the interface. If the worker does not care about the times then neither does the Time Notepad – it does not care if entries overlap, if times don't line up nicely, or if they are on the wrong day. It is possible that such a worker may feel wrong making an entry that is at the wrong time. If this is the case then the user really does care about the times involved, and would probably benefit from making more accurate entries, which would take no longer to make anyway. All of that said, because of my bias I would ensure that this issue was specifically tested once a working prototype was built.

The Current Design

It was never intended to develop a fully functional artefact during the research, but to focus on key elements of the interaction design process. Originally I had hoped to be able to build and test a partially working prototype, however as my research continued this became less of a priority. Following on from the prototype presentations the design of the Time Notepad was revised in both significant and small ways, most of which have been mentioned or discussed above. While I feel that a working prototype could be built from this design, rather than present a detailed specification for this purpose, I have decided to present the design in the form of a Getting Started Guide. This guide has been reproduced in its full size on the inside front and inside back covers, a slightly reduced version is in Appendix H. While this format may not provide the level of detail of a full interface specification, it communicates a better idea of how the Time Notepad would work and what it might be like to work with.

While creating the Getting Started Guide, I was conscious of the work Suresh Bhavnani & Bonnie John presented in their article *The Strategic Use of Complex Computer Systems*. This article explores efficiencies use of artefacts, that seem to stem from an intermediate level of knowledge that is not present in the artefact itself or in the knowledge of the functions that artefact offers. Put simply, knowing how the artefact works and functions does not automatically lead to efficient use of that artefact. They provide a simple example of a hammer, which when used by inexperienced users often results in bent or crooked nails, or hit

fingers. Efficient hammer users know how to drive the nails in straight by first tapping the nail in to ensure the proper angle, and then using heavier blows after removing fingers from the nail. This intermediate level of knowledge has to be learnt. This resonated with my experience of demonstrating the more advanced features of Time Notepad, which required several examples before participants understood the value of these features. Bhavnani & John suggest that one of the best methods of achieving this level of knowledge is through the strategic instruction of users in the efficient use of these artefacts.

Another way of looking at this level of knowledge is as experience gained using the artefacts. Going back to the hammer example, an apprentice would learn these skills through on-the-job experience with an experienced mentor. This form of instruction takes place in a workplace that appreciates the passing on of skills, however workplaces like this seem to becoming less and less common. Bringing an experience-based approach to design to this issue, it would be expected that the designer of an artefact would have considered and designed the artefact to allow for its efficient use, and that they would have considered or developed experiences in which this efficiency was demonstrated. However, as Bhavnani & John point out, these efficiencies are not always obvious in an understanding of the functioning of an artefact. This is the case with the *variations*, *interruptions*, and *notes* features of the Time Notepad. These features are fairly easy to explain and understand, but how they should be used to make the process of recording time use more efficient is not evident. To this end I have attempted to include experiences and situations in the Getting Started Guide which demonstrate the efficiencies to be gained by using these features. Doing this takes advantage of the designer's processes, their work with user experiences, and helps to express the vision the designer had in mind when they created the artefact. This is consistent with the theories of semiotic engineering and embodied interaction discussed earlier, in that it assists the designer in communicating their vision and their expectations of how the artefact should be used. Additionally, following through with the creation of such a level of documentation at this early stage of development may help the designer to refine and find flaws in the artefact, and provides another way of obtaining feedback on the design from potential users before committing to the development of a functional prototype.

Review of Methodologies and Approaches

Without being able to fully evaluate and trial a functioning artefact it is difficult to report on how successful the design process was in delivering a good result. As the designer in the process, I felt very comfortable with the methodologies and approaches used and feel

confident that the current design would work well as a finished artefact. Obviously, before committing to production of the artefact I would like to conduct further evaluations of the design and review the project, particularly in light of the limitations on the process imposed by being part of a honours research project.

The main difficulties that arose during the process seemed to be centred around a key part of the design process, communication. Both methodologies attempted to address this and did help, but this may be outside the bounds of methodological intervention. These difficulties can be summarised as: does the client know what they want?; client expectations and responses; and, how do you manage both of these without damaging the process and the relationship.

The question of 'Does the client know what they want?' is a common one in design, and is covered briefly by Jonas Löwgren & Erik Stolterman while discussing the questioning qualities of a designer (26-27). Clients usually approach designers and ask for a solution, a solution they think will fix a problem they have. Clients don't normally communicate the problem and ask for a solution. Often clients do not have the distance, skills or knowledge to determine the right solution. Sometimes clients may not have considered the problem at all, but have decided the solution is what they need anyway. Designers need to be able to listen to and question the client to uncover the real problems the client is trying to solve, in order to assist the client in designing the right solution for them.

These difficulties did come up in the design of the Time Notepad, even though I was responsible for many of the bigger design questions in this project. Some participants had very fixed views on how time recording worked, and could not see them as being separated from particular office processes, even when they were already actually quite separate. Some participant discussions and suggestions had little to do with time recording and were quite specific to human resources management or project management issues. Under these circumstances trying to uncover a participant's true intent was often difficult, and sometimes trying to move their focus away from their desired solution, towards what I understood as the key problem, was almost impossible without agitating or aggravating the participant. This meant that on occasion, certain issues were not fully explored and some questions were left unasked. Similarly, this is the first project in which I have encountered such strong defensiveness, possibly because I approached the *clients* rather then the other way round. Even so this was not consistent within each organisation, some people would see the current practices as highly flawed, while others would see them as working well. At times I was not sure how much of the disagreements had to do with the discussion at hand, or existing personal and political differences which ran much deeper.

These are areas where personal communication skills, experience and being able to successfully educate and communicate the design process to a client is essential. There is little that a specific methodology can do, as all clients and designers are individuals and require different styles of interaction and management to get them through the process successfully. Thankfully these experiences were only a very small part of my overall experience in this particular process.

Throughout the design of the Time Notepad, both the LUCID and the Utrecht methodologies clearly demonstrated their value, and I would be very comfortable using them on future projects of this kind. One of the key advantages of the LUCID methodology was the flexible way it allowed me to incorporate other methodologies and use a variety of approaches, including those which may be less familiar in the human-computer interaction universe such as phenomenology and embodied interaction.

At this point, it is useful to consider how some of the approaches to interaction design discussed in Chapter One have impacted on the design of the Time Notepad. It is difficult to bring these out in isolation, and the reality of the design process would be that they all (and others not discussed) had some impact on the design simply because I had spent so much time researching and reading about them.

Firstly, while there were no formal usability evaluations conducted on the design in this research project, the desire to create a highly usable artefact was a key driver in the design. As an artefact which is intended to integrate itself into worker's everyday practices, conducting formal quantitative usability studies would only be of use in identifying problem areas within the design. Less formal and more qualitative approaches would be required to evaluate the design's overall success over a longer period of time.

Secondly, the impact of cognitive and ergonomic approaches to the design were significant, even though no specific laws or formulas were applied to test various ideas and concepts. Certain options were evaluated on the basis of how many options or choices they would create for the user, and keeping the number of modes in the artefact to a minimum was also a key part of a couple of decisions. To some degree, these types of cognitive considerations arose through the use of the user experiences in evaluating various design options.

Thirdly, while the LUCID methodology used in this project is based on a user-centred approach, my actual design process was more user-focused than user-centred. The users were not the drivers of this process, rather they were well researched, considered in all decisions, and consulted at major points of the process. This process appeared to balance the advantages

and disadvantages of the user-centred design, by carefully evaluating the users' input into the project and through considering a broader range of users and activities than the sample group of users could represent.

Fourthly, I would like to be able to think of myself as a *thoughtful designer* in the sense of Löwgren & Stolterman, and I hope that this research project demonstrates this to some degree. With the amount of reading and research that went into this project, the design of the Time Notepad had little choice but to emerge from a thought-filled and considered approach. Beyond that, this thesis demonstrates an ongoing questioning and evaluation of both the design process and the role of design in the world.

Fifthly, the theory of semiotic engineering could be said to have had the least obvious impact on the Time Notepad of any of the approaches discussed. This may be because I have always considered that my own mental design processes follow a semiotic approach – it appears to be an integral part of my thinking to consider the various *signs* created by a design, and the various interpretations and meanings that these *signs* could create out in the wider world. For this reason I would like to explore and focus on semiotic approaches to design in more detail in future projects.

Finally, the use of phenomenology, experiences and embodied interaction in design was at times the most difficult to apply and then to get right. Yet they could also be said to be the most valuable approaches to this particular project. The use of experiences proved invaluable in understanding the specific needs of users while they were recording their time use, and in considering the value and appropriateness of various design options. The theory of embodied interaction provides strong support to many aspects of the current design, including the key concept of a diary-style interface. The intersection of embodied interaction and semiotic engineering also had a significant impact on this project. As Dourish suggests, 'We act in a world that is suffused with social meaning, which both makes our activities meaningful and is itself transformed by them' (189). Perhaps then it was actually the combination of a semiotic sensibility with an exploration and application of embodied interaction that has had the greatest effect on the design of the Time Notepad. The intersection of semiotics and phenomenology – the way they describe the process of interaction, explore the creation of meaning and can then be used to help design improved interactions – together with interaction design, is to me, the most interesting convergence to come from this research, and is worthy of detailed exploration in future research and design projects.

Conclusion

> *We have been obsessed with learning how to get the design right rather than how to get the right design.*
> – William Buxton, Who cares if you are dressed if you are alone? (6)

In setting out on this research I hoped to find suitable methodologies for designing successful interactive artefacts. As the research unfolded I found that much more was required to improve the design of interactive artefacts than the development or promotion of particular design methodologies.

Most importantly, it would appear that design needs to be accepted as a more important and integral part of the development process than it currently occupies, both in commercial and research environments. It would also appear that the act of design needs to be better understood, and its value in helping to make good decisions during the development of an artefact needs to be recognised beyond the artefact's aesthetic attributes. Specifically in terms of research, the field of interaction design needs to be better accepted and integrated with the field of human-computer interaction, as these fields are too interrelated to sit outside each other.

Simply adding designers to the existing development process will not provide a good result either. Designers, engineers, users, marketers, business managers and other stake-holders need to work together through a design process from the very beginning of product development. Bringing in designers after development has begun severely limits the designer's ability to question and make recommendations that require the undoing or redoing of extensive or existing investments in the process.

Designers themselves can do a lot more to improve the design of interactive artefacts. Those designers who engage themselves in holistic and thoughtful processes with both the users and

the engineers of artefacts will be able to produce more successful concepts, in a shorter space of time, with fewer compromises required to meet the needs of either group. The more involved that designers are, and the broader their design research, the better informed they are to make decisions throughout each project, but also right through their design careers.

In particular, there is a strong potential for designers to significantly improve their designs through more research and involvement in understanding both the context of use and the experiences of users. The philosophy of phenomenology and the concept of embodied interaction have a great deal to offer to designers who take the time to understand and employ these ideas into their own processes.

Through this research project I have explored a number of approaches to interaction design, using a blend of theoretical and empirical methods, together with a reflection on my own design praxis. The key recommendations to come from this exploration are for the integration of designers and the act of design into the development of interactive artefacts, and for designers involved in the design of interactive artefacts to broaden their design considerations.

Appendix A.
Letter to Participants

The two letters on the following pages were sent to potential participants following on from an initial contact, usually a phone call. The first letter outlines the project and invites them to participate in the project. This was customised for each individual and as appropriate, included the organisations name and the person within the organisation who had approved the organisation participating in the research. The second is a formal agreement, that participants were required to sign as part of meeting the ethical requirements for the research. These were sent via traditional post or email to suit the individual circumstances.

Dear [insert participants name],

As per our earlier conversation, I am completing my Multimedia Honours degree at Murdoch University and would like your assistance with this project. My focus is on interaction design and my project is titled, "Designing a better tool for recording time usage at work." This project is best described as follows:

> *Many workers, whether they be freelancers, contractors or employees, monitor and record the time they spend working on projects throughout their day. This information is then used to bill clients, track the efficiency and progress of a project, or simply to assist workers in managing their own time.*
>
> *This primary goal of this project to design a user focused interactive tool which will allow, and hopefully assist, workers to quickly generate accurate records of how they use their time.*
>
> *This tool will require an active involvement from the user; it is not intended to monitor or automatically collect information. There are two main reasons for not monitoring users: personal and privacy concerns; the technical logistics of translating monitored data into useful records. I also expect that making users more actively involved will lead to a more accurate result.*

As part of this project I am conducting research into the users of such a product. This first stage of this research looks at the technical requirements of the system (what data it is required to produce at the end), and most importantly trying to understand the users requirements (the tasks they perform, the information they need, terminology, priorities and their mental models). The second stage will involved conducting user evaluation of the various design prototypes throughout the project.

I would like to request your participation in this research. The first stage will require about half an hour of your time in a short discussion with myself. The second stage will be similar, but may also be recorded for research purposes. I would like to conduct the initial interviews for the project in the second half of January 2006. The followup research will be conducted from March to August 2006.

This project has been examined and approved by the Murdoch University Ethics Committee, and all information collected will be kept strictly confidential. A copy of the consent letter is attached, and you will be required to sign it prior to the first interview.

In return for your support you will have access to an executive summary of the project, as well as final honours thesis at the completion of the project in December 2006. I will also be happy to discuss the results from the project with you as the project progresses.

If you can assist me with this project it would be greatly appreciated. Please feel free to contact me via email, or on the phone 041 123 9190, if you'd like to discuss anything in regards to the project. If you can assist them please reply to this email at your earliest convenience.

Regards,

Chris McLay

School of Media Communication and Culture
Division of Arts
Murdoch University
South Street
Murdoch WA 6150

Project Title: *Designing a better tool for recording time usage at work.*

I am an Honours student at Murdoch University undertaking the design of an interactive tool for the collection of time usage information under the Supervision of Ingrid Richardson. The purpose of this study is to find out how workers currently collect and report on their time utilisation, to discover the various issues and inadequacies of the current interfaces, and to design and (if possible) test a new interface to improve the accuracy and user experience of the collection of this data.

You can help in this study by consenting to participate in a brief interview/discussion, allowing me to observe your current time collection practices, and (if possible) to test and comment on prototypes of the newly designed interface. It is anticipated that the initial interview and observation will take no more than one hour. The interviews and evaluations may be recorded on video. Participants can decide to withdraw their consent at any time. All information given during the survey is confidential and no names or other information that might identify you will be used in any publication arising from the research.

If you are willing to participate in this study, could you please complete the details below. If you have any questions about this project please feel free to contact either myself, Chris McLay, on 041 123 9190 or my supervisor, Dr Ingrid Richardson, on 08 9360 2321.

Should you agree to participate in this project you will be able to view an executive summary of the projects results online at the conclusion of the project in December 2006.

My supervisor and I are happy to discuss with you any concerns you may have on how this study has been conducted, or alternatively you can contact Murdoch University's Human Research Ethics Committee on 08 9360 6677.

I (the participant) have read the information above. Any questions I have asked have been answered to my satisfaction. I agree to take part in this activity, however, I know that I may change my mind and stop at any time.

I understand that all information provided is treated as confidential and will not be released by the investigator unless required to do so by law.

I agree for the interview and evaluations to be taped/videotaped or otherwise recorded.

I agree that research data gathered for this study may be published provided my name or other information which might identify me is not used.

Participant's Name:_____

Participant's Signature:_____ Date:_____

Investigator's Signature: _____ Date:_____

Investigator's Name: *Dr. Ingrid Richardson*

Appendix B.
Interview Worksheets

The worksheets on the following two pages were used during the initial interviews with my research participants. My main interest with these interviews was getting the specific requirements of the systems the users worked with. I also wanted to gain an understanding of how they felt about the systems they used and the activity of recording their time use in general.

The worksheets were designed to ensure that I covered all of the information and topics I was interested in, without having to follow a linear flow or list. I was keen to try and make these interviews as conversational as the interviewee was comfortable with. As the interviews were recorded I allowed only a small amount of room for notes to prompt me to ask further questions or return to topics raised earlier.

Interview Worksheet - Workers

Walk through the system

- (note down terminology)
- Demonstrate the entry of a event
  - …the changing of an event
  - …checking back over the days activities
- How much detail you need to enter?
  - … to keep working?
  - … to submit your data?
- What is it all used for?
  - Who reads it?
  - What impact does it have on you?

Actual usage

- How often are you supposed to use the system?
- How often do you use the system?
- Do you make notes as you work?
- How?
- Do you try and remember at the end of the day or week?

Work Practices

- Are you always at the computer?
- Are you off site at all?
- How does this work?
- Do you work to a routine or habit?
- Or deal with things as they happen?
- If something was to hand would you use it?

Accuracy

- How accurate do you think the data you enter is?
- Could this be improved? How?
- Do you ever deliberately fudge figures?

Concerns

- Do you ever worry about how the data is used?

Getting something back

- What do you get from the system now?
- Do you track your day / see how efficient you were?
- Is this useful?
- What would you like to see in the system…
  - To make your life easier?
  - To give you something back?

Interview Worksheet - Managers

Output requirements

- (note down terminology)
- Elapsed time
- Adjustments
- Start time / date
- End time / date
- Date
- Project (code)
- Activity (code)
- Client (code)
- Notes
- ID

Usage requirements

- Record as-you-go / end of day
- Submit records daily / weekly
- Checked how often
- Does it effect the users pay / performance management

How does the system work

- Demonstrate from user
- Demonstrate from manager

Issues and Problems

- Is the data accurate?
- Do users have problems with it?
- Is data deliberately "fudged"? (by users or by the organisation)

Users

- Privacy concerns
- Workflow concerns
- Management practices

Future

- What improvements would you like to see?
- What could the system do better?

Appendix C.
Design Documentation

The following documentation was developed following the initial interviews, and during the design research that followed on from that time. It is based on the recommendations outlined in the Envision and Discovery stages of the LUCID methodology.

High-Level Concept

Time Pad will support workers who have to keep track of how they spend their time during the day for billing or project management purposes. It will provide simple tools for quickly and accurately tracking work done as it happens, as well as assisting users to complete their records at the end of the day.

Business Objectives

Time Pad will:

- Reduce time spent completing time sheets;
- Improve the accuracy of time sheet data; and,
- Provide workers with an accurate picture of their time usage/efficiency.

High-Level Functionality

Time Pad will allow users to:

- Record their work on projects as it happens;
- Add project times after the fact;
- Modify and update time records as required;
- Easily view their time usage for a whole day;
- Produce a summary of data for submission to other systems, or archive; and,
- Keep track of time used on a daily basis for at least a month.

User Population

Time Pad is intended for workers who:

- Record their time for project management or billing purposes; and,
- Work primarily at a desktop or laptop computer system;

Time Pad is *not* intended for workers who:

- Are mobile, such as tradesmen, or on site service providers.

High-Level Constraints

The Time Pad system must:

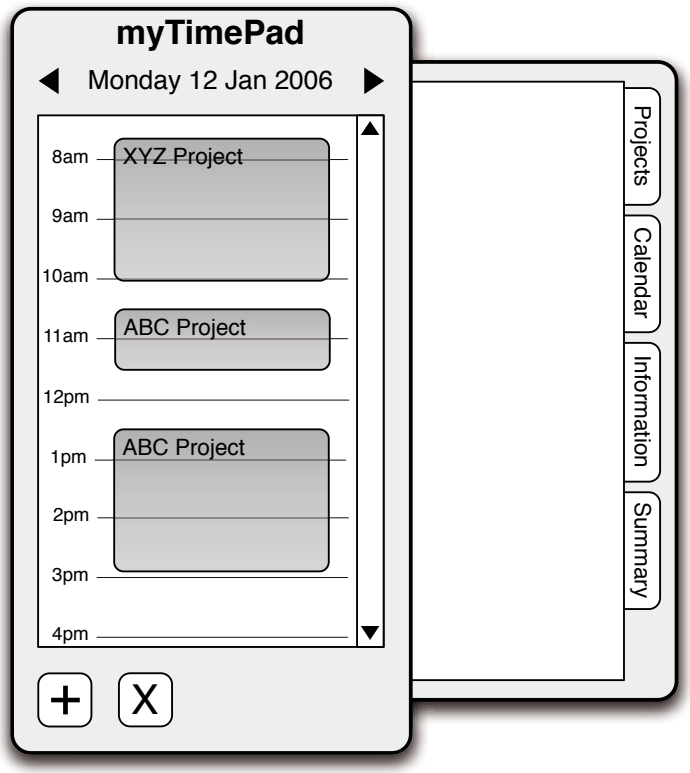
- Run on current desktop and laptop based computers;
- Be available quickly and simply, with little or no delay;
- Not hinder or delay users, or interfere with their actual work processes.

Potential Problems

- Lack of a committed user base - due to the nature of this project (being a research project) all users are participants and the direct benefits to them are limited;
- Limited technical and programming expertise available to follow through the design phases into development of timely functional prototypes.

Concept Sketch

An initial concept of how the Time Pad might look based on the use of a day to a page diary.



Business Requirements & Goals

- Time Pad needs to allow for between one and thirty entries per day.
- Data needs to be collected for at least a month to allow for weekly, fortnightly or monthly submission of the data to project management or billing systems.
- Each entry needs to record:
  - Project (text and/or code)
  - Type of activity (text and/or code)
  - Date
  - Amount of time spent
  - A description of the work done
  - Amount of adjustment to the time spent
  - A reason for the adjustment
  - Specific start and stop times are **not** required.
- Provide a range of summary reports which collate and exclude data as required by the user:
  - Project work done in a day, week, month etc.
  - Include activities, notes, adjustments, dates as specified.
  - Provide for tracking of time in a variety of units, mainly quarter or whole hours.

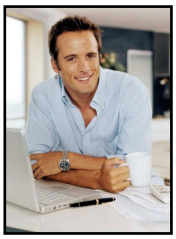
Appendix D.
User Personas

The following three user personas and the following User Persona Needs Chart where developed from the initial interviews with the research participants. They are based on examples and advice from Abbe Don & Jeff Petrick.

I have developed three personas for potential users of Time Pad. These are not actual people, but are constructed from the user interviews and my own experience. The following items are not specific to any persona, but cover all three…

- For some users the data they collect has little or no effect on their pay and performance management. For others, such as freelancers and consultants it means a lot.
- No one was able to review or search their current records in a useful or practical way.
- Very few people tracked the adjustments they made to entries or why those adjustments were made.
- All users do the vast majority of their work at a computer, those who do not fall outside the scope of this system.

Median Mike



Mike is lower to middle level worker who is good at his job and has a good understanding of what goes on around him. He likes to be organised, but often deals with his work as it comes up…

- Mostly makes simple paper or diary notes of work as it happens, but sometimes has to go back to fill in the gaps.
- Uses diary entries, or emails to remember what he did and when.
- Feels the pressure to keep within budget and will sometimes not record hours, or move them to general admin projects to keep within budget.

Mike needs a system which…

- Is as quick and easy to use as the paper notes he takes now.
- Helps him to remember what he's missed.
- Allows him to track actual task time, but to make adjustments as required.

Lazy Leroy

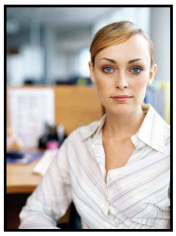
Leroy is a lower level worker who will do something only if it is required to keep his job, and not always then. He's never heard of a to do list and will only do whatever is handed to him…

- He enters data only when he has to, and mostly from memory.
- He will adjust the time spent on a task down if he feels it will lead to a query from above, or adjust it up if he thinks he can get away with it.
- Not interested in using the data going into the system, does not see the value.

Leroy needs a system which…

- Helps him to remember what he has done.
- Enables and encourages him to make entries more regularly.
- Allows him to record the actual time spent on a project, and adjustments as required.

Detailed Jane



Jane is a middle to upper level worker, and is well organised and highly confident with her work. She is well organised, keeps a detailed diary and is on top of it all…

- Records data into a diary or directly into the main system as-it-happens (or at least at the end of the day).
- Always makes accurate entries of her time spent.
- Would like to have personal sub-project or task codes.
- Would like to be able to generate reports to see her time on tasks and projects.
- Worried that no one reads her time sheets in enough detail.

Jane needs a system which…

- Is quicker and easier to use then her current systems, and allows her to record in more detail.
- Provides for simple reporting or export to other systems for her to generate personal reports (such as Excel).

User Persona Needs Chart

	Lazy Leroy	*Median Mike*	*Detailed Jane*
Record time usage, completing all necessary fields as specified	X	X	X
Update & modify entries as required	X	X	X
Simple export to common systems	X	X	X
Very quick access to system		X	X
Very quick to make a simple entry		X	X
Assistance remembering tasks & time	X	X	
Record adjustments to actual entries	X	X	
Record additional details either as sub-project codes, or a personal code			X
Custom export options			X
Encouraged to make regular entries	X		

Appendix E.
User Experiences

These experiences provide further detail and insight into the users who have to record their time. They are not actual experiences from individual users, but are constructed from user interviews, as well as my own experiences. They were based on examples given as part of the Utrecht methodology (Barfield et. al.).

Simple and Organised

"I have an important report to write this morning, so I check my watch and make a mental note of the time (9:15 a.m.). I start writing, but am interrupted by a phone call from a client needing some quick on the spot advice. After a few minutes I resume work, but have lost my place. I get up to make a cup of coffee and return to writing. The phone rings again, it is the same client and he takes a bit longer this time. I finish the report and file it away. It Is now 12:20 p.m. so three hours work, minus say half an hour for the phone calls. I open my diary to this morning and write down the project name and 2.5 hours."

What did I do yesterday?

"I'm looking at yesterday's time records and they're blank. Problem is I worked flat out all day and didn't have time to even think about making notes. I know I got to work late at about 9:30 and went straight into fixing bugs on the Home project, and when I finished that I responded to some queries on the Eastern project. After lunch I wrote a new function for the O'Hanlon system, imported some new test data into the Build-It database, and did some more bug fixing for the Home project. I met Andy at the pub at 6:00, so I must have left work at about 5:40. So all up that's about 8 hours work, maybe 7 for lunch and stuffing around - so Home gets three hours, Eastern gets an hour, and Build-It and O'Hanlon can split the difference."

Resourceful

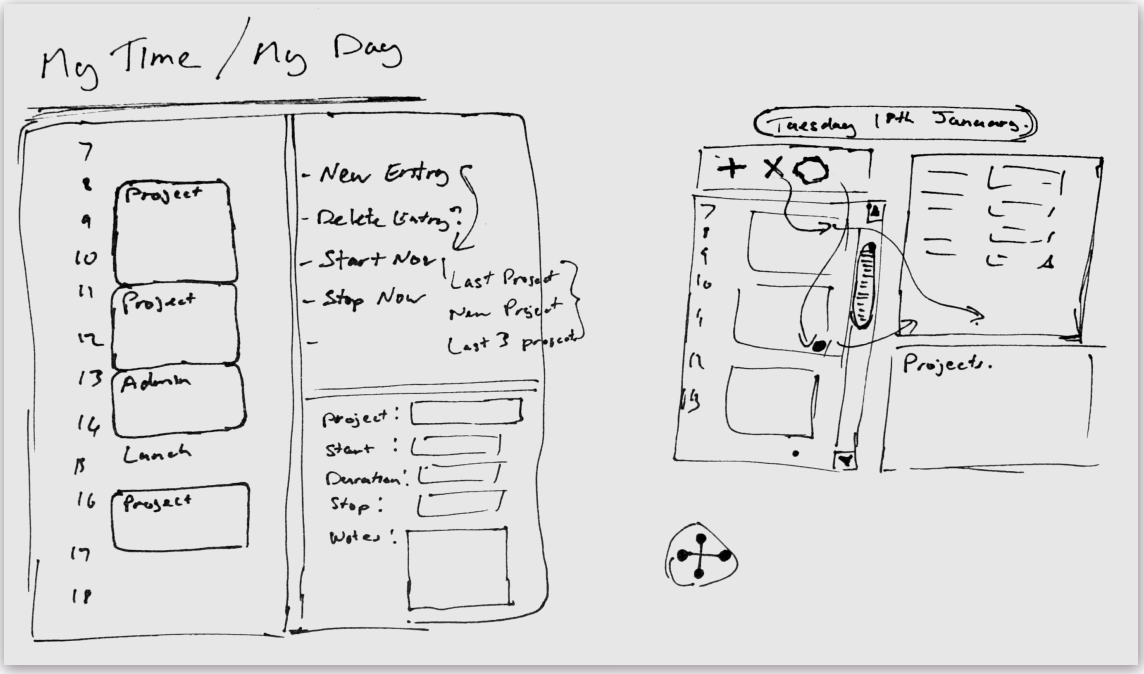
"12:30 time for lunch, but I better do my time sheets first. I just finished the 3rd ad concept, but when did I start it? I did the new real estate banner ad's before that and emailed them off - what time was that? 11:00. So 1.5 hours for the ad concept. Before the banners was the new cover revisions and they were emailed at 9:30 so that's an hour and half for the banners. What time did I start on the revisions? When I got to work which was? I was on the mobile to Kim, so let's see he called me at 8:30 for 20 minutes so that's about forty minutes for the corrections - let just say half an hour."

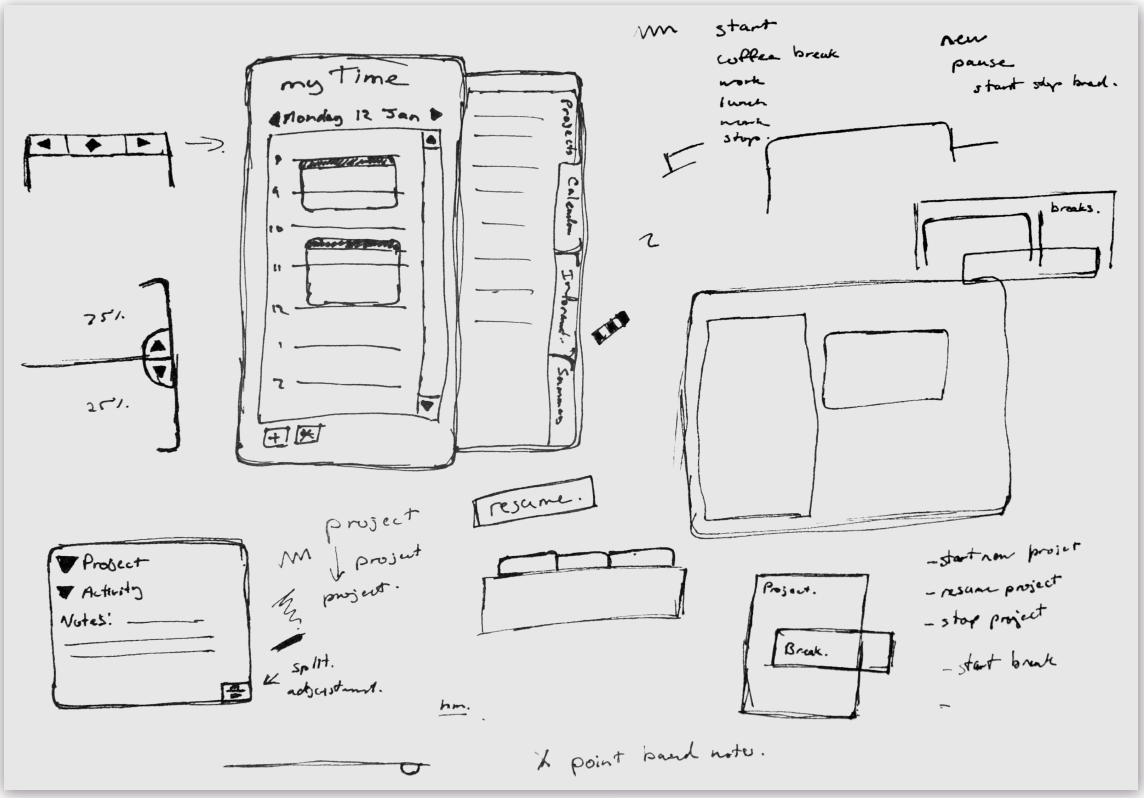
Complex and Detailed

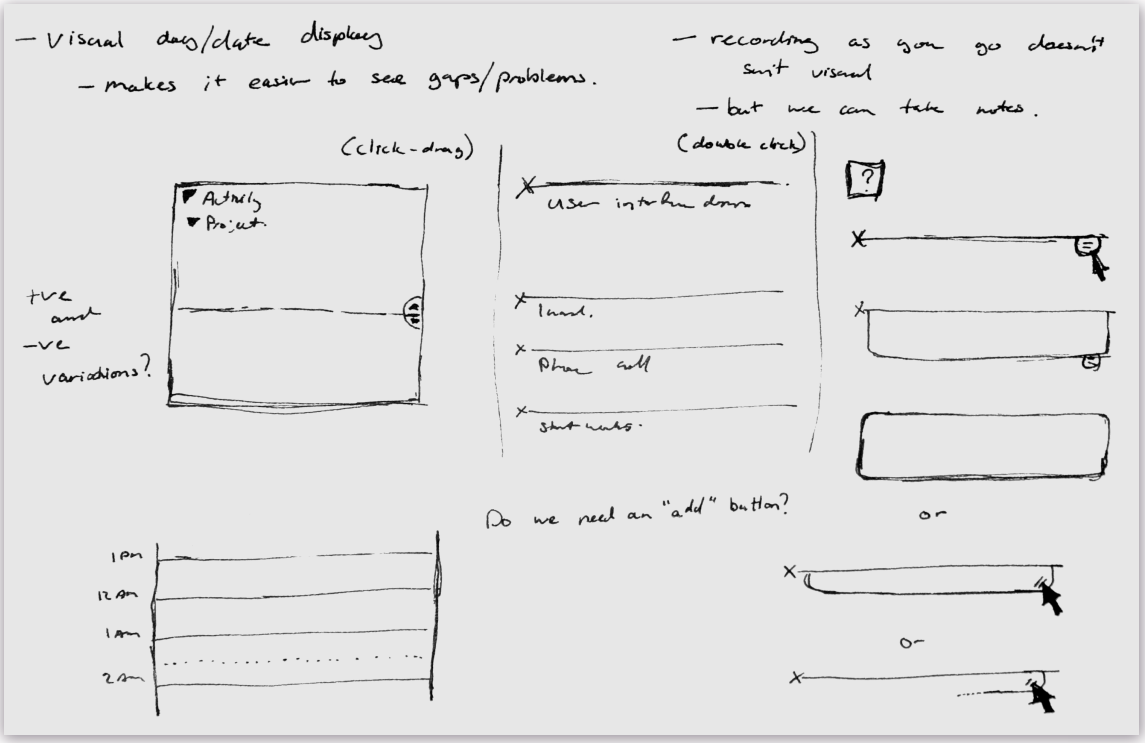
"Ok finished that one, better put it in the billing system before I forget. Let's see… project: Eastern Suburbs Extension; activity: Design; billable hours: about 3.5; start time: about 1 p.m.; finish time: about 5:00 p.m. BEEP! Yes I know that doesn't add up, but… Ok finish time: 4:30 p.m. Happy Now! BEEP! I know I haven't entered 8 hours for today! Lets see, new entry… project: Admin; activity: Admin; billable hours: 1; start time: 4:30 p.m.; finish time: 5:30 p.m. BEEP! Yes I know it hasn't happened yet! Ok, billable hours 0.5; finish time: 5:00 p.m. #%^&*!!!"

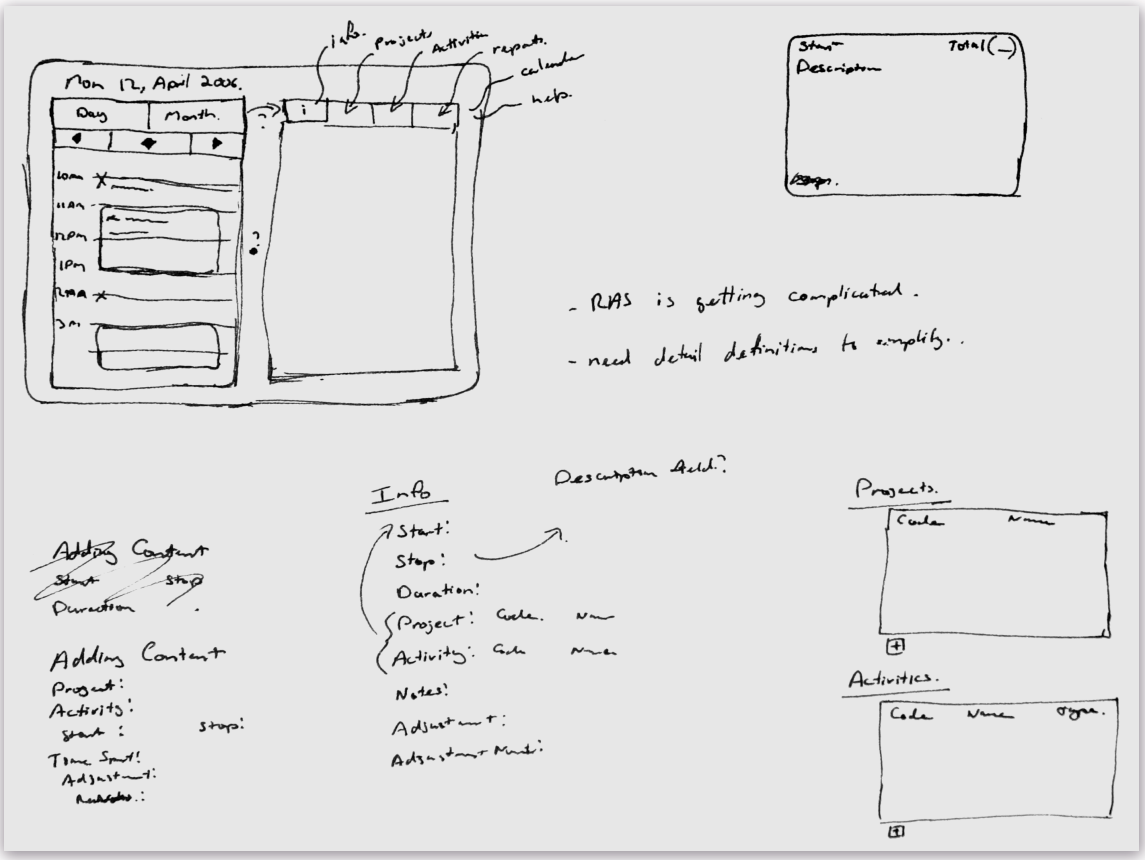
Appendix F.
Design Sketches

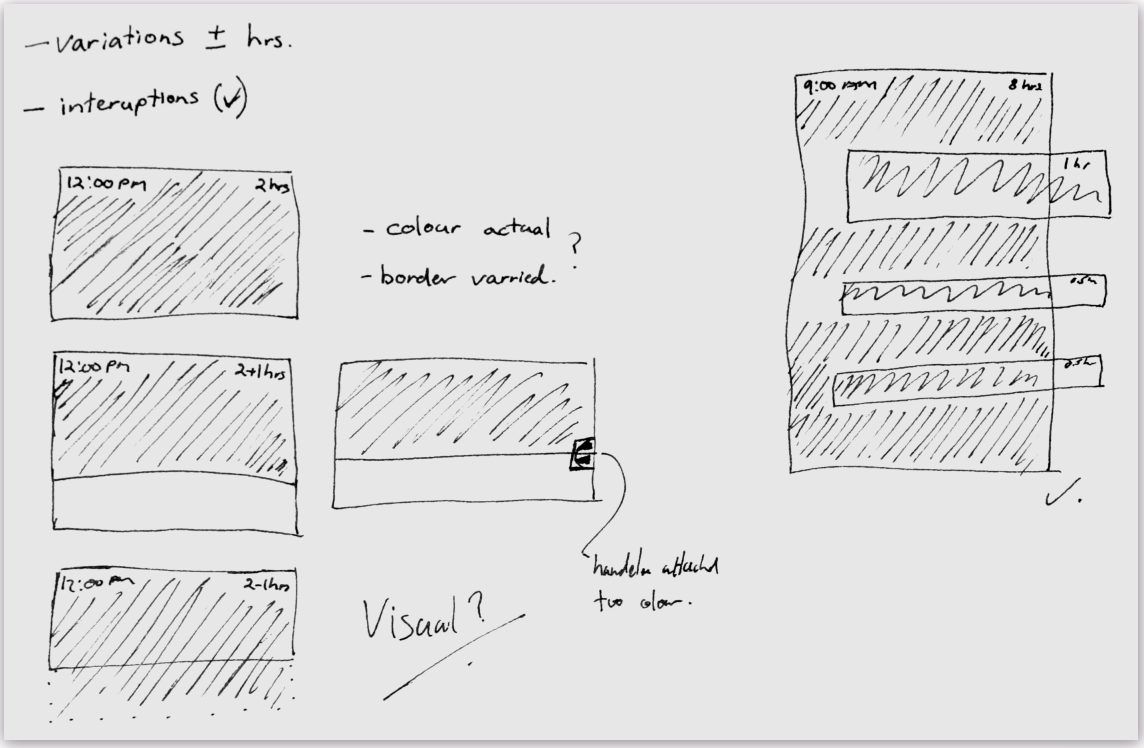
The following pages contain a sample of the sketches and notes that were made during the design process for the Time Notepad artefact. They are roughly in chronological order, but often sketches were returned to at a later time to try out new ideas or concepts. The sketches show some of the different concepts, large and small, that were worked with during the design process that lead to the versions shown in the prototype and the Quick Reference Guide in the following appendices.


My Time / My Day
Project
Project
Admin
Lunch
Project
- New Entry
- Delete Entry
- Start Now
- Stop Now
Last Project
New Project
Last 3 projects
Project :
Start :
Duration :
Stop :
Notes :
Tuesday 18th January.
Projects.


my Time
Monday 12 Jan
Projects
Calendar
Summary
75%
25%
Project
Activity
Notes:
project
project
project.
split.
adjustment.
resume.
start
coffee break
work
lunch
work
stop
new
pause
start stop break.
breaks.
Project.
Break.
- start new project
- resume project
- stop project
- start break
hm.
point band note.

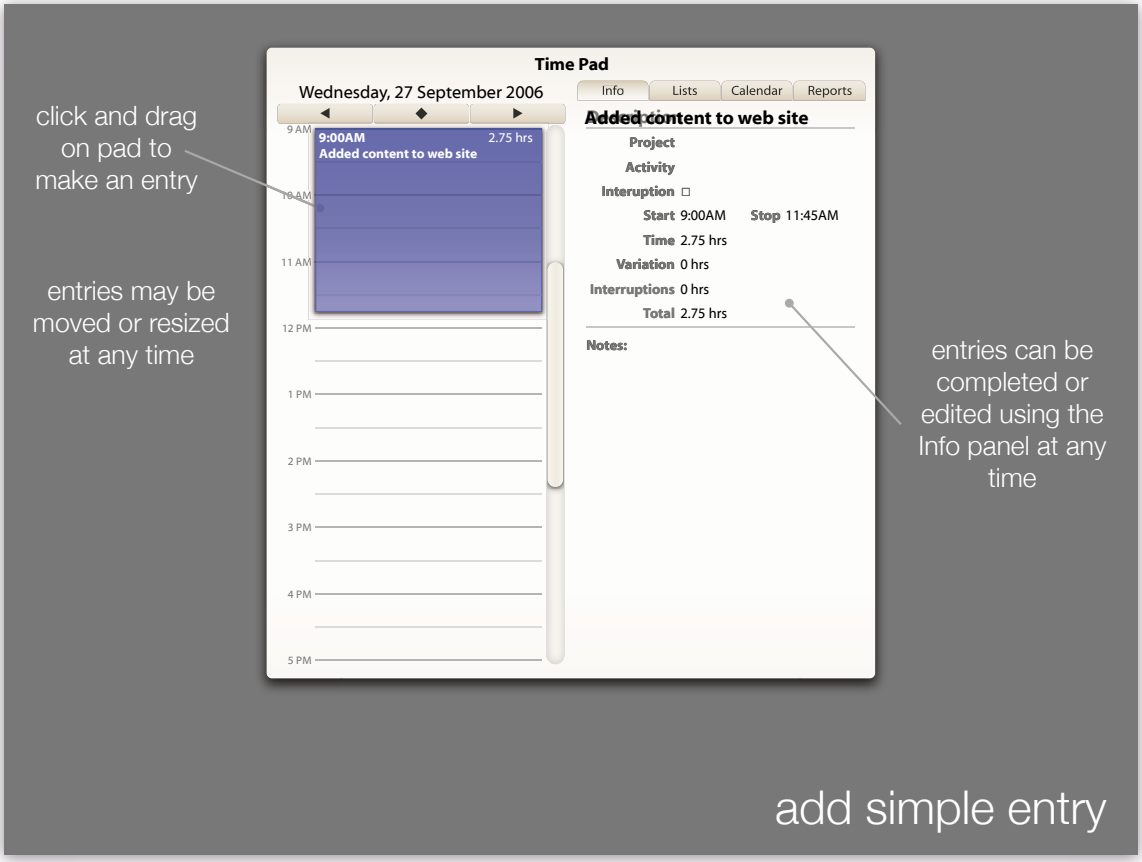

– visual days/date displays
– makes it easier to see gaps/problems.
– recording as you go doesn't suit visual
– but we can take notes.
(click-drag)
(double click)
Activity
Project
+ve and -ve variations?
User interface down
Insert.
Phone call
Start work.
?
Do we need an "add" button?
or
1Pm
12Am
1Am
2Am
or

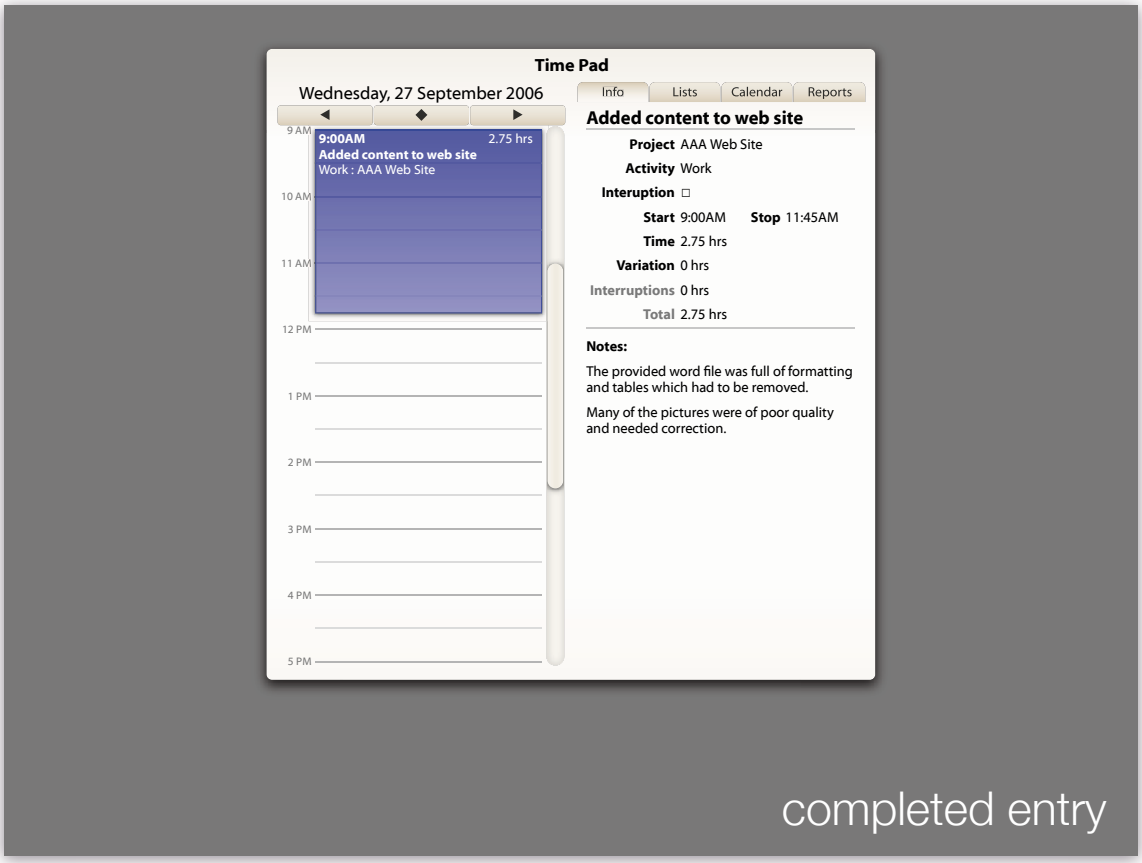

Info.
Projects
Activities
reports.
calendar
help.
Mon 12, April 200x.
Day
Month.
Start
Total(–)
Description
Stop.
– RAS is getting complicated.
– need detail definitions to simplify.
Adding Content
Start
Stop
Duration
Adding Content
Project:
Activity:
Start:
Stop:
Time Spent:
Adjustment:
Notes:
Info
Start:
Stop:
Duration:
Project: Code. Name
Activity: Code Name
Notes:
Adjustment:
Adjustment Mins:
Description Add?
Projects.
Code
Name
Activities.
Code
Name
Type.

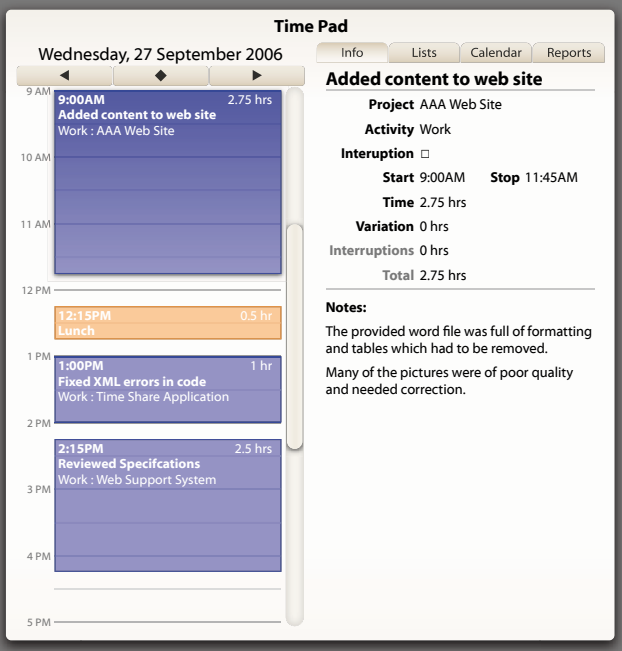

– variations ± hrs.
– interuptions (✓)
12:00 PM
2 hrs
- colour actual ?
- border varried.
12:00 PM
2+1 hrs
handels attached
two colour.
12:00 PM
2-1 hrs
Visual?
9:00 AM
8 hrs
1 hr
✓.

Appendix G.
Screens from Prototype

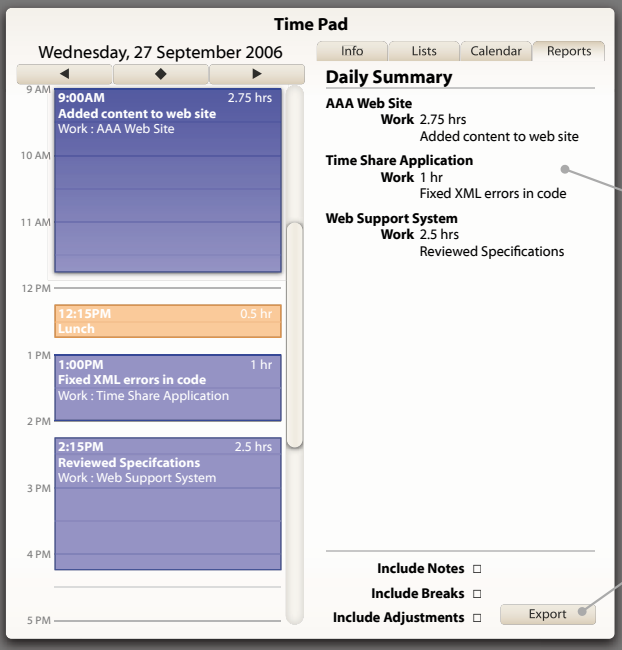
The following screens are taken from the "paper-prototype" that was used to gain user feedback on the design and specification of the Time Notepad (or Time Pad as it was called at the time). These screens were sequenced and animated to demonstrate certain features, and examples of how the Time Notepad could be used. They were presented on a small laptop computer, which I controlled as it recorded the discussion and comments of the user looking at the prototype.


click and drag on pad to make an entry
entries may be moved or resized at any time
Time Pad
Wednesday, 27 September 2006
Info
Lists
Calendar
Reports
9:00AM
2.75 hrs
Added content to web site
Project
Activity
Interuption
Start 9:00AM
Stop 11:45AM
Time 2.75 hrs
Variation 0 hrs
Interruptions 0 hrs
Total 2.75 hrs
Notes:
9 AM
10 AM
11 AM
12 PM
1 PM
2 PM
3 PM
4 PM
5 PM
entries can be completed or edited using the Info panel at any time
add simple entry


Time Pad
Wednesday, 27 September 2006
Info
Lists
Calendar
Reports
9:00AM
2.75 hrs
Added content to web site
Work : AAA Web Site
Added content to web site
Project AAA Web Site
Activity Work
Interuption
Start 9:00AM
Stop 11:45AM
Time 2.75 hrs
Variation 0 hrs
Interruptions 0 hrs
Total 2.75 hrs
Notes:
The provided word file was full of formatting and tables which had to be removed.
Many of the pictures were of poor quality and needed correction.
9 AM
10 AM
11 AM
12 PM
1 PM
2 PM
3 PM
4 PM
5 PM
completed entry



a full day's entries

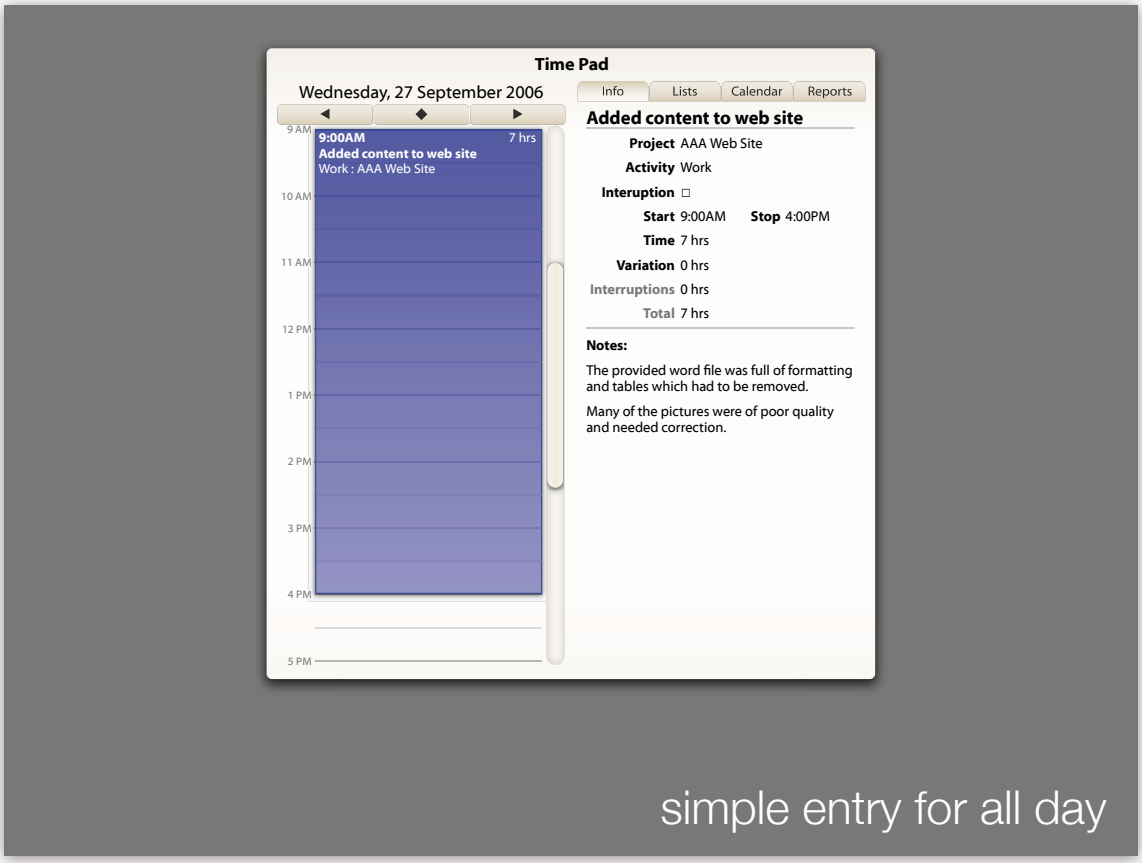


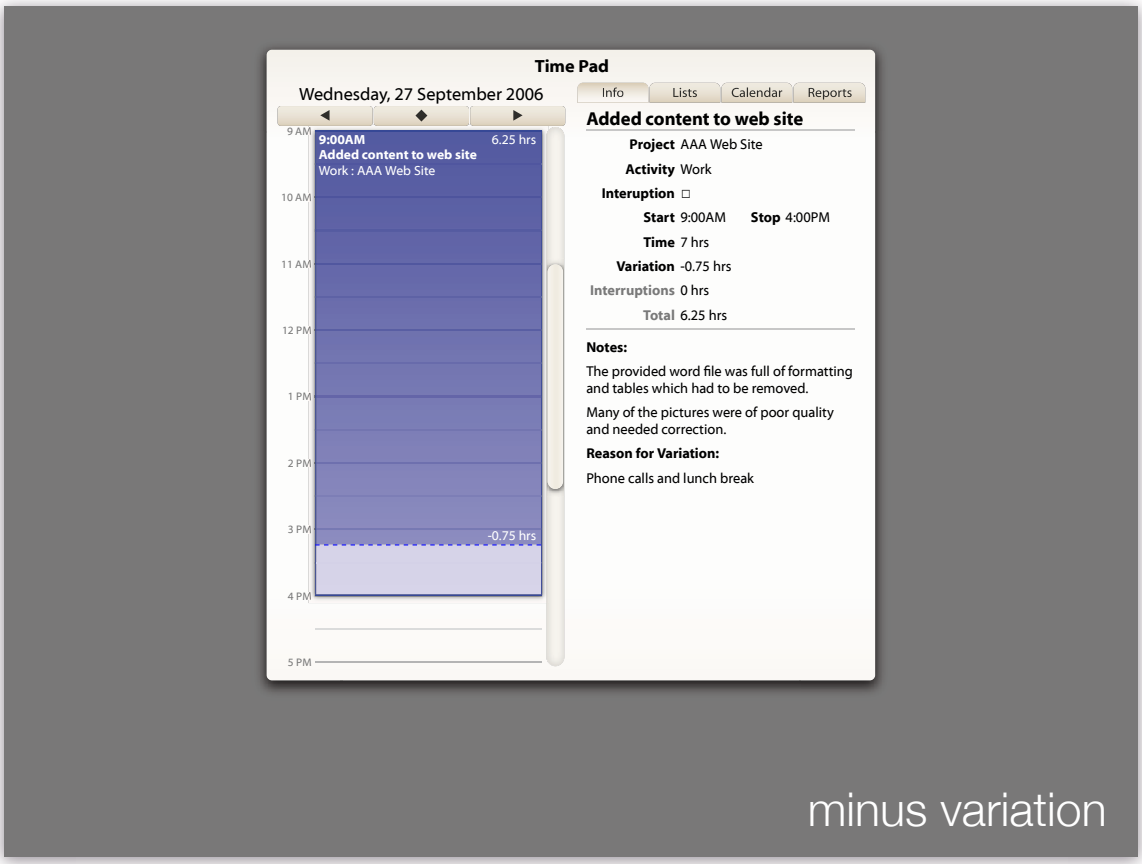
key data is summarised for entry into billing or project management system

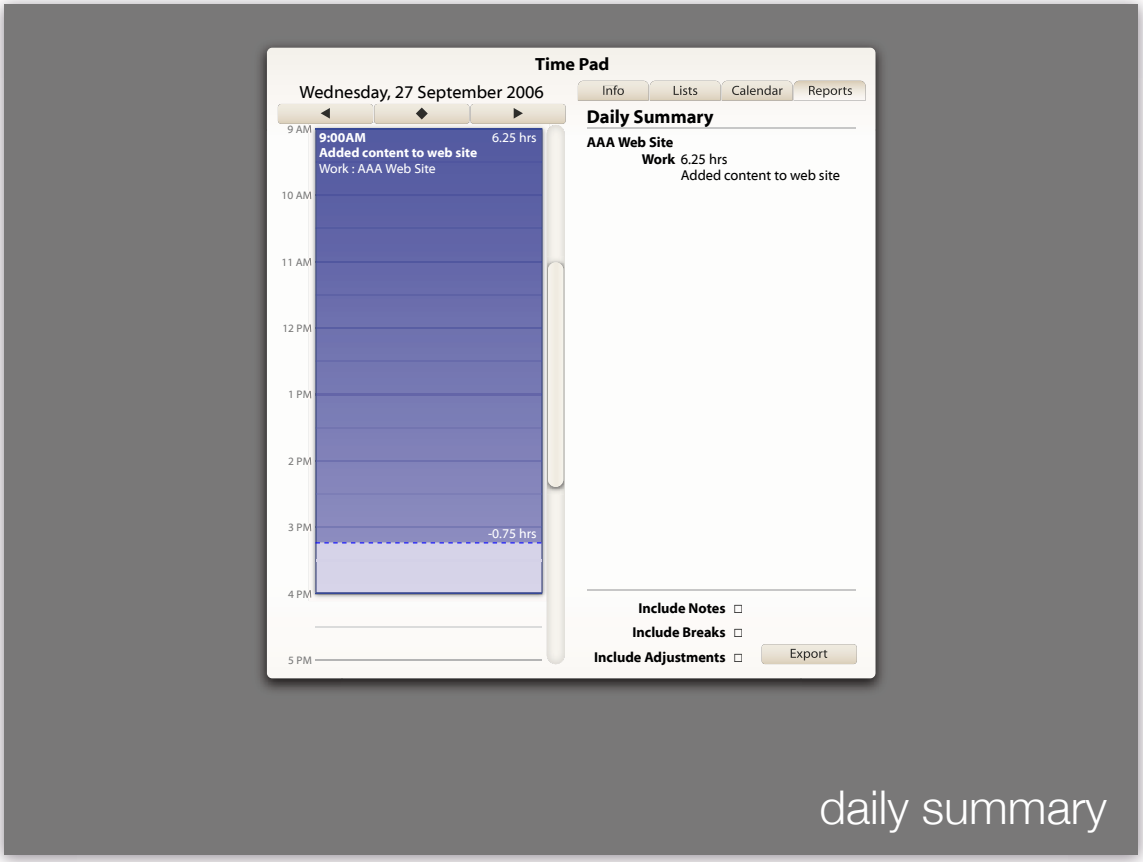
simple data exporting to support some systems

daily summary

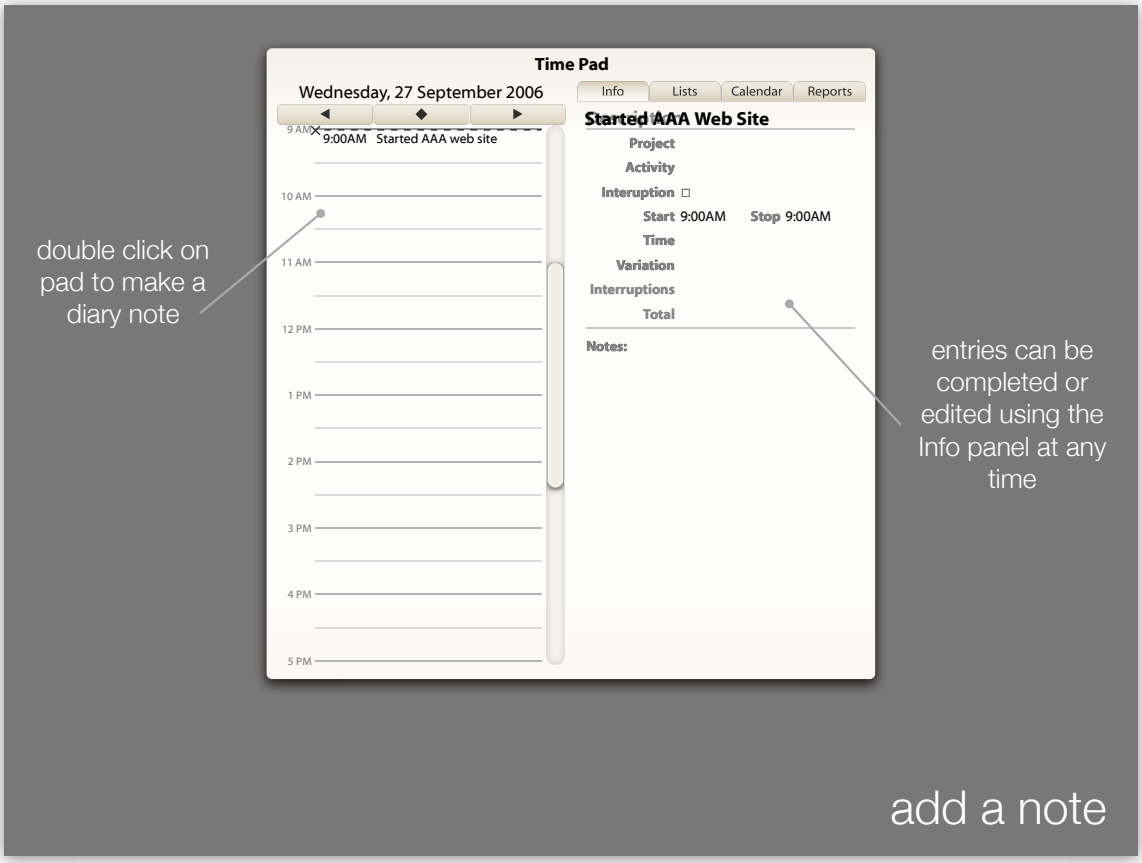
Example showing variations feature…

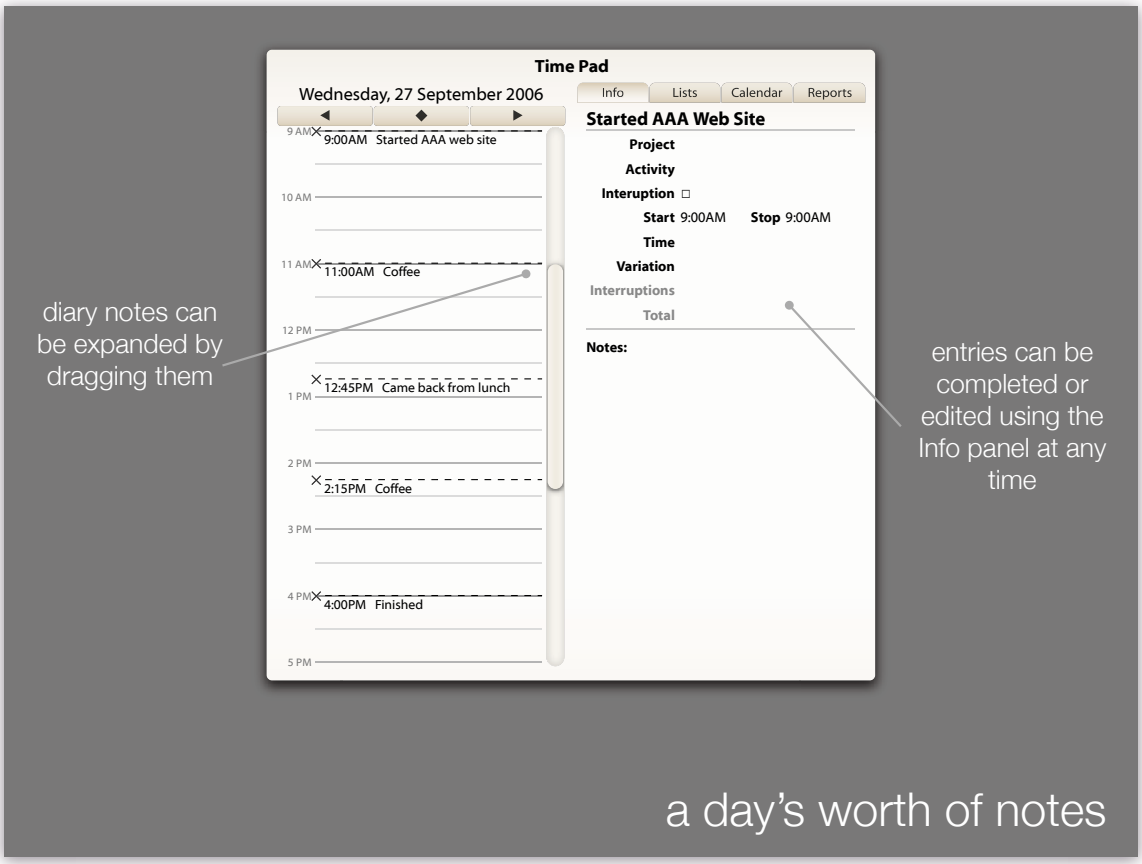


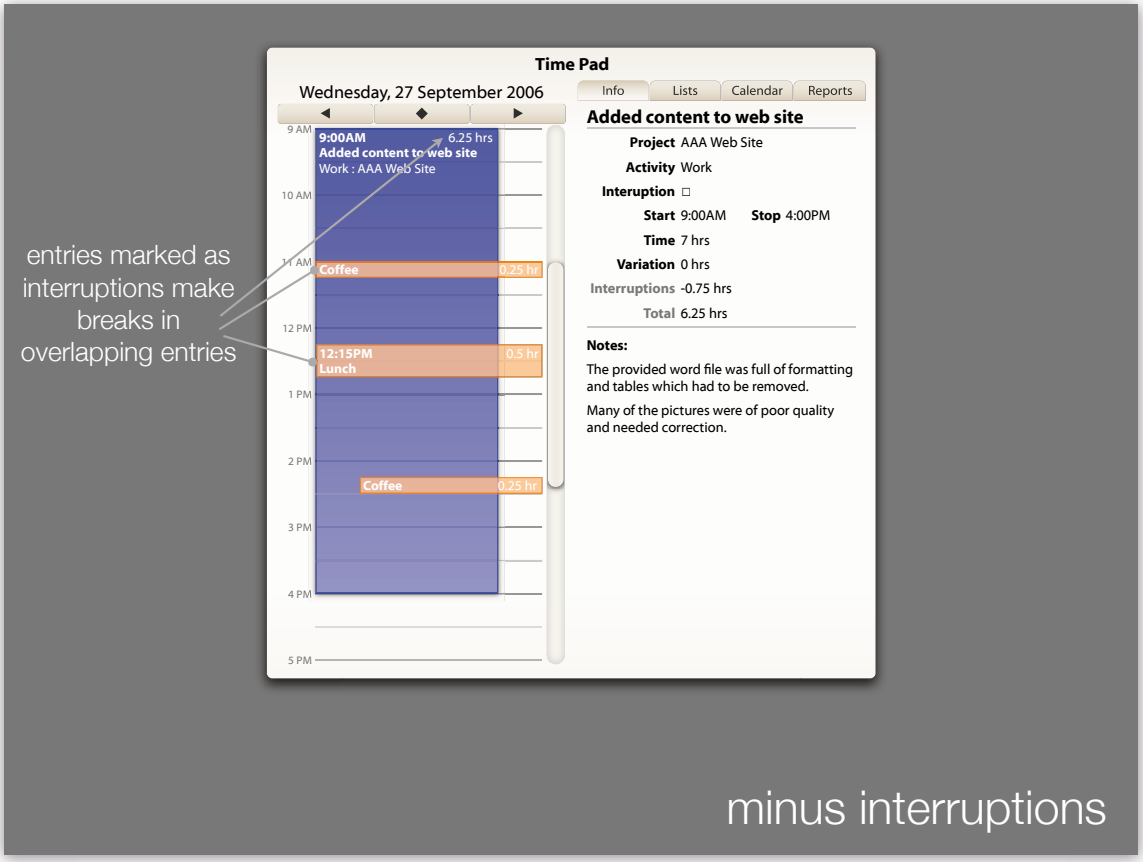


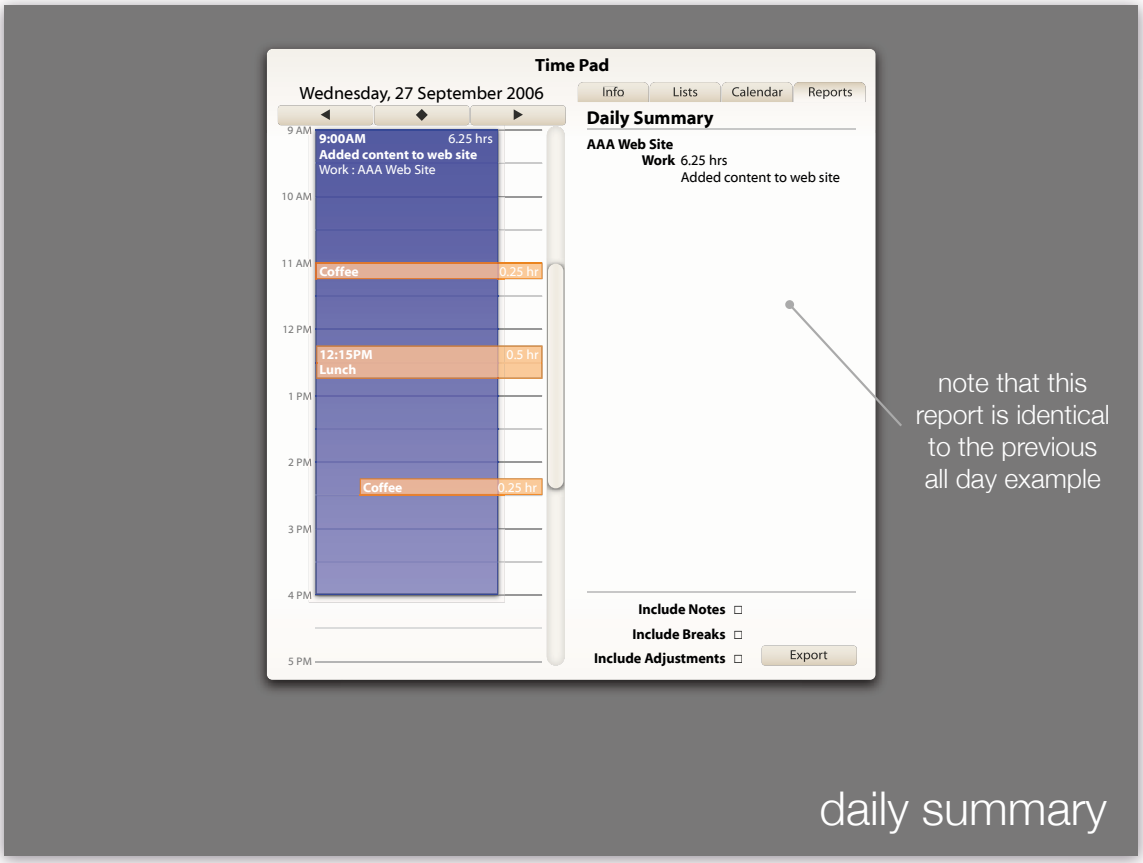

Time Pad
Wednesday, 27 September 2006
Info
Lists
Calendar
Reports
Daily Summary
AAA Web Site
Work 6.25 hrs
Added content to web site
9:00AM 6.25 hrs
Added content to web site
Work : AAA Web Site
-0.75 hrs
9 AM
10 AM
11 AM
12 PM
1 PM
2 PM
3 PM
4 PM
5 PM
Include Notes
Include Breaks
Include Adjustments
Export
daily summary

Example showing use of notes…






entries marked as interruptions make breaks in overlapping entries
Time Pad
Wednesday, 27 September 2006
Info
Lists
Calendar
Reports
Added content to web site
Project AAA Web Site
Activity Work
Interuption
Start 9:00AM
Stop 4:00PM
Time 7 hrs
Variation 0 hrs
Interruptions -0.75 hrs
Total 6.25 hrs
Notes:
The provided word file was full of formatting and tables which had to be removed.
Many of the pictures were of poor quality and needed correction.
9:00AM 6.25 hrs
Added content to web site
Work : AAA Web Site
Coffee 0.25 hr
12:15PM 0.5 hr
Lunch
Coffee 0.25 hr
9 AM
10 AM
11 AM
12 PM
1 PM
2 PM
3 PM
4 PM
5 PM
minus interruptions


Time Pad
Wednesday, 27 September 2006
Info
Lists
Calendar
Reports
Daily Summary
AAA Web Site
Work 6.25 hrs
Added content to web site
9:00AM 6.25 hrs
Added content to web site
Work : AAA Web Site
Coffee 0.25 hr
12:15PM 0.5 hr
Lunch
Coffee 0.25 hr
Include Notes
Include Breaks
Include Adjustments
Export
note that this report is identical to the previous all day example
daily summary

Appendix H.
Getting Started Guide

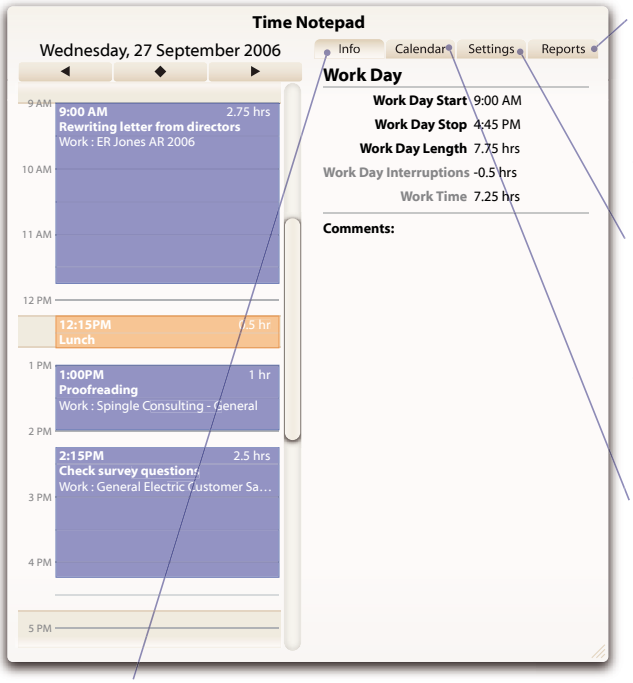
Rather than provide a detailed design specification for Time Notepad, I have decided to produce a "Getting Started Guide" which should give a better idea of how the software is intended to work. As well as showing the basic functions and usage, the guide tries to educate users in the efficient use of the Time Notepad through examples of use.

Time Notepad - Getting Started Guide

Time Notepad is a tool for helping you keep track of how you spend your working time. It is not a project management system, it is not an billing system, it does not monitor your activities. Time Notepad has been designed to help you quickly and accurately record the time you spend working on your various projects and tasks during the day.

The Day Panel displays your day just like a diary. Time Notepad will show today's date when opened. Use the arrows to see yesterday, tomorrow, or other recent days. Clicking the diamond will take you to today.

To make sure it is available at a moments notice Time Notepad has been built as a Dashboard Widget. This ensures Time Notepad is available exactly when you need it without taking up valuable screen real estate.



The Reports Panel summarises the work you have done during the day into an easy to read format, that can be copied, exported or submitted to other software.

The Settings Panel allows you to set many details for the Time Notepad. These include: a list of Projects you are working on; a list of Activities, or types of work, that you do; and your normal Work Day times and days.

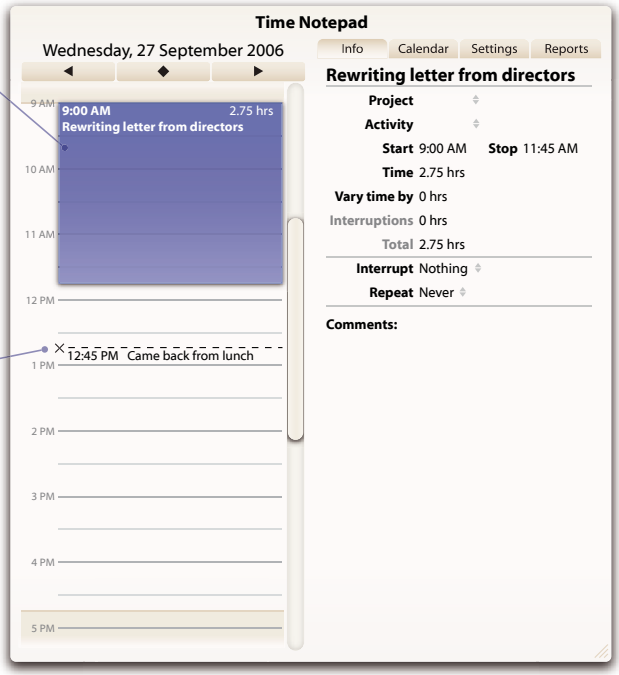
The Calendar Panel allows you to quickly navigate to a specific date without having to repeatedly click on the arrows in the Day Panel.

The Info Panel, shown, displays detailed information on what ever is selected in your day view. As nothing is selected, the Info panel is showing information about your Work Day. The Work Day allows you to record the time you spend at work aside from the time you spend working on projects. The work day is shown in the Day Panel as a white, non-shaded area. You can change the times for your Work Day by dragging its border in the Day Panel, or by changing the values in the Info Panel.

Making Entries & Notes

You can make an **Entry** by clicking-and-dragging on the Day Panel, and then typing in a short Description of what you did during that time. Entries can be moved by dragging them up or down, or you can change their length by dragging the top and bottom border of the entry.

You can make a **Note** by clicking once on the Day Panel, and then typing a short description. A Note is for a single point in time and has no duration. Notes are useful for when you start working on something and you don't know how long you will be working on it for. You can drag out a Note to make an Entry when you are ready.



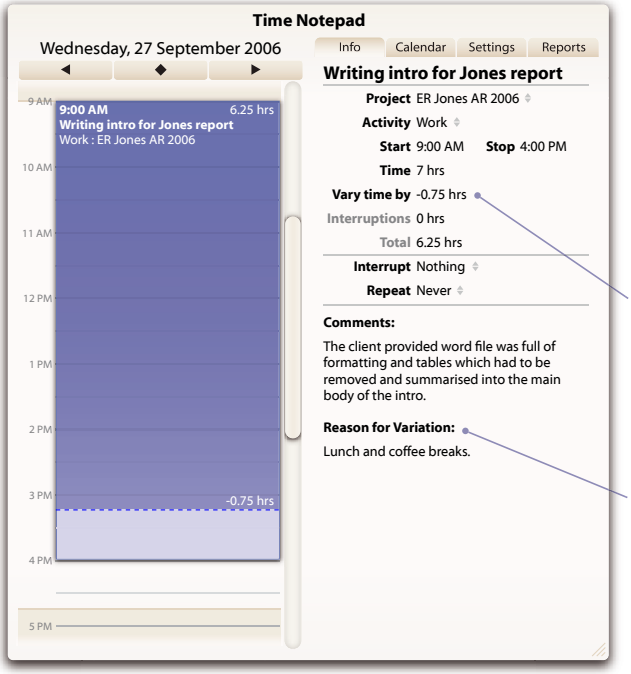
When you are ready, you can complete or edit an Entry or a Note by selecting it and filling in the required details in the Info Panel.

Projects and Activities can be chosen from a pop-up menu, or you can type in the first few characters of the name and the field will automatically fill in the rest of the name for you. If it is not in the list then you can type it's full name and it will be added to the Projects or Activities lists for you.

As well as a Description for each entry you can add detailed Comments about the work you did in the bottom of the Info Panel.

Making a Variation

Time Notepad is designed to make accurate records of how you use your time. Sometimes you may need to change these times – you may have had a break, needed to learn something, or you're just having a slow day. Rather than changing an Entry and losing an accurate record of your day, Time Notepad allows you to Vary an Entry's time. These Variations can be negative (reducing the Entry Time) or positive (increasing Entry Time).

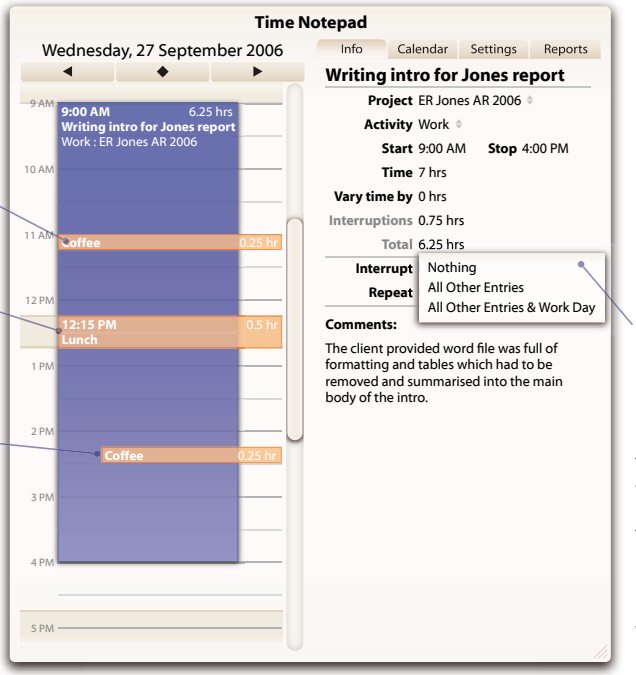


You can Vary an Entry by entering a positive or negative number into the **Vary time by** field.

When you Vary an Entry you have the option of making a specific Comment for the Variation. In this example this person worked most of the day on one report. They have made a single Entry for this, with a small variation to allow for a lunch and coffee breaks.

Interrupting Other Entries

When using Time Notepad, two Entries which overlap the same period of time have no effect on each other. There may be times that you want one of Entry to cancel out the other one. For these cases Time Notepad allows you to set an Entry to Interrupt other Entries. Entries can also be set to Interrupt your Work Day.



Interrupts other Entries.

Interrupts other Entries and the Work Day.

Does not Interrupt.

Interrupt pop-up menu.

This example represents the same work day as the example given above. The end result on the main Entry is the same in both examples (6.25 hours), one through using Variations, and one through using Interruptions.

Using Time Notepad Efficiently

The key ideas behind the design of the Time Notepad were…

- To reduce the time you spend recording your time use.
- To improve the accuracy of the records you make.
- To provide you with an accurate picture of your time use, and the efficiency of your time use.

While a lot of work has gone into making sure that Time Notepad can meet these objectives, it is still possible to use the system inefficiently or ineffectively. The following tips will help you get started on the right path to using Time Notepad efficiently.

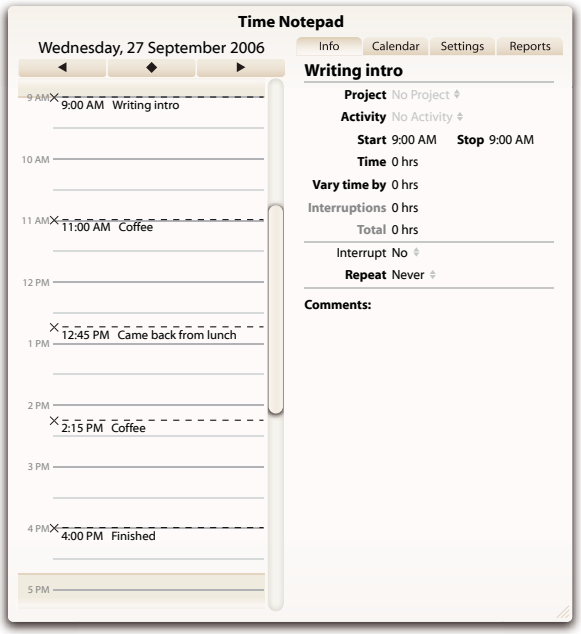
Sketching out your day

Many people complete their time sheets at the end of the day (or the next day) out of habit or simply because they forgot to do it sooner. Remember that Time Notepad is very flexible in how you enter information, use this flexibility to sketch out your day…

- Start by quickly making the Entries you remember easily – just enter a short description then come back and fill them in later.
- You should now be able to see any gaps in your day that you might have forgotten about. Review your emails, diary, call records etc. to help you remember what you did during these times.
- Once you are happy that your day looks right, go through and complete each Entry filling in all the details you require.

Get in the habit of making notes

Trying to work out and remember what you did during the day (or yesterday) is a time consuming task that you're unlikely to get right most of the time. This is the reason that Time Notepad includes Notes as well as Entries. You can make as many Notes as you want, very quickly and very simply, and they don't have any effect on your time use data until you make them into an Entry.



Try to make frequent and regular notes in Time Notepad as you go through your day. Making a Note takes only a few seconds, but can save you many minutes at the end of the day. Once you get in the habit of making Notes you will discover that this feature is so powerful it works anywhere, when you're on site, travelling, or in meetings you can make notes in your diary or notepad that you can refer to later when you are back at your computer. (Of course these notes are not quite as flexible as Notes made directly in to Time Notepad, but they'll save you almost as much time.)

At the end of the day, you can then make these Notes into Entries, following the same process as above.

Variations help keep track

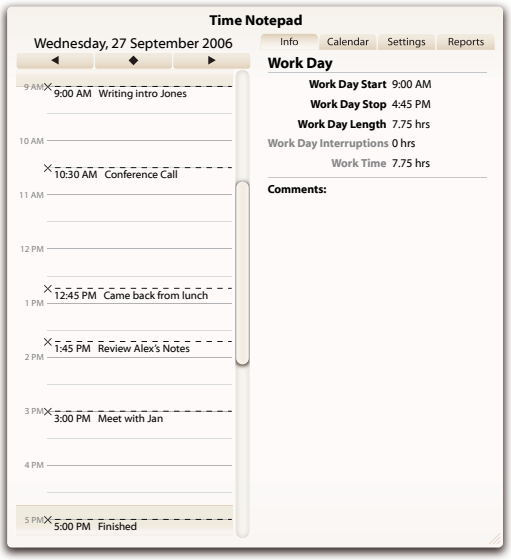
Once you've got to the end of the day you may see that you have spent six hours working on a project when you only quoted four to your client. Looking back over the work you don't feel you can justify the extra two hours to your client. Rather than taking two hours off the Entry by changing the Entry's Stop time, enter "-2" in the **Vary time by** field for the Entry. Why?

If you change the Stop time, you will have two hours unaccounted for in your day. You might remember why this is the case now, but you might forget in a few days time. Having a record of the change makes it easy for you to see and remember when your boss asks you about it at a later date.

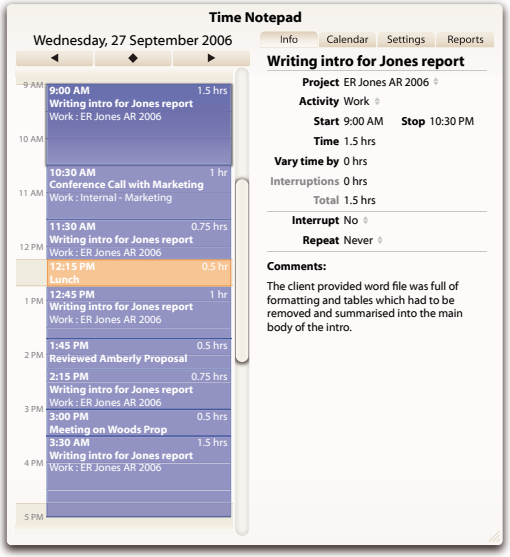
Another advantage of keeping this information, is that you may notice that you are regularly having to vary your Entries. This would be a sign that you are working inefficiently and need to speed up, or that you are regularly underestimating the time you take to do tasks and you need to adjust the way you make your estimates.

Interrupt to save time

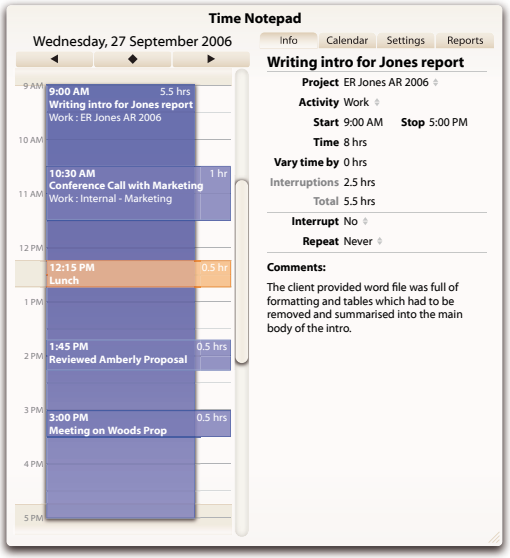
Some days are nothing but interruptions. You might start your day and end your day working on the same project, but in between you may have worked on two other projects, participated in a conference call and had a lunch break. Because you're getting the hang of Time Notepad you've made lots of notes and you're day may look like this…



Now one way of expanding all of these notes is to make lots of small entries for all your projects. This looks okay, but you've had to double enter a lot of data…



A much faster way is to use interruptions to make your data entry much simpler…



Find your own way

Don't do it just because we say so. We think these are good ways to work, but maybe you think or work differently, so play around with the Time Notepad, try out our ideas and find your own way to work.

Also remember that Time Notepad has lots of features to meet the needs of lots of different types of workers and organisations. Don't feel that you have to use all the fields and features, if they are useful to you then use them, if not then leave them be.

One last thing, if you like it or hate it please feel free to share your experiences of using Time Notepad with us. Your experiences are what help us make Time Notepad better in future.

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