INFORMATION BEHAVIOUR

IN DESIGN

A Thesis Submitted for the Degree of Doctor of Philosophy

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ABSTRACT

Designers draw on a significant volume and range of information throughout the design process. This could include information on people, materials, markets, processes, etc. However, not all this information is effectively communicated to and used by designers. In order to provide designers with information that is useful, useable and engaging for them, it is important to understand why designers use information, what information they use and when and how they use it. This will be collectively referred to as 'information behaviour' in this thesis.

There is currently a lack of a holistic understanding of designers' information behaviour. Through developing a framework for investigation, analysis and reflection on designers' use and requirements of information, this research aims to provide a better understanding of information behaviour in design, leading to a systematic way to address the key dimensions of information used in a design process. For this purpose, the research focuses on 'practicing designers' as key users of information in the real-world practice of design and 'people information' as a major type of information used during the design process.

An initial framework for addressing key dimensions of information used in the design process is outlined through the analysis and synthesis of relevant literature. The framework is then evaluated and refined through four complementary studies: an interview and questionnaire administered to nine design companies; observation of a design team in a real-world design project; observation of three teams through a design competition; and a survey of designers and design researchers. The outcomes of the studies lead to a refined version of the information framework that includes seven key dimensions and details designers' behaviour in regard to 'purpose', 'source', 'format', 'type', 'attributes', 'stage' and 'intensity' of people information they use.

The research conducted with designers leads to an enhanced understanding of their information behaviour with respect to the seven key dimensions. A new information framework has been created and evaluated; and it is argued that it can be used as a research and education tool to investigate and analyse information used during core stages of a design process. The framework can also assist developers of information tools to make informed decisions on what, how and when to communicate information to designers, ensuring that this information is delivered in a way which has maximum impact on the design process.

DECLARATION

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ACKNOWLEDGEMENTS

"I want to stand as close to the edge as I can, without going over. Out on the edge you see all kinds of things you can't see from the centre."

Kurt Vonnegut (1922-2007)

In completing this long journey I am grateful to many people; individuals who have informed, inspired and supported me and more importantly, made me who I am. I have been extremely lucky and privileged to be surrounded by great people who are passionate about what they do and do it well.

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I would like to dedicate this thesis to my mother and father for whom my love expands and deepens as I go through life. Words cannot do justice. I am forever indebted.

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Chapter One

Introduction

"The experience and understanding that we bring to the research, and which we develop during it, are an important ingredient of the research."

Colin Robson (2003, p.xvi)

1.1 Overview and research motivation

'Information behaviour' is defined as "how people need, seek, give and use information in different contexts" (Pettigrew *et al.*, 2001, p.44). The many technological, social and cultural changes and developments in recent decades have highlighted the role and importance of information and information behaviour. The increased volume and diversity of information together with improved access to it have brought up terms such as information society (Webster, 2006; Kidd, 2007) and consequently information overload (Hwang and Lin, 1999). This has subsequently increased the importance of study of information behaviour and the significance of understanding the user of information when designing and developing information systems, products and services (Hepworth, 2007).

In design, similar to other fields, designers draw on a significant volume and range of information throughout their design process. This could include information on people, materials, markets, processes, etc. This information is collectively called 'design information' and is described as referring to features of design including functions, material selections, process of manufacturing, etc. (Li and Ramani, 2007). A review of the nature of design practice, current uptake of design information, and some emerging areas in design, identifies both opportunities and problems in regards to designers' information behaviour. These key issues and emerging opportunities, either way, highlight the need for study of information behaviour in design and underline the important role this could play in facilitating better uptake of design information and improving current design practices. Some of these challenges and opportunities include:

❖ **Designerly ways of knowing**

In his book 'Designerly Ways of Knowing', Cross (2006) makes the case for building a network of arguments, articulation and evidence for the particular nature of design behaviour and activity. He argues "If we want to develop a robust, independent discipline of design - rather than let design be subsumed within paradigms of science or the arts - we need to make evidence for 'designerly ways of knowing'." (Cross, 2006, p.3)

❖ **Limited understanding of designerly ways of knowing**

A conventional lack of interest in the study of designers' information behaviour and their ways of knowing and doing has been noticeable. This could be due to the fact that in design, focus has typically been on the 'end-product' to be delivered by the designers, rather than the 'process' they went through. This brings up the notion of 'Black-Boxing' (Jones, 1970), describing lack of knowledge of the design process, focus on the 'input' and 'output', and limited understanding of designers' information behaviour.

❖ **Emerging design approaches and abundance of information**

New design approaches such as people-centred design (Wood, 1990; Darses and Wolff, 2006), inclusive design (Keates and Clarkson, 2004), and user-led innovation (Dibben and Bartlett, 2001) have emerged. These design approaches bring with them a wealth of new and existing design information (specifically on people) that needs to be effectively communicated to designers, if they are to be successfully adopted. This highlights the need to better communicate not only the existing but new and diverse sets of design information to designers.

- **Growing number of information tools aimed at designers**

The ever-increasing volume, range and diversity of design information and the growing demand for better ways of using it in order to facilitate existing and new design approaches, has led to more information systems and tools being designed and developed aimed at designers. Such information tools have a broad range and format including books, handbooks, online tools, CD packages, cardsets, etc.

- **Limited use of information tools and resources in design**

Despite all the design information available, there is evidence that this information is not effectively used by designers in practice (Mieczakowski *et al.*, 2010; Law *et al.*, 2008; Burns *et al.*, 1997). Also, various studies of designers show the use of design tools and resources is currently limited and not effective within the design industry (Green and Jordan, 1999; Restrepo and Christiaans, 2003; McGinley and Dong, 2009). The minimal use of information tools and resources by designers could have various reasons. Study of designers' information behaviour would be one first step to address these issues.

A brief review of major design challenges and opportunities highlighted the need for and importance of studying information behaviour in design. However, there is currently a lack of a holistic and methodical understanding of designers' information behaviour. Therefore this research is carried out to provide a structured understanding of information behaviour in design, leading to a systematic way for investigation, analysis and reflection on designers' use and requirements of information. It is hoped that through this, the limited understanding of designerly ways of knowing is improved, new and existing design approaches are better supported and their uptake by designers is facilitated, and the design and development of new information tools is better informed.

1.2 Scope of research

In studying designers' information behaviour, this research specifically focuses on a number of areas and aspects as listed below.

❖ **Industrial design and product design**

Design is a wide-ranging term that could encompass many different disciplines. In this research, two specific design disciplines i.e. industrial design and product design have been focused upon.

❖ **Practicing designers**

Student designers and design practitioners have different needs, attitudes and criteria when approaching a design task (Ahmed, 2003) and thus different information behaviour. This research focuses on practicing (as opposed to student) designers as key users of information in the real-world practice of design.

❖ **People information**

Design information encompasses various types of information. This research focuses on 'people information' as a major type of information used throughout the design process. In this thesis, people information is broadly defined as 'all types of information that help designers better understand people and their context'.

1.3 Research aim and objectives

This research aims to both provide a structure for investigation and analysis of information behaviour in design and to detail identified aspects of designers' information behaviour throughout a design process. The research objectives are as below:

- To develop a structure for better understanding of information behaviour.
- To evaluate and refine the developed structure through research.
- To detail the developed structure in order to shed light on designers' information behaviour throughout a design process.

1.4 Thesis structure

The eight chapters of the thesis are summarised below:

❖ **Chapter One - Introduction**

Provides a brief overview of research and its motivation, scope, aims and objectives, and overview of thesis structure.

❖ **Chapter Two - Literature Analysis and Synthesis**

Provides the background to the research through analysis and synthesis of relevant literature in two fields of information sciences and design. Based on this, the 'design context' and 'initial information framework' for information behaviour in design are outlined.

❖ **Chapter Three - Research Methodology**

Describes how, based on a critical review, the research methodology and strategy are adopted for carrying out the research; outlines a set of triangulated research methods and a series of studies planned to be carried out.

❖ **Chapter Four - Interviews with Designers**

Refines, evaluates and details the initial information framework using interviews with designers and ranking questionnaire as the first of three triangulated research methods.

❖ **Chapter Five - Observation of Designers I**

Reports observation of a team of designers in a real-world design project and further refines, evaluates and details the information framework through 'marginal participant' observation as the second of three research methods.

❖ **Chapter Six - Observation of Designers II**

Reports observation of three teams of designers in a real-world design challenge and further refines, evaluates and details the information framework through 'recognised outsider' observation as the second of triangulated research methods.

❖ **Chapter Seven - Survey with Designers and Design Researchers**

Describes a survey of designers and design researchers carried out with over 66 respondents, and refines, evaluates and details the information framework through the survey as the last of the three research methods.

- **Chapter Eight - Conclusion and Further work**

Discusses and summarises the key findings from the four studies, reviews research contributions and limitations, and suggests further work.

Figure 1.1 presents the structure of this thesis.

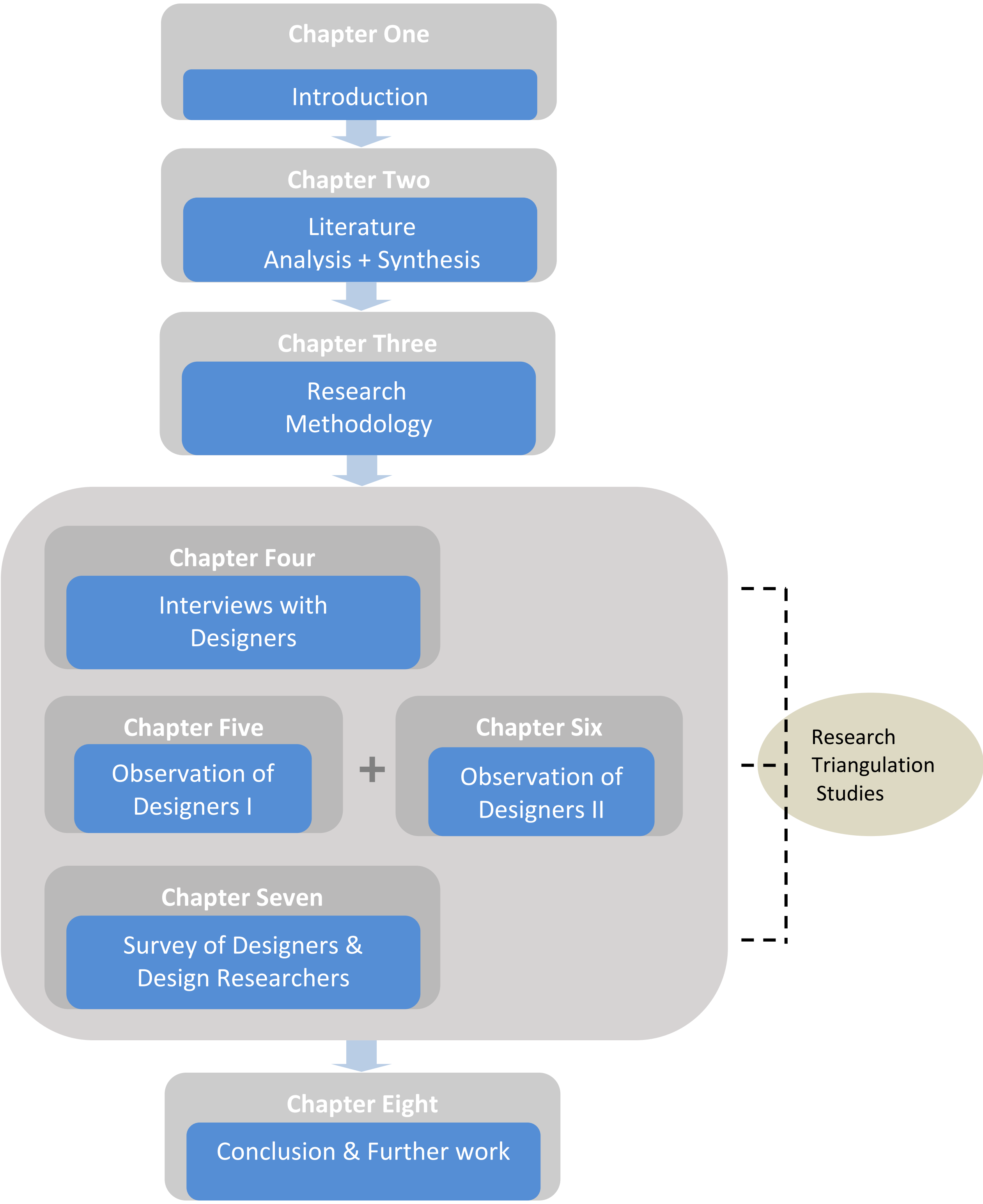


Figure 1.1 Thesis structure

Chapter Two

Literature Analysis and Synthesis

"What you don't know has power over you; knowing it brings it under your control, and makes it subject to your choice. Ignorance makes real choice impossible."

Abraham Maslow (1963, p.116)

Chapter one provided a general overview of the motivation and scope of the research and its aim and objectives. This chapter provides the background to the research through analysis and synthesis of relevant literature.

After revisiting some definitions fundamental to the research, the contexts for information in design are discussed. A critical overview of the models, theories, contexts and dimensions of 'information behaviour' in the fields of Library and Information Sciences (as the nesting field) and Design is then carried out. Through analysis, gaps in existing understanding, study and investigation of information behaviour in design are identified. Through synthesis of relevant literature in these two fields, the 'design context' and 'initial information framework' for information behaviour in design are outlined. The initial framework is then to be refined and evaluated through a series of design studies. In doing so, the research focuses on people information and practicing designers. The structure of the chapter is illustrated in figure 2.0.

Figure 2.0 Chapter Two structure

[2] Library and Information Sciences
[3] Information Behaviour

2.1 Introduction

Understanding the user of information is becoming increasingly important when designing and developing information systems, products and services (Hepworth, 2007). This is due to many technological and societal shifts and progress made in recent decades, bringing up terms such as *information society* (Masuda, 1980; Webster, 2006; Kidd, 2007), *information overload* (Schick *et al.,* 1990; Hwang and Lin, 1999), *people-centred* (Linney, 1995; Eade, 1997; Frascara, 2002), *customisation* (Kelly, 1996; Da Silveira *et al.*, 2001; Lampel and Mintzberg, 1996) and *inclusion* (Minow, 1990; Atkinson *et al.*, 2003; Keates and Clarkson, 2004). In an extensive review of recent shifts and approaches to studies of information behaviour, Hepworth (2007) highlights an increasing 'people-centred' as opposed to 'system-centred' approach to design and development of information systems and products, and clarifies its strong links with the understanding of people information behaviour and how it has evolved.

Understanding the users of information is closely linked with understanding of their information behaviour; this would include their information needs, seeking and information use. The outcome of research into people's information behaviour could be information products, services and tools that are specifically aimed and designed for them or sets of guidelines and recommendations related to the 'what' and 'how' of communicating information. This has been the subject of investigation by both practitioners and academics in various fields. The library and information sciences field is the frontier of research in this area. Many studies of information behaviour have addressed different professionals, communities or specific groups. Hepworth (2007) suggests a number of classifications including social workers (Wilson *et al.*, 1979), scientists (Bichteler and Ward, 1989; Palmer, 1991) and engineers (Fidel and Green, 2004; Pinelli, 1991), and business people (Choo, 1994). Computer science and information systems and also engineering have made major contributions to the research in this area. In design, the breadth and depth of such investigations are considerably less, with few studies conducted on designers' information behaviour as users of information.

Information behaviour could be examined not only within the occupational, but also the organisational and social settings of the users. Choo and Auster (1993, p.284) argue that "information needs vary according to users' membership in professional or social groups, their demographic backgrounds, and the specific requirements of the task they are performing". Thus, apart from the occupational approach to studying of information behaviour, it could also be studied according to the 'role' and 'demographic group' of information users. In this thesis, the study of information behaviour has an occupational approach in that it focuses on designers as one community of common practice.

Information behaviour captures varied aspects. There are various definitions of information behaviour, one of the most referred to is Wilson's encapsulation that "information behaviour is the totality of human behaviour in relation to sources and channels of information, including both active and passive information seeking, and information use" (1999, p.249). Building on Wilson's definition, Pettigrew *et al.*, (2001, p.44) suggest a simplified explanation of information behaviour: "How people need, seek, give and use information in different contexts." Wilson's description also "includes face-to-face communication with others, as well as the passive reception of information" (1999, p.249). Clarifying passive information reception, Wilson gives the example of watching TV advertisements while there is no intent or purpose to actually do anything based on the information received. In this thesis, Pettigrew's (2001) definition of information behaviour is adopted and active information behaviour is focused upon.

2.2 Design information and design process

In both fields of engineering and industrial design, terms such as design problem or input, design process, design output, design activity, designer and design information have been widely used (Pahl and Beitz, 1988; Pugh, 1997; Cross, 2000, Howard *et al.*, 2007). Prior to addressing information behaviour in design and the role and significance of its study, some of these definitions fundamental to this research are briefly reviewed.

2.2.1 Design information

Design information is generally defined as all the information that is generated, used, referred to, consulted with or transformed during a design process (Shooter *et al.*, 2000; Baya *et al.,* 1992) and includes various types described by researchers in different ways. Lim and Sato (2001) argue that design information includes user studies information, prototype models and also design concepts and scenarios. Shooter *et al.* (2000) argue that design information covers three major types including information on *form*, *function* and *behaviour*. Li and Ramani (2007, p.138) describe design information as referring to the design "specifications, such as functions, performances, material selections, manufacturing process, environments and so forth".

Figure 2.1 (Shooter *et al.,* 2000) shows the increasing amount of design information as it accumulates with the progress of the design process. It demonstrates the reverse connection between 'design information' and 'design space' as design information increases throughout the design process and the design space shrinks as the move from the fuzzy front end - with lots of options - to a finalised design happens. Through this model, Shooter *et al.* (2000) highlight the importance and the challenge in characterising the large volume and diversity of design information in order to "facilitate its capture, cataloguing and retrieval so as to support the design process" (Shooter *et al.,* 2000, p.181).

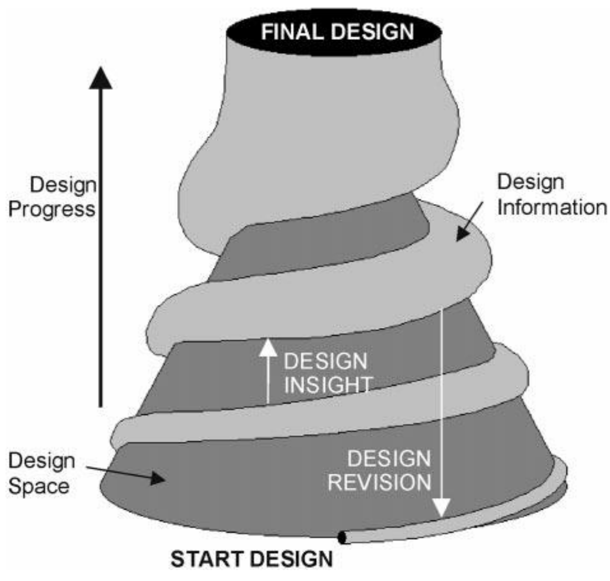


Figure 2.1 Design information development (Shooter *et al.*, 2000)

As the key driver for design specifications, design information has a direct impact on defining the end product and most importantly influencing the generative phase of design and creativity throughout the design process. Bouchard *et al.* (2009) argue the increasing importance of design information is "demonstrated by studies of the design process, information processing, design expertise, sources of inspiration, Kansei Engineering and trend boards" (Bouchard *et al.*, 2009, p.3). Specifically, in the early stages of the design process, diversity and richness of design information can help both define the context in which the end-product will be used and stimulate a creative approach towards the design process (Eckert and Stacy, 2000; Westerman and Kaur, 2007). Consequently, it could be argued that better provision and use of design information could result in more informed and inspired design solutions. Moreover, there are a number of fundamental and emerging contexts in design that reinforce the importance of design information and make the key role it plays in the current practice of design even more significant. Some of these key and emerging contexts are discussed in Section 2.3.

❖ **Data, information and knowledge in design**

There is an abundance of data, information and knowledge in design. However, these terms are quite unclear in their definitions. First, the differences between data, information and knowledge in design need to be clarified as each could focus on and convey certain areas and aspects of design. Ahmed (2000) uses the simple and clear definition of data by Jones as "symbols that represent, describe or record states of the world" (Jones, 1995, p.64). Information is then defined as data that has been organised or given a structure, i.e. data placed within a context. Data can be in numerical form or other formats, such as recorded user stories. Books, websites, conferences, and networks are all vehicles for information. Commonly referred to as 'DIKW hierarchy', Ackoff's (1989) hierarchical framework of information consists of four key elements of Data, Information, Knowledge and Wisdom. It is a fundamental and widely recognised and used framework in information sciences literature (Wodehouse and Ion, 2010) as it helps address the elusive nature of the terms in a relative and comparative approach. In a review of current taxonomies and approaches to information in design, Wodehouse and Ion (2010, p.54) defined the four fundamental constructs of DIKW:

“Data: observable properties of objects, events and their environment.

Information: inferred from data, containing descriptions of how data can be used.

Knowledge: the abstraction, generalisation and application of information.

Wisdom: judgment and the ability to review the other levels critically.”

Overall, in studying various facets of information behaviour, the focus is mainly on information and data, rarely on knowledge and hardly ever wisdom (Rowley, 2007; Buckland, 1991; Wilson, 2000). The DIKW hierarchy has been adopted in the design field as well, in order to explain the association and connection amongst data, information and knowledge and their transformation throughout the design process. Similar to information behaviour studies, the focus of design studies is on information and knowledge. These design studies reflect on design practice and how information is used and shared by designers working on a particular design problem (Wodehouse and Ion, 2010). Figure 2.2 shows Wodehouse and Ion’s adaption of DIKW hierarchy based on Sherdroff’s (1999) classification of ‘location’ and ‘context’ for concept design. Integrating the information behaviour and design studies approaches, the key aspect and focus of this research is design ‘information’.

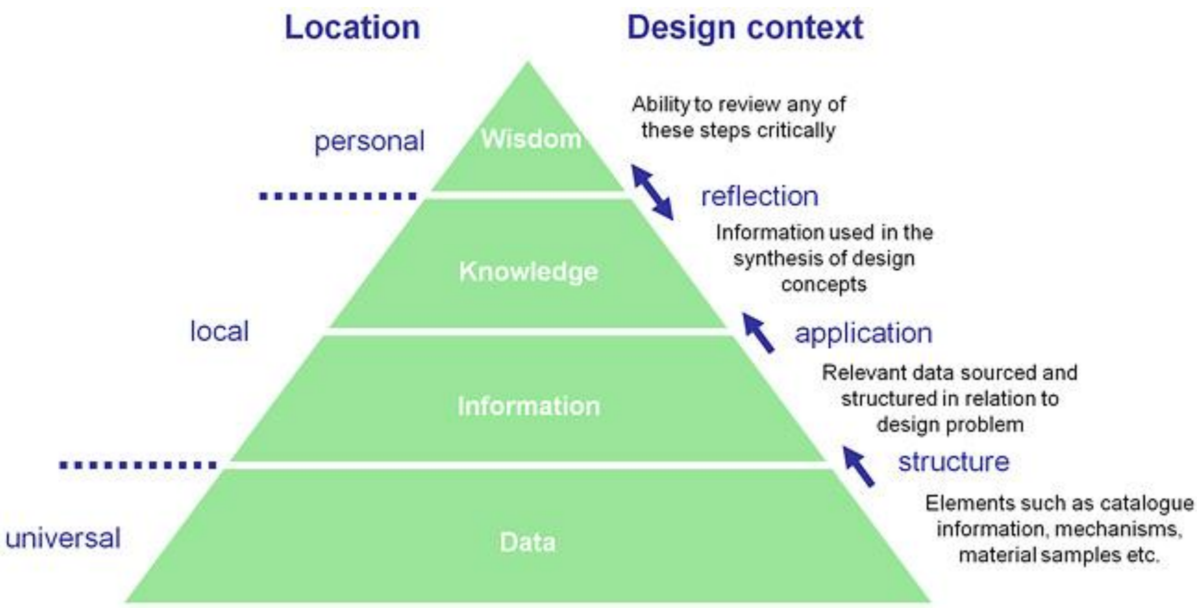


Figure 2.2 DIKW hierarchy adapted for Information in the design context (Wodehouse and Ion, 2010)

2.2.2 Design process

A considerable range and volume of information is sought for, collected, processed and used throughout the design process. Table 2.1 (adapted from Wodehouse and Ion, 2010) provides some typical examples of information through various stages of the design process by differentiating between 'generated' and 'sourced' information. The table clarifies that at each stage of the design process various and different types of design information are prevalent.

Table 2.1 Information and the design process (adapted from Wodehouse and Ion, 2010)

Design stage	Information generated	Information sourced
Planning	PDS, briefing documents, project plan, general communications	Market data, company reports
Concept development	Brainstorming notes, sketches, rough calculations, meeting notes	Competitor products, past design schemes
System level design	Sketches, drawings, rough mock-ups, cost evaluation, meeting notes	Patents, previous design schemes
Detail design	Detailed drawings and calculations, final costing, 3D models, meeting notes	Text books, suppliers' data, catalogues
Testing and refinement	Experimental data, manufacturing drawings, bills of materials, test specifications, assembly methods	Standards, databases
Production ramp-up	Sales presentations, photographs, demonstrations, presentations graphics, product instructions	Customer feedback, retail data

In addressing information in the design process, first, the design process needs to be briefly overviewed to shed light on its nature and to find a relevant representation of it. Numerous generic design process models have been generated and used by researchers in various fields such as engineering design (Roozenburg and Cross, 1991), industrial design and architectural design. However, differences have been identified between engineering design processes, architectural design and creative processes (Roozenburg and Cross, 1991; Howard *et al.*, 2008). The major differences overall are identified between engineering design processes and creative processes. Roozenburg and Cross argue that "models of architectural or industrial design emphasise the cycle of cognitive processes that the designer is required to perform (e.g. productive-deductive-inductive thinking)" (1991, p.217). Also, engineering design processes are seen as more prescriptive with a focus on 'sequences' while industrial design processes focus more on thought processes to be employed, thus are more descriptive.

One interesting analysis on industrial or architectural design processes is that they have been mainly developed by practitioners, thus are closer to actual practice of design and better reflect and 'describe' what *is* practiced rather than 'prescribe' what *should be* practiced. Therefore adopting the second model of design process i.e. industrial or architectural model, is more beneficial as it is closer to the actual design process practiced by professionals in the field (also briefs are considered ill-defined by industrial designers while typically useful and well-defined by design engineers).

Howard *et al.* (2008) reviewed more than 23 engineering design processes and suggest a framework that defines the boundaries of design process and embodies all stages suggested in various models of design process. Comparing engineering design process models, Howard *et al.* (2008) report on a number of commonalities and differences between the design processes. One of the major differences they identified between the various design process models is divergent-convergent models versus linear models. Double Diamond model of design process(Design Council, 2005) is an example of a divergent-convergent models. One major difference between a divergent-convergent and a linear model is that the assessment and selection is an inherent part of the process (Howard *et al.*, 2008). Howard *et al.* argue "this is potentially a useful outlook on design from a creativity perspective, as separating the generation and evaluation periods is considered good practice for both lateral thinking and brainstorming" (2008, p.168).

The majority of design process models are stemmed from the fields of architecture or engineering design (Roozenburg and Cross, 1991). The closest in this range to industrial and product design processes is the field of architectural design which still has some considerable differences to the field of industrial and product design. The Double Diamond design process model (Design Council, 2005), however, is based on the study of 11 leading companies in the fields of product and service design and has a strong industry and real world realm to it. As already mentioned, it also embodies a non-linear divergent-convergent approach and has been mainly developed by practitioners, thus being closer to actual practice of design and better describing what is practiced. The Double Diamond model, presented in Figure 2.3, has been widely adopted by non-academic industrial design, product design and service design communities as well as academic researchers in those fields (Roworth-Stokes, 2010; Childs and Tsai, 2010; Marshall, 2008; McGinley and Dong, 2009; Annable and Burns, 2009). Thus, this research also adopts the Double Diamond design process model.

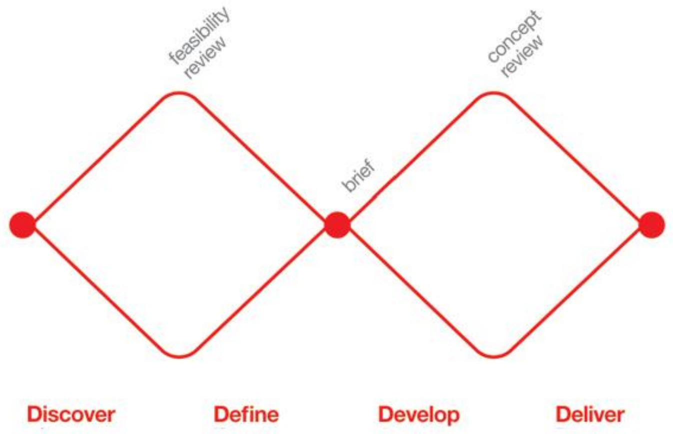


Figure 2.3 Double Diamond model of design process (Design Council, 2005)

2.3 Contexts for design information

Before analysing the existing knowledge and approaches to the study of information behaviour in design, it is important to review some fundamental and emerging contexts for design information and its increasing importance. A review of nature and the conventional approach to design practice, current status of design information and its uptake, and some emerging areas in design, identifies both opportunities and problems that either way, highlight the need for studies of information behaviour in design and the important role this could play in facilitating better uptake of design information and improving current design practices.

One challenge is the limited understanding of designerly ways of knowing. The notion of 'Black-Boxing' and the conventional lack of interest in designers' information behaviour could to a certain extent explain all the interest being shifted towards the end-product designers deliver (detailed in Section 2.3.2). This leads into a chronic problem in communicating information with designers, clearly manifested in minimum and limited use of information tools and resources by design practitioners (detailed in Section 2.3.4). Thus one challenge is to enhance the use of existing information by designers.

Potentials include emerging design practices and approaches such as people-centred design, inclusive design and user-led innovation, where a wealth of existing and new design information (specifically on people) needs to be implemented in order to facilitate these new approaches (detailed in Section 2.3.3). This wealth of design information covers a range of information types (not only anthropometrics but also psychosocial and emotional information on people) and is new in that it includes older and disabled people conventionally marginalised in design practice (Coleman, 1994). This makes a strong case for the need to better communicate not only the existing design information but also the new sets of information, specifically people information to designers; thus highlighting the importance of understanding designers' information behaviour in order to facilitate a better information uptake.

2.3.1 Designerly ways of knowing

One fundamental context that highlights the importance of design information and the significance of study of designers' information behaviour is that designers have their own 'designerly' ways of working with information and using it. In his book 'Designerly Ways of Knowing', Cross (2006) makes the case for building a network of arguments, articulation and evidence for the particular nature of design activity and design behaviour by highlighting the need and importance of it. He argues "If we want to develop a robust, independent discipline of design - rather than let design be subsumed within paradigms of science or the arts- we need to make evidence for 'designerly ways of knowing'."

Various theoretical and empirical studies have highlighted that designers have their own ways of thinking, working with information and adopting strategies for understanding the design problem and synthesising the design solution. This has been highlighted by both design researchers and practitioners. Cross (2006) addresses these specific capabilities and acts by defining and distinguishing 'Design Ability' and summarising its constituents. Moggridge (2007) refers to 'Design Thinking' as a process that "harnesses tacit knowledge rather than explicit knowledge" (2007, p.650) and differentiates designers' approach to information from other professionals based on their "ability and training to harness the tacit knowledge of the unconscious mind, rather than being limited to working with explicit knowledge" (Moggridge, 2007, p. 650). He then argues how this makes designers different; better at synthesising complex problems but not as good in "explaining or defining what they are doing or thinking" (2007, p.650).

Lawson (2004) argues that having confirmed there are designerly ways of doing and knowing, the key focus of design studies should move to defining what these designerly ways are and to 'demystify' them. He says "It is now probably fair to say that there is a general consensus among researchers that there is such a thing as designerly ways of knowing. But just how do we find out what it is?" Studying designers' information behaviour would be both needed and helpful, knowing that designers do approach information differently.

2.3.2 Lack of understanding of designerly ways of knowing

Having acknowledged that 'designerly' ways of knowing exist, the next step would be to investigate these designerly ways through studying designers' information behaviour. However, there is a considerable lack of existing knowledge and literature on designers' information behaviour in a holistic and systematic way. Various studies, mostly aimed at designing information tools for designers, have addressed single aspects of information behaviour in design, mainly focusing on information input and its specifications including information 'content' and 'presentation'. Information is considered as one input of the design process and information use is one key aspect of the design process. However, there is very little literature available on information use or seeking and an overall lack of a holistic understanding of all aspects of information behaviour. Design, as a profession, has been conventionally seen as dealing with and responsible for the end product rather than the process (Lawson, 2004; Cross, 2006), shifting the focus from the design process to the end-product.

Historically, design has been mainly driven by output, focusing on delivering an end product that embodies certain qualities rather than focusing on the process through which that end product has been designed (Lawson, 2006). This lack of interest in the design process and 'how' a certain product or service is designed has led into a considerably small body of research and understanding of the process of designing and how it happens.

This, interestingly, brings up the notion of the 'Black-Box' theory and how it can help describe the current lack of clarity of design process and our limited understanding of it (Jones, 1970). The Black-Box theory is a popular method used to explain and analyse many phenomena in science, psychology and philosophy. Bunge (1963) describes a Black-Box as an obscure system where mainly the input and output of the process is known of but what happens is usually not known of. According to this definition, the notion of 'Black-Box' could be applied to describe a design process where typically the focus is on the input and output of the process as two elements that are known of and less on what happens in the process itself as an element that is not known of. Figure 2.4 shows a basic schematic of a Black-Box.

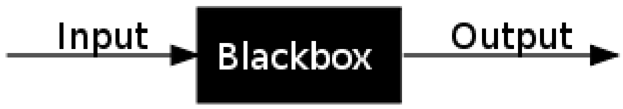


Figure 2.4 Scheme of a Black-Box

The predominant product-centred (in contrast to process-centred) approach to design is supported by some observational studies that show how the problem solving approach of designers differ from those of scientists (Lawson, 1980). In a number of designed experiments, Lawson shows that designers (architects in his study) have a more solution-focused strategy while scientists have a more problem-focused strategy (Lawson, 1980). Cross (2006) argues this suggests that designers problem-solve by synthesis while scientists problem-solve by analysis. This builds up as one reason why Cross argues there are 'designerly' ways of knowing and doing things that distinguish what designers do and their design process from other disciplines and professionals. Studying information behaviour and tapping into the 'process' part of the system which has been conventionally ignored and dismissed, will help clarify and detail designerly ways of knowing.

2.3.3 People-centred approaches and key role of people information

Over the years design has become increasingly people-centred (Bailey, 1982; Budnick *et al.*, 1992; Haslegrave and Holmes, 1994; McClelland, 1990; Wood, 1990; Tytyk, 2006; Darses and Wolff, 2006). One major shift in the direction of design practice, research and policy is the focus on the end-users, bringing them back to the heart of the process of designing. The chronological shift in design outlook clarifies this, with design starting as a 'creative expression', then design as 'prescribing what is good for the user', to design as 'user-centred' with a usability and later desirability focus.

With the emergence of emotional design (Norman, 2004) and the introduction of pleasure into the world of product design (Jordan, 2000), the user-centred design further expanded to focus on pleasurability. The next phase saw the mainstream adoption of participatory design approach (Spinuzzi, 2005) also referred to as co-design, considering design as a 'co-creation' process. A subdivision of people-centred design, inclusive design is another emerging approach to the "design of mainstream products and services that are accessible to and usable by as many people as reasonably possible, without the need for adaptation or specialist design" (BSI, 2005). Through this, designers not only ensure that products, services and environments are easier to use for those with special needs or limitations, but in doing so they also make them better for everyone (Clarkson *et al.*, 2007). Through all this, design has become increasingly people-centred and the requirement to make designs people-centred, thus the demand for diverse and in-depth information on people (as end-users) has increased. With this demand, information on people has considerably grown in terms of its volume, type, depth and diversity. Good use of such information in a most diverse, rich and inspiring way, is considered critical in order to facilitate wider uptake of people-centred design approaches.

In line with the above shift, the terminology addressing the end-user has also evolved as some designers and researchers have tried to avoid the term 'user' and replace it with more inclusive and holistic terms such as 'human' or 'people', thus changing 'user-centred' design to 'human-centred' or 'people-centred' design (Gasson, 2003). There have been various motivations for this including the narrow definition of user being too 'functional' and task-based, therefore limiting interaction of a person with a product, environment or service only to 'use' aspect (Pullin, 2009). Also, approaching people as 'users' has been criticised as limiting, dehumanising and lacking deep understanding and empathy for people's 'experiences' (Gill, 1991; Scarbrough and Corbett, 1991). The same principle would apply to 'user information', being a narrower and more limiting definition compared to 'people information' or 'human information'. In this thesis, the term 'user information' has been avoided and the term 'people information' is adopted as an umbrella term. Information on people includes a wide range and diversity; this could be marketing information, ergonomic, ethnographic or behavioural information, socio-economic, statistical or demographic information. In this thesis, people information is broadly defined as 'all types of information that help designers better understand people and their context' and covers all the aforementioned information types.

2.3.4 Limited use of information tools and resources in design

Despite all the design information available, there is evidence that this information is not effectively used by designers in practice (Mieczakowski *et al.*, 2010; Law *et al.*, 2008; Burns *et al.*, 1997). The ever-increasing volume, range and diversity of design information and the growing demand to use it in order to facilitate new approaches such as people-centred and inclusive design, has from one side led into increased scrutiny from product managers, clients and design professionals to ensure information is used effectively. This has placed more demand for presentation of this information in an accessible, usable and useful way. From the other side, this has led into more information systems and tools being designed and developed aimed at designers. Information tools could have a broad range and format such as books, handbooks, online tools, CD packages, cardsets, etc.

However, various studies of designers show the use of such design tools and resources is currently limited and not effective within the design industry (Burns *et al.*, 1997; Green and Jordan, 1999; Restrepo and Christiaans, 2003; McGinley and Dong, 2009). Aurisicchio *et al.* argue that "designers are overloaded with information coming from multiple sources (Butcher 1995; Eppler and Mengis, 2004)" (2010, p.717). However, at the same time "seeking design information from these sources is often complicated and time consuming" (Aurisicchio *et al.*, 2010, p.717). Results of a comprehensive empirical evaluation of eight inclusive design tools (Law *et al.*, 2008) clarified that in most cases the tools were not designed based on the designers' needs and ways of working. Choi *et al.* (2006) also report that majority of such tools aimed at communicating design information to designers, were inadequately designed and failed to support the typical design process and design psychology.

The minimal use of information tools by designers could have various reasons. Perceived lack of value, accessibility (Fidel and Green, 2004) or relevance (Restrepo and Christiaans, 2003), are some prominent reasons. This lack of awareness (Cross, *et al.* 1994; Court, 1995) results in end products that have not benefited from available information (Restrepo and Christiaans, 2003). It is worth considering that such tools, resources or pieces of information are typically developed or delivered to designers by non-designers. This could include clients, ergonomists, marketers, engineers or social scientists and researchers who are not fully familiar with the nature and practice of design. Lack of understanding of designers and their information behaviour, could lead into communication and presentation issues between these information providers and designers (Green and Jordan, 1999), resulting in limited use of important design information.

Designers' lack of use of existing information could also be due to some inherent differences in their approach to sourcing and use of information. Various studies reveal that designers very much depend on past experiences and collected knowledge (Restrepo and Christiaans, 2003). Study of designers' information behaviour would be one first step to address these issues.

2.4 Information behaviour in library and information sciences

This section reviews and discusses key facets and models of information behaviour in the field of library and information sciences. This review and analysis is essential in order to facilitate the next steps in Sections 2.5 and 2.6. In Section 2.5 the existing knowledge of information behaviour in design would be reviewed. Then in Section 2.6 the existing knowledge in the two fields of library and information sciences and design would be analysed.

After clarifying the importance of and the need for studying of information behaviour in design, a brief analysis of key theories, facets and models in other fields (specifically field of library and information sciences) was undertaken. This was in order to lay the theoretical foundation for the study of information behaviour in design and provide a basis to facilitate analysis of the existing knowledge and gaps in the field.

Most existing literature comes from the field of library and information sciences as the historical origin and frontier of the research into human information behaviour. Information behaviour is a vast field with varied aspects and areas of research, each individually established and developed through time. One "most comprehensive textbook on information behaviour" (Fisher and Julien, 2009, p. 320) is written by Case (2008). In his book, Case addresses information behaviour as a "currently established covering term for a broader range of information related phenomena" and argues that information behaviour is a term "whose time has come" (Case, 2008, p. 81), highlighting how vast the field of studies of information behaviour has grown over the time.

There are two approaches to studying information behaviour; using 'information behaviour' narrowly to refer to 'information seeking' activities (Fisher *et al.*, 2009; Case, 2008), or approaching it as an umbrella term that encompasses the whole of human behaviour in terms of information needs, seeking, and use (Wilson, 1999; Pettigrew, 2001). The second approach is adopted in this thesis. Also, as this thesis intends to address designers' information behaviour in the context of a design process, the focus is on active, specific and task-oriented information behaviour that is an act of problem solving, oriented towards making some sort of decision, rather than ‘everyday’ (Case, 2008) or ‘passive’ information behaviour.

2.4.1 Facets of information behaviour

Information behaviour is classified into a number of facets that each has over the time turned into a distinct independent branch of research. Alongside these facets, there are other related concepts such as information retrieval, information management, information processing, information foraging and other areas such as information avoidance. These have been largely studied as independent research areas considered outside the field of information behaviour.

Information retrieval is a major facet in the information behaviour field with a considerably large body of research, however, it is considered to be mainly dealing with ‘documents’ and it primarily focuses on design and development of information systems rather than acts of information behaviour (Beaulieu, 2003; Case, 2008).

Information foraging is an interesting facet that explores the relationship between the environment - in terms of the constant changes in information availability, volume, type, etc. - and the users’ adaptive strategies and approaches to seek, manage and use the information. Information foraging “assumes that people, when possible, will modify their strategies or the structure of the environment to maximise their rate of gaining valuable information” (Pirolli and Card, 1999, p.646).

Information management is argued to be a secondary act of information behaviour throughout and after the information use stage which could be addressed as an aspect of information retrieval. However, there are more general definitions of information behaviour, describing it as “the study of behaviours related to information seeking, foraging, retrieving, organising, and use” (Spink and Cole, 2004, p. 375). Within facets of information behaviour, information searching is addressed as a subcategory of information seeking. In Figure 2.5 Wilson (1999) presents a nested model of conceptual areas visualising the interrelation of the mentioned central concepts of information seeking and searching.

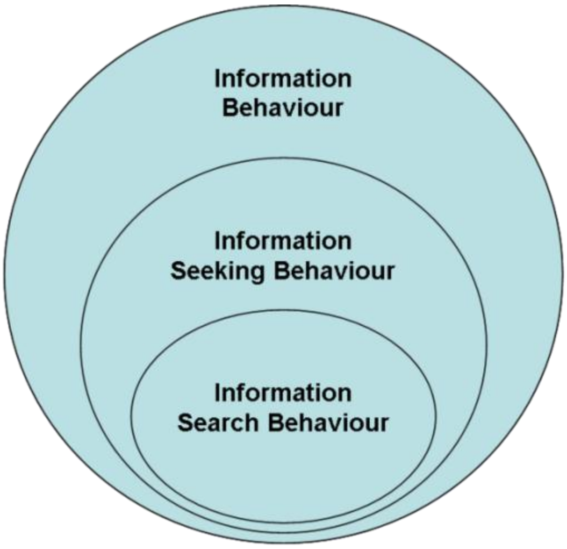


Figure 2.5 Wilson's Nested Model of Conceptual Areas (Wilson, 1999)

Beaulieu (2003) reports how through development of online platforms it is difficult to identify distinctions between information seeking and searching. Beaulieu (2003) also discusses how the two areas of information needs and information seeking have grown as independent areas of research in the context of evaluation and development of information retrieval systems.

The above overview highlights facets of information behaviour as three key dimensions including information needs, information seeking and information use. For the purpose of this study, these three aspects are adopted and information behaviour is defined as an umbrella term including these three dimensions. Information needs, seeking and use cover distinctive areas of human information behaviour in a task-oriented, active, problem-solving act and each represents a substantive stage of active information behaviour. Not all dimensions of information behaviour have been equally addressed and studied. Information seeking is by far the most studied and investigated area in information behaviour studies. Information needs come second, while information use comes last. Figure 2.6 presents the three key facets of information behaviour, their relationship, and the current state of research focus.

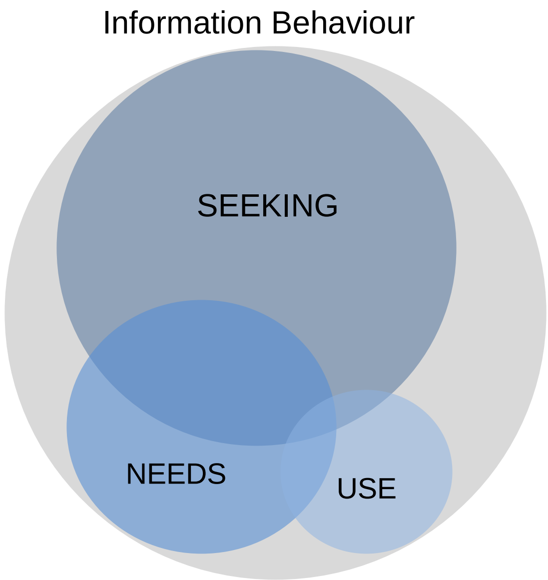


Figure 2.6 The three key facets of information behaviour

❖ **Information needs**

Wijngaert (1999, p.463) suggests information need is "the process of perceiving a difference between an ideal state of knowledge and the actual state of knowledge." Much scholarly research has been done on investigating information needs, how they arise and their characterisation. Taylor (1968) characterises information need as seeking answers and suggests a typology of information needs (Figure 2.7). Visceral need is defined as a conscious or unconscious need for information that is unexpressed. The next level is a conscious mental description which could lead to sharing that need with other people in a verbal format. A formalised need is the one that is qualified and rational, however there is no certainty whether there would be an answer to this need in that form by any information system or source. The final level is compromised need which is a question that embodies some specifications of the type and the format of information that is obtainable. This research focuses on the last two levels of information needs. To summarise, Case (2008) identifies the key characteristics of information needs as 'answers' (Taylor, 1968), as 'gaps and sense making' (Dervin *et al.*, 2003) and as 'uncertainty reduction' (Kuhlthau, 2005).

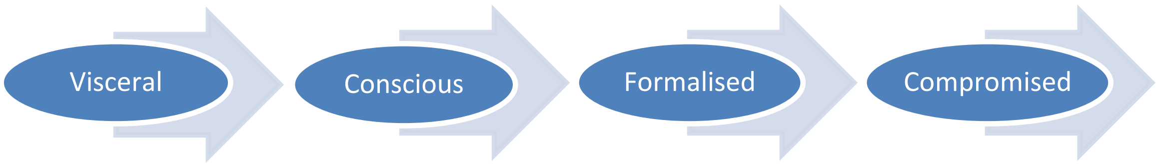


Figure 2.7 Taylor's typology of information needs

❖ Information seeking

Information seeking is the most widely studied facet of information behaviour studies overall. It is defined as "the act of actively seeking information in order to answer a specific query", while information searching is "the behaviour which stems from the searcher interacting with the system in question" (Wilson, 1999, p.250). Wilson discusses this search could include interacting with a technological source such as a search engine or simply choosing a book which would best fit the search criteria. Case (2008) categorises investigation of information seeking into two areas; focus on 'seeker' or focus on 'sources or channels' of information they use. In engineering, information seeking has been extensively studied, "characterised using parameters such as source, location, communication media, storage media and mechanism" (Aurisicchio *et al.*, 2010, p.719).

❖ Information Use

Savolainen (2009) argue the importance and at the same time the difference of the information use as one fact; "Information use is an area of interest to information professionals who rely on research outcomes to shape their practice" (Savolainen, 2009, p.189). Spink and Cole (2004) argue that compared to other facets of information behaviour, information use has been addressed and explored the least. In supporting this argument, they also refer to work of Vakkari (1997). There is considerably little body of research available on the 'what' and 'how' of information use stage compared to what and how of information seeking and searching and information needs. Spink (2006) argues that the role of information use in regard to information behaviour as a whole is unclear and suggests an additional information approach solely based on information use would be useful in order to create a comprehensive and more balanced picture of all dimensions of the human information behaviour. Lack of in-depth research and understanding of the information use dimension is due to a number of reasons, for example conventionally less interest in understanding this aspect.

Information behaviour science originates from librarian studies. Spink (2006) argues that the conventional focus and point of attention in librarian studies has been active information seeking. Also, Wilson (2000) discusses the historic prominence of information seeking as this field is conventionally more focused on users seeking information and how to better facilitate the information seeking and searching process rather than how that information is actually used. Also, this could be due to methodical and practical limitations in researching the use aspect.

2.4.2 Models of information behaviour

Before moving to the analysis of existing knowledge of information behaviour in design, this section reviews some useful and relevant theoretical ground developed for the study of information behaviour in library and information sciences. For this purpose, three key models of information behaviour are selected and further discussed, in order to identify the building blocks and fundamental concepts and dimensions.

Formation and development of theories and models not only could help scientists better understand complexity of human system, but also provide a systematic approach (Beaulieu, 2003). These theoretical underpinnings help construct a foundation for a rigorous and methodical approach to carrying out research in a field. The library and information sciences field has made a major contribution to information behaviour studies by laying theoretical foundations for research in this area through a considerable number of theoretical models, theories, and frameworks. Beaulieu (2003) highlights the role and significance of research frameworks by mentioning then different purposes they could serve. These include clarifying and differentiating between context, purpose and type of information behaviour studies (Beaulieu, 2003).

Models of information behaviour exist with different levels of detail, focus, scope and generalisation. Various researchers have developed and suggested a number of models and theories that in their own right shed light on different facets of information behaviour and various approaches to its study (Hepworth, 2004; Fisher and Julien, 2009). Spink and Cole (2006) argue that each model has weaknesses and strengths in its approach to identify and understand diverse facets of information behaviour and the its related issues, while no one model could address every aspect of information behaviour. Thus it is necessary to review different yet relevant models of information behaviour. Based on an extensive review of various existing models, Case (2008) identified seven prominent models that were most inclusive, holistic, detailed and applicable to various fields. These included Wilson's first model (1981), Krikelas model (1983), Leckie model (1996), Bystrom and Jrvelin model (1995), The Savolainen model (2005), Johnson model (1997) and Wilson's second model (1999). Case then compared these seven models based on their main outcomes, stages, variables and main antecedents. Out of these seven, three are most related to this research and provide useful theoretical ground for study of information behaviour in design. These three models are briefly discussed here.

Two of Wilson's models on information behaviour are reviewed here. Wilson's first general model of information behaviour, shown in Figure 2.8, revisited and revised in many later editions, was proposed in 1981. In this model which he later called a macro-model (Wilson, 1999), Wilson identifies and differentiates the essential elements of information behaviour as information need, information seeking and information use. He argues that the primary research attention is focused on how users seek information, ignoring 'why' they do so and 'what use' they make of the information they have sourced. Thus, Wilson asks for a 'holistic view' when it comes to the user of information (Beaulieu, 2003).

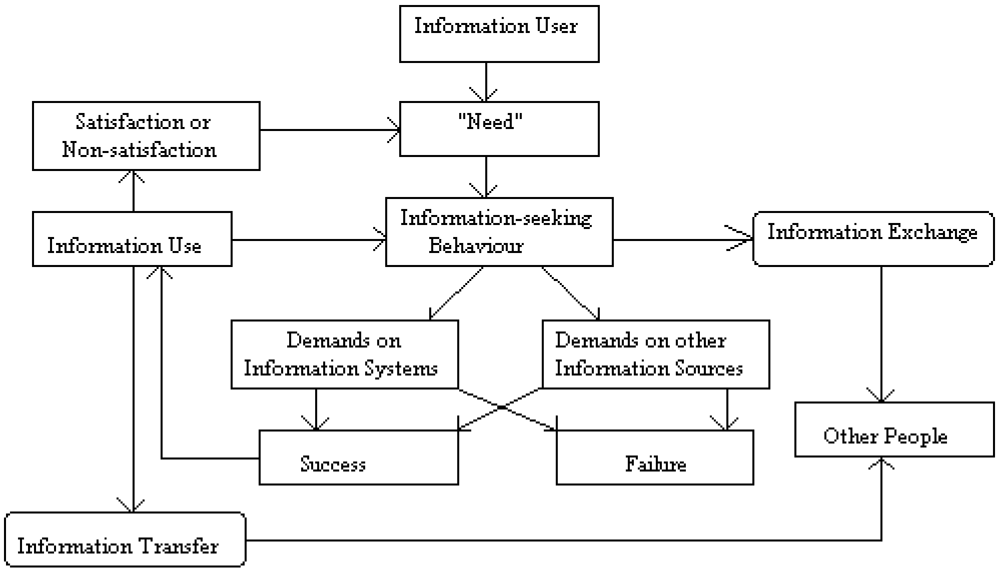


Figure 2.8 Wilson's 1981 Model of Information Behaviour, in Wilson (1999)

The model of information behaviour by Wilson developed in 1996 is a revision of his first model, incorporating research from fields other than information sciences. In this model, mainly driven from his general information behaviour model, Wilson focused on information seeking and searching process and active problem-solving models (Wilson, 1999). This was a more comprehensive model. One contribution of it was to render information behaviour not as a detached act, but one that always happens in a 'context'. Wilson highlighted both 'behavioural' and 'organisational' contexts of information behaviour and information seeking and defined context in three key levels i.e. 'individual', 'role-related' and 'environmental' (Beaulieu, 2003). He then explicitly specified the intervening variables in regard to the context of information behaviour, as Psychological, Demographic, Environmental, Role-related and Source characteristics. Figure 2.9 presents the second model of information behaviour by Wilson.

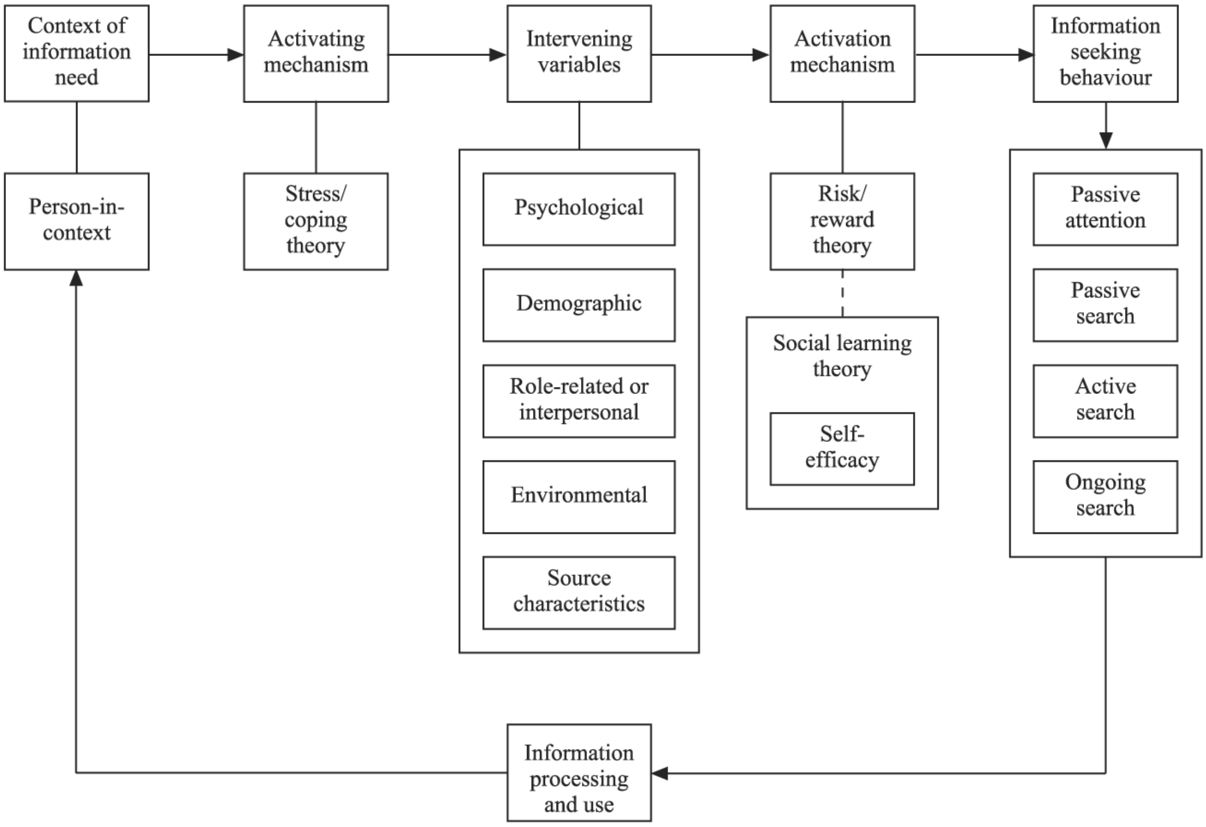


Figure 2.9 Wilson's 1996 Model of Information Behaviour, in Wilson (1999)

As mentioned, information behaviour can be studied at different levels and on the basis of various aspects such as individuals, local social context or wider cultural context (Hepworth, 2004). One categorisation is on the basis of expertise looking into professionals; some models and many studies of information behaviour have focused on practitioners in various fields such as science and engineering. Engineers' information behaviour is an area quite well studied; Allen (1977) laid the foundation for research on engineers' information behaviour. In later engineering studies, aspects such as information channels used, the factors affecting channel selection, etc. were studied. Pinelli *et al.* (1993) conducted a study of engineers' general information-seeking behaviour. However, as Bruce *et al.* (2003) state, most of these studies focused on describing the general information seeking behaviour of engineers as a whole without considering factors such as background, level of expertise, etc.

Leckie *et al.* (1996) created a model of information seeking behaviour in professionals. They collected data from a diverse range of professionals including engineers, health care professionals and lawyers. This model interestingly, brings up the issue of work-related processes and focuses on one specific group of people i.e. professionals. In this model, 'work roles' and 'tasks' are identified as the main influencing factors on information behaviour, specifically information seeking. In Leckie's model, key factors discussed bring the attention back to information alongside the information user and highlight the key qualities or specifications of information needed and to be sought and used. Figure 2.10 shows the Leckie *et al.* model.

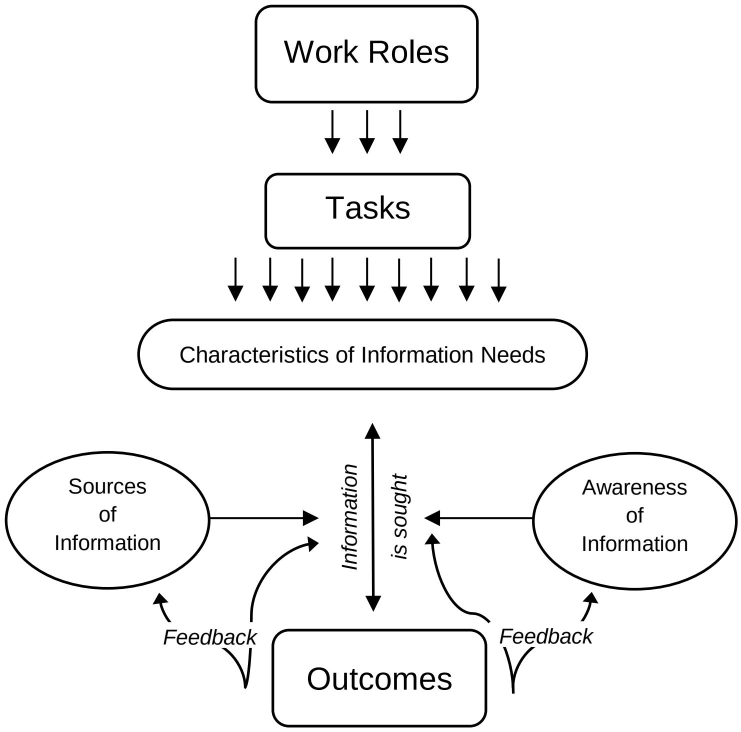


Figure 2.10 Leckie *et al.* (1996) model of information seeking behaviour in professionals

Case (2008) summarises the main antecedent of Wilson's first model of information behaviour as 'need' and the main antecedent of Wilson's second model of information behaviour as 'context' and 'person-in-context'. 'Work roles' and 'tasks' is identified as the key ground to Leckie *et al.* model. While the two models of information behaviour by Wilson emphasise the three facets of information behaviour and the role of context and its constituents respectively, the Leckie model highlights the variables in regard to information to be sought by professionals.

Jansen and Rieh (2010) studied both information searching and information retrieval fields, in order to explore the similarities and differences and identify their interconnection. This resulted in a nested model of information behaviour based on Wilson's model (1999). The nested model helps clarify different levels and layers on which the two fields are connected and yet distinguished. The framework on the left presents the behaviour of people when they access, use and browse or search an information system, and the other parallel framework outlines the system that supports, affords and enables such behaviours. The model adopts 'information', 'people', and 'technology' as its theoretic orientations. Figure 2.11 presents the Jansen and Rieh (2010) nested model. This integrative approach could be adopted in comparative analysis and synthesis of information behaviour in design and library and information sciences fields.

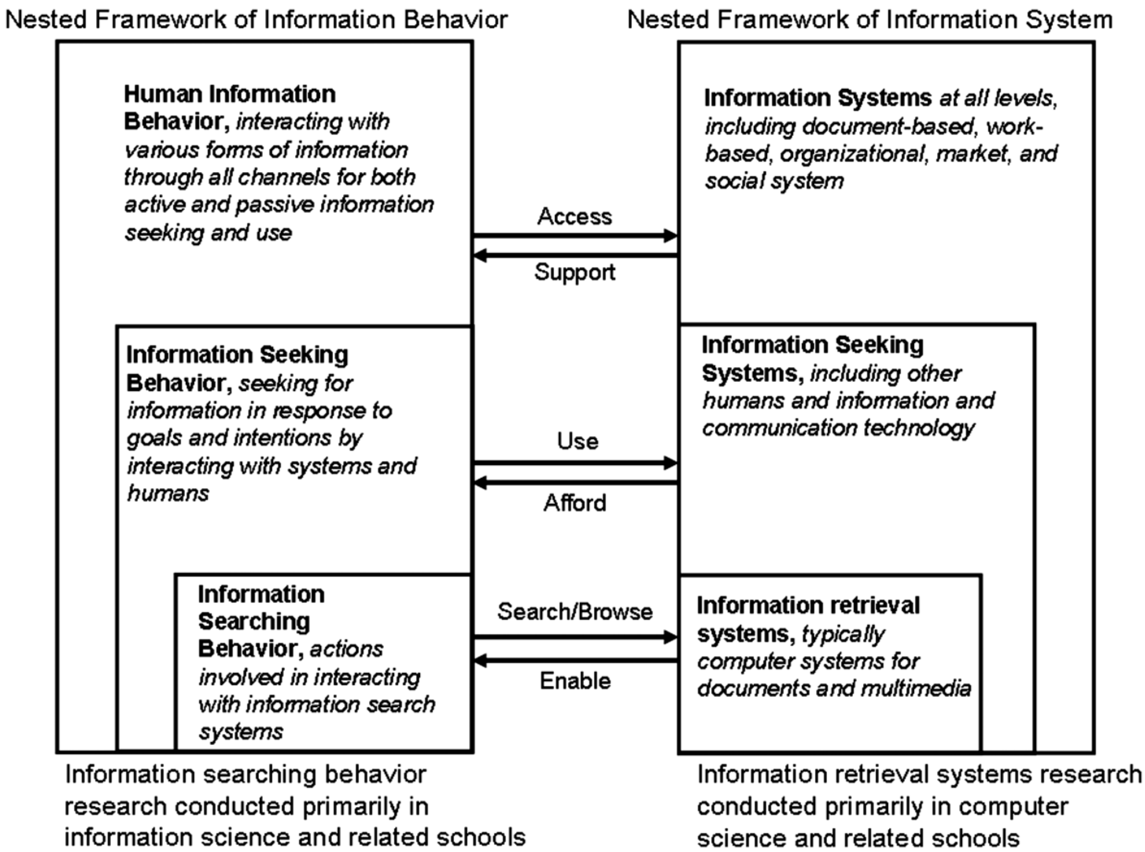


Figure 2.11 The model of human information behaviour and information system (Jansen and Rieh, 2010)

2.5 Information behaviour in Design

This section reviews and discusses key existing concepts and facets in regard to information behaviour in design. This illustrative review is essential in order to facilitate the next steps in Sections 2.6 and 2.7. The existing knowledge of information behaviour in the two fields of library and information sciences and design would be analysed and synthesised respectively in Sections 2.6 and 2.7.

After a brief analysis of information behaviour facets and models in library and information sciences field, a review was undertaken on the existing knowledge of information behaviour in the field of design, as well as what is not known.

As already discussed, the width and depth of information behaviour studies in design is considerably limited and the existing knowledge of information behaviour in design is scarce and fragmented in that it addresses various constituents and aspects of information behaviour separately, in a small scale, and does not present a holistic understanding of the overall information behaviour in design. Thus an overall comparative analysis could help identify approaches and gaps. In reviewing the information behaviour literature in the design field, a considerable lack of systematic and integrated approach adopting and linking knowledge from library and information sciences field, became clear.

The review of literature identified no considerable models or theories used in or resulting from studies of designers' information behaviour and only one framework of design information (DIF) was found in the literature (Lim and Sato, 2006). However, there were some concepts widely addressed in design studies which could be relevant to the study of information behaviour in design. Also, studies were carried out addressing various facets of information behaviour in part. In this section, some design concepts relevant to information behaviour are reviewed and then a table of information behaviour studies, illustrative of information behaviour facets in design field is summarised.

2.5.1 Concepts relevant to information behaviour

- **Behaviour in design**

As opposed to information behaviour, general design behaviour has been the subject of various studies in design research and practice. However, a review of some prevalent areas and concepts in design behaviour, highlighted the elusive and intuitive nature of design behaviour and the importance of adopting a descriptive rather than prescriptive approach to it. Thus, some concepts of design behaviour highlighting its unstructured nature, and specifically relevant to information behaviour, are presented here in an illustrative rather than exhaustive review.

The concept of 'designerly ways of knowing' (Cross, 2006) is one pertinent area in design behaviour studies. It deconstructs ways of knowing in design to two categories of design 'processes' and 'products' and through comparison of design 'nature' as what designers do, and design 'nurture' as the development of design ability through design education, highlights some inherent behavioural elements in design. Through a review of studies of design activity, Cross (2006) proposes an understanding of 'design cognition' through interpreting findings, issues and patterns. Figure 2.12 summarises three key areas of design cognition and their sub settings identified by Cross (2006).

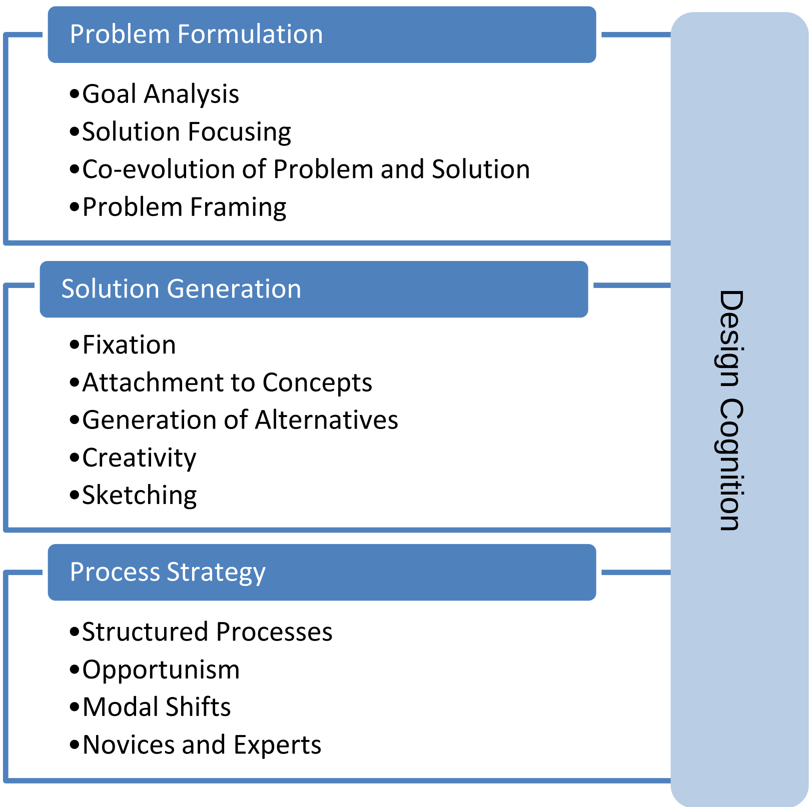


Figure 2.12 Key areas and aspects of Design Cognition (Cross, 2006)

Among the three key areas in design cognition, the process strategies are the most relevant to design behaviour and thus study of information behaviour. The key issue highlighted in studying of design behaviour by Cross is the mainly 'intuitive' aspect of designers' behaviour, largely observed in practicing designers. Cross (2006, p.93) argues: "Empirical studies of design activity have frequently found 'intuitive' features of design behaviour to be the most effective and relevant to the intrinsic nature of design." Cross then discusses how "some aspects of design theory have tried to develop counter-intuitive models" (2006, p.93) which are 'prescriptive' models of design behaviour and mentions the need for an improved exploration and recognition of design expertise and what it consists of. This brings to attention the critical importance of adopting a 'descriptive' and avoiding a 'prescriptive' approach in the study of information behaviour in design.

Design students and practicing designers

Both student designers and design practitioners go through a design process aiming to solve a problem, address a situation or improve a condition, however they have different needs, attitudes and criteria when approaching a design task (Ahmed, 2003). This depends on the context in which they are designing, with different parameters and measures, and also their own characteristics and design behaviour. In an extensive study aimed to understand what differentiates the experienced designers from the novice in their approach towards a design task, Ahmed et *al.* (2003) clarified that design practitioners and design students each have their own design behaviour. This could also include different information needs, information seeking and use behaviour. In addressing the novice and experienced in design, Cross (2006) differentiates between their design behaviour; associating a 'depth-first' approach to novice and a combined approach yet mainly 'breadth-first' to the expert. Practice of design as a student in the academic context and application of design as a practitioner in the context of industry and business are two clearly distinguishable areas, often studied and compared for various research or business purposes; looking at how design is practiced and how it is educated. As the information behaviour could vary depending on level of experience (novice or practicing designer) and as practicing designers are the main group dealing with real-world application of design in practice, they are the focus of this research.

Fixation and Opportunism

Two other concepts prevalent to design behaviour and relevant to information behaviour are fixation and opportunism, mainly observed in expert designers. Fixation (Jansson and Smith, 1991) to a certain design solution or way of thinking could sometimes prevent the designer from looking into and using all the related and potentially useful information that should be considered to address a problem. However, it is an aspect that could result in both limited and unimaginative, and innovative design, depending on the designer who applied it and the context of the design task. The notion of opportunism brings attention to the issue of intuitive and unstructured designerly behaviour and challenges the approach to identifying design behaviour as fairly 'structured'. Kushalani *et al.* (1994, p.13) argue opportunism happens where "designers discover or adapt their problem solving goals and activities, in response to the state of the problem and the environment in which that problem exists."

Tacit and explicit design knoweldge

Knowledge in design has attracted the interest of many design researchers and has been subject to considerable theoretical and practice-based studies. This is partially due to the specific nature of design knowledge acquired, shared and retained throughout a design activity and designers' different approach toward it. One key element of design knowledge is that it is largely tacit. Wong and Radcliffe (2000, p.495) adopt a definition of tacit knowledge as "the knowledge component that is extremely difficult, if not impossible, to articulate, put in writing or codify". Tacit knowledge plays a major role in development of the final design deliverables (Wong and Radcliffe, 2010) and there is considerable interest in extracting this embedded tacit knowledge in new product development (Nakayama, 1997) and innovative processes (Senker, 1993). The role of tacit knowledge in design activity is prominent; Moggridge (2007) refers to design thinking as a process that connects mainly and most importantly with tacit knowledge and differentiates designers' approach to information from other professionals based on their "ability and training to harness the tacit knowledge of the unconscious mind, rather than being limited to working with explicit knowledge" (Moggridge, 2007, p. 650). Thus, in investigating designers' information behaviour, the significance of tacit knowledge as a major source and its influence on design behaviour should be considered.

2.5.2 Facets of information behaviour

After reviewing key design concepts relevant to information behaviour in design, a review of facets and various aspects of information behaviour addressed in design studies was carried out. Many studies were identified that in one way or another addressed various facets and aspects of information behaviour in part. The width and depth of these studies and their level of comprehensiveness however, was considerably limited. The existing knowledge of information behaviour in design was considered scarce and fragmented. This was because it addressed various constituents of information behaviour separately and in a small scale, and failed to present a holistic understanding of overall information behaviour in design.

More than 40 design studies addressing various aspects of designers' information behaviour were initially reviewed. These papers were identified through searching various scholarly databases. In order to render a clear picture of the scope, level and focus of information behaviour studies in design, and to better present and compare them, ten of the most relevant design studies representative of the field, were summarised in Table 2.2. The table aimed to present an 'illustrative' rather than 'exhaustive' list of relevant studies. The aim was to give an overall picture of the existing understanding and approaches to information behaviour in design studies, to provide a critical review of key directions, dimensions and theories, and to identify the scope and depth of what was studied and the existing gaps in knowledge.

Table 2.2 Illustrative review of important design studies addressing information behaviour

Study	Year & Author	Subject	Information behaviour Facets	Information Aspects	Contexts	Models/ Frameworks
1	1996 Baya, V.	Information handling behaviour of designers during conceptual design	Information - Handling - Requests - Capture - Re-use	- Descriptor - Subject-class - Medium - Level of detail	- Alternatives - Construction - Location - Operation - Performance - Rational - Relation & requirement	Design Information Framework
2	2001 Lim, Y. & Sato, K.	Development of design information framework for interactive system design	Information - Management	- User Study - Design - Prototyping - Evaluation	-	Design Information Framework
3	2004 Ahmed, S. & Wallace, K.M.	Understanding knowledge needs of novice designers	Information - Obtaining	- Types (presentation) - Topics (content)	-	-
4	2004 Restrepo, J. & Christiaans, H.	Problem structuring & information access design	Information - Access	- Source - Accessibility	- Education - Experience - Design situation - Idiosyncratic	-
5	2004 Song, S.	Information behaviour of designers	Information - Sharing - Seeking	- Type - Source - Share & exchange - Needs	- Individual /Team - Project - Company - Business Milieu	Layered Behavioural Model for Software Design

6	2005 Cardoso, C. *et al.*	Designer requirements for user information	- Data Quality	- Quality - Format - Source	-	Data Quality Framework
7	2006 Goodman, J. *et al.*	Providing user information to designers	Information - Use - Work practices	- Type - Format	-	-
8	2007 Goodman, J. *et al.*	Working with user data in designing	Information - Communication	- Presentation format	-	-
9	2010 Aurisicchio, M. *et al.*	Information requests & seeking behaviour of aerospace designers	Information - Seeking	- Search - Sources - Type - Media (format)	- Source - Seeker Background Level of education Role - Work context - Environment - Task - Stage - Info needed	-
10	2011 Mason, H. & Robinson, L.	Information-related behaviour of emerging artists and designers	Information - Practices	- Accessing - Sources	- New practitioner - Established practitioner - Cost factors	-

The summary table highlights a number of trends, approaches and issues in studies of information behaviour in design. The key insights listed below, help identify a number of gaps in current studies of information behaviour in design (to be discussed in Section 2.6).

1. There is a clear lack of holistic studies of information behaviour in design. Studies of designers' overall information behaviour, including all facets of information behaviour, are very limited in terms of number, scope and depth. In terms of facets addressed, design studies lack comprehensiveness and robustness as there is little, partial or no reference to theoretical models of information behaviour.

2. Information seeking, in its most general definition, is one key facet of information behaviour largely studied in design. Most studies have only focused on one facet of information behaviour, sometime this has been intentional and explicitly mentioned and clarified, like studies one and nine. However, sometimes studies have been considered as information behaviour studies without addressing key facets of information behaviour, such as study five.

3. In most cases, there is a lack of correct and clear distinction between facets of information behaviour in design studies. Boundaries are blurred and not precisely defined. The terminology used to address facets of information behaviour is not accurate and there is very limited adoption of information behaviour definitions from library and information sciences field.

4. There is considerable lack of theories, models and frameworks used in studies related to information behaviour in design, both as input and output.

5. The key focus of information behaviour studies in design is on the 'information aspects' rather than the 'information behaviour facets'. Design investigations tend to mainly address 'information-related' rather than 'behaviour-related' aspects of designers' information behaviour.

6. There are not clear common definitions and distinctions in addressing various information aspects in information behaviour studies in design. The terminology used to address information aspects lacks rigour, accuracy and clarity and cross-disciplinary adoption. This results in unregulated definitions and classifications and causes confusion and mixing up of the aspects due to the lack of a clear hierarchy in the breakdown of information aspects. Examples of this could be seen in studies three and six.

7. There is a lack of a holistic approach in identifying, distinguishing and addressing information aspects in information behaviour studies of design.

8. Context and contextual factors have been directly and indirectly addressed in some information behaviour-related design studies and seem to have attracted good research interest.

2.6 Analysis of information behaviour in Design and Library and Information Sciences

After a review of knowledge and understanding of information behaviour in both fields of library and information sciences and design, a comparative analysis was carried out in order to identify approaches and areas of focus in the two fields, providing platforms and foundations to link them. The specifications, similarities and differences between the two fields in their addressing of information behaviour are briefly discussed here. An analysis of information behaviour literature in both fields highlighted key approaches, attempts and issues:

- Considerable attempts of Library and Information Sciences studies at devising theories, meta theories and conceptual frameworks of information behaviour, compared to lack of such attempts in design is understandable. This is considering the historical and frontier role of library and information sciences as a nesting field for information behaviour studies. However, the lack of models and frameworks addressing information behaviour in design needs to be addressed as a critical gap in the existing knowledge in the field.

- There is a considerable lack of holistic approach to study of information behaviour in design; both behavioural and information focused studies of information behaviour undertaken in design fail to provide a comprehensive picture of behaviour-oriented or information-oriented characteristics.

- There is a lack of a systematic and integrative approach to investigations of information behaviour and information related aspects of design activity; very few studies have adopted, linked or attempted to apply theories, models or facets of information behaviour established in library and information sciences field in a systematic way. This could have some explanations such as the practical and pragmatic nature of design research being primarily concerned with providing ‘applied’ knowledge and research findings that are applicable to the practice of design, thus not mainly concerned with producing theoretical work.

- This ‘pragmatic and applied’ nature of design research has in many cases resulted in short-sightedness and the lack of a comprehensive approach in design investigations of information behaviour, narrowing down the scope of investigation and limiting integration of the research due to the lack of a theoretical model or framework. This has resulted in a research field that is scattered, small in scale and scope and lacks integration, theory and a holistic approach. This narrow scope in some cases has resulted in mixing various information aspects and the lack of a detailed and clear definition of each aspect.

Analysis of information behaviour studies in library and information sciences highlighted a focus on behavioural characteristics of information behaviour with the strong presence and significance of information behaviour facets (including information needs, information seeking and information use) which led into well-established research areas, models and theories. However, in information behaviour studies in design, the focus was mainly on information related characteristics. Information aspects were the main subject of information behaviour investigation in design, though not systematically addressed. This is directly related to the applied nature of design research.

Reflecting on information behaviour studies in library and information sciences aimed at design of information systems, Beaulieu (2003, p.241) highlights the difference between behavioural and information related characteristics in relation to system design: “Although some behavioural features have been observed in initial studies, it has proven to be much more difficult to identify contributory factors or explanations for these behavioural characteristics or to determine how they can inform actual systems design.”

2.6.1 Key information behaviour approaches in Library and Information Sciences

❖ **Information behaviour facets**

As discussed in Section 2.4.1, Wilson's model of information behaviour help categorise key aspects of information behaviour into three facets i.e. information needs, information seeking and information use. Wilson highlights the need for a holistic understanding of information user by focusing on all their key information behaviour facets rather than focusing on one facet of information behaviour - typically the information seeking. Thus the three identified facets help render a holistic picture of information behaviour and its key facets.

❖ **Information behaviour context**

Case (2008) defines "context" as the specific arrangement of a 'person' and a 'situation' that lead into and cause an act of information behaviour. 'Context' and contextual factors in information behaviour have been widely addressed and investigated in library and information sciences studies. Many models and theoretical frameworks have addressed the context and its constituents and emphasised its role in information behaviour. The two information behaviour models by Wilson (1999), presented in Figures 2.8 and 2.9, are among the major theoretical adettempts in addressing context in information behaviour. Table 2.3 presents an illustrative list of key contextual factors identified in information behaviour studies in library and information sciences.

Table 2.3 Illustrative review of information behaviour contextual factors identified in library and information sciences

Wilson (1981)	Wilson (1999)	Case (2008)
Behavioural	Psychological	Person
	Demographic	
Organisational	Environmental	Situation
	Role-related	
	Source characteristics	

2.6.2 Key information behaviour approaches in Design

In the design field, information behaviour has been principally addressed and studied in terms of its 'information' aspects. In studies of information for designers, designers have been approached as the end-users and the information has been approached as the end-product aimed at them. Thus the key activity in this, based on a core design approach, is to establish the PDS (product design specification) (Pugh, 1997), defining the 'specifications' of the product - thus information - aimed at the end-user. This is understandable as there has been an 'applied' interest rather than a 'theoretical' interest in designers' information behaviour. Thus, if aimed to be directly applicable to and adoptable in design practice, the focus and final deliverable of information behaviour research in design needs to directly and explicitly address information related characteristics of information behaviour. The review of some relevant concepts to design behaviour such as the notion of 'opportunism' and 'fixation', 'design cognition' and 'novice' versus practicing designers in Section 2.5.1, also supports this approach as these concepts highlight the intuitive and unstructured, thus elusive nature of design behaviour and the importance of approaching it in a descriptive rather than a prescriptive way. These set major challenges in aiming to approach and address 'behavioural' aspects of information behaviour in a direct structured way. This is while addressing the information-related aspects of information behaviour proves to be more pragmatic, useful and achievable. At the same time, these two aspects are strongly interrelated and have a causative link in that behavioural characteristics will result in information-related behaviour. While the former may be elusive and difficult to pin down and unfold, the latter, being a result of the former, is obviously observable and reportable.

❖ **Information dimensions**

The review of information-related aspects in design studies (summary provided in Table 2.2) identified various elements of information. For the purpose of this research, these information-related aspects will be called information 'dimensions' and are defined as various characteristics and aspects of information needed, sought and used by designers in the design process. The summary provided in Table 2.2 also identified some issues regarding limited theoretical foundation of studies as they had not adopted relevant models of information behaviour. This has caused most studies of information behaviour in design to suffer from lack of comprehensiveness, not being holistic in their addressing of information dimensions. As discussed, this has caused confusion in terminology and clarification of information dimensions. Sometimes these dimensions have been mixed and taken for one another due to lack of a clear definition and a systematic, detailed and widely accepted distinction. For the audience of design research, the key has been application of designers' information behaviour findings into better communication of information rather than clarity of their definition. Thus, a holistic and inclusive approach was adopted in order to identify all the information dimensions and to cover all aspects of information, representing a comprehensive and inclusive understanding of information needed, sought and used in the design process.

In order to identify a comprehensive set of information dimensions, the information aspects addressed implicitly or explicitly in more than 40 studies of design were reviewed, collated, analysed, coded and finally merged into an expanded final list (Table 2.4). Adopting the template approach (Robson, 2002), the identified aspects were coded and clustered in a number of iterative cycles; first, the coded information aspects were clustered into initial information dimensions. These initial information dimensions were coded and clustered again in a second round. This resulted in coded information dimensions. These coded dimensions were then collated and merged in a third round. This last analysis cycle resulted in a set of information dimensions including 'Source', 'Format', 'Type' and 'Qualities'. Table 2.4 shows the three stages of this coding and clustering.

Table 2.4 Illustrative list of information aspects, initial information dimensions, coded information dimensions and final collated information dimensions

Study	Year	Subject	Information aspects	Initial Information dimensions	Coded information dimensions	Merged information dimensions
1	1996	Information handling behaviour of designers during conceptual design	- Descriptor - Subject - Class - Medium - Level of detail	Subject Medium Level of detail	Type Format Attributes	
2	2001	Development of design information framework for interactive system design	- User Study - Design - Prototyping - Evaluation	User study	Type	
3	2003	Understanding knowledge needs of novice designers	- Types - Topics	Types Topics	Format Type	Source Type Format Attributes
4	2004	Problem structuring & information access design	- Source - Accessibility	Source Accessibility	Source Attributes	
5	2004	Information behaviour of designers	- Type - Source - Share & exchange - Needs	Type Source	Type Source	
6	2005	Designer requirements for user information	- Quality - Format - Source	Quality Format Source	Attributes Format Source	
7	2006	Providing user information to designers	- Type - Format	Type Format	Type Format	
8	2007	Working with user data in designing	- Presentation format	Presentation	Format	

9	2010	Information requests & seeking behaviour of aerospace designers	- Search - Sources - Type - Media	Sources Type Media	Source Type Format	
10	2011	Information-related behaviour of emerging artists and designers	- Accessing - Sources	Source	Source	

❖ **Design context**

Every act of information behaviour, whether observed in its behavioural or information-related manifestation, happens in a context. It is important to define the 'design context' and its constituents, alongside investigation of information dimensions. This is in order to provide a holistic understanding of information behaviour and facilitate design and development of information systems and tools for designers. In design, contexts have been largely - yet again partially - addressed. Some examples of design context investigations are summarised in Table 2.2 (studies one, four, five, nine and ten). Some key design context classifications are briefly summarised here. Several accounts have been identified as influencing factors on designers' behaviour. Some of these include: education (Thomas and Carroll, 1979; Lawson, 1979), experience (Lloyd and Scott, 1994) and idiosyncratic aspects (Christiaans and Dorst, 1992; Dorst, 1997; Christiaans and Restrepo, 2001). The Layered Behavioural Model of Product Design presented in Figure 2.13 (Curtis *et al.*, 1988), addresses a number of hierarchical aspects that could be seen as the context to information behaviour. These include Individual, Team, Project, Company and Business Milieu.

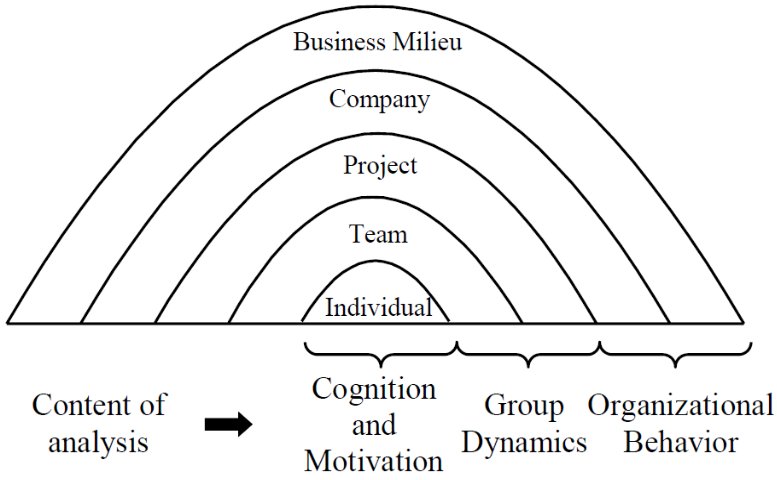


Figure 2.13 Layered Behavioural Model of Product Design (Curtis *et al.*, 1988)

In a study about information needs of aerospace engineering designers and its consequences on information seeking, Aurisicchio *et al.* (2010, p.711) describe the 'work context' based on "the environment, the role of the seeker, the project type, the stage of the project life cycle, and the task or activity type". An illustrative list of contextual factors in design, or in other words, 'design context' constituents is summarised in Table 2.5.

Table 2.5 Illustrative review of design context in studies of design

<table>
<tr><th>Restrepo & Christiaans (2004)</th><th>Song (2004)</th><th>Aurisicchio et al. (2010)</th><th>Mason & Robinson (2011)</th></tr>
<tr><td>Education
Experience
Idiosyncratic</td><td>Individual</td><td>Seeker
Background
Education
Role</td><td>New
Established</td></tr>
<tr><td rowspan="7">Design situation</td><td rowspan="4">Project</td><td>Task</td><td rowspan="4">Cost factors</td></tr>
<tr><td>Stage</td></tr>
<tr><td>Source</td></tr>
<tr><td>Info needed</td></tr>
<tr><td>Team</td><td>Work context</td><td></td></tr>
<tr><td>Company</td><td>Environment</td><td></td></tr>
<tr><td>Business milieu</td><td></td><td></td></tr>
</table>

The context studies showed a certain level of convergence in terms of the overall areas they addressed. As Table 2.5 shows, the context is divided into two key areas i.e. designer and the design situation. Each model, depending on its angle and focus, identifies these two areas in certain or no detail. The design situation factors are generally more detailed, however the designer specifications are also addressed based on criteria such as background, education, experience and role.

2.7 Synthesis of information behaviour in Design

An illustrative review of knowledge of information behaviour was carried out in Sections 2.4 and 2.5 focusing on the library and information sciences, and design respectively. The existing knowledge of information behaviour in these two fields was then analysed in Section 2.6. This section will synthesise and link the key identified aspects and facets of information behaviour in these two fields in order to reach an integrated and inclusive structure to be adopted in the design field.

Several yet narrow and scattered attempts to address information-related characteristics in information behaviour studies in design, on one hand reinforced the significance and inherent value of such studies of information behaviour and on the other hand highlighted a major gap in such studies and therefore existing knowledge. This was mainly due to a 'practice-triggered' yet not 'theory-based' approach lacking a holistic systematic outlook. Subsequent to 'analysis' of the two fields, the second stage in the literature investigation was 'synthesis' of the two fields, linking the key aspects of information behaviour in design with key facets of library and information sciences in an integrative approach. The inherently distinctive terminology and language of design and library and information sciences in addressing and investigating information behaviour resulted in identification of different focus and various aspects. This could be synthesised for a more rigorous, holistic and integrated approach to study of information behaviour in design. This way, the applied and information-oriented language of information behaviour in design was maintained yet enhanced. Adopting and being built upon theoretical frameworks of information behaviour in library and information sciences, information behaviour structures in design could be made theoretically rigorous and comprehensive.

2.7.1 Synthesis of Design Context

Many parallels were observed between the design and library and information sciences' categorisation of 'context'. These are shown in Figure 2.14, through grouping and leveling certain categories of the seven selected structures. The synthesis of design context and contextual factors of information behaviour in library and information sciences resulted in an integrated 'design context' for information behaviour in design as shown in Figure 2.14. The synthesised design context merges Case's (2008) and Wilson's (1999) perspective on contextual factors from the information sciences, together with Song's (2004), Restrepo and Christiaans's (2004) and Aurisicchio's (2010) detailed classifications of context in design. The resulting design context includes 'designer' representing the individual and behavioural aspect of context, and 'brief', 'team', and 'client' representing the organisational and situational aspects. The resulted design context is thus inclusive and integrated, yet specific and reflective of design context.

The four key constituents of Design Context are outlined below based on the four sections identified following linking, grouping and leveling various categories:

Section **1**: **Designer** - merging Education, Experience and Idiosyncratic with Individual and Seeker.

Section **2**: **Brief** - merging Project with Cost factors, and Task, Stage, Source and Info needed.

Section **3**: **Team** - merging Work context with Team and Company, coming up with a wider definition of Team.

Section **4**: **Client** - merging and reflecting on Environment and Business milieu.

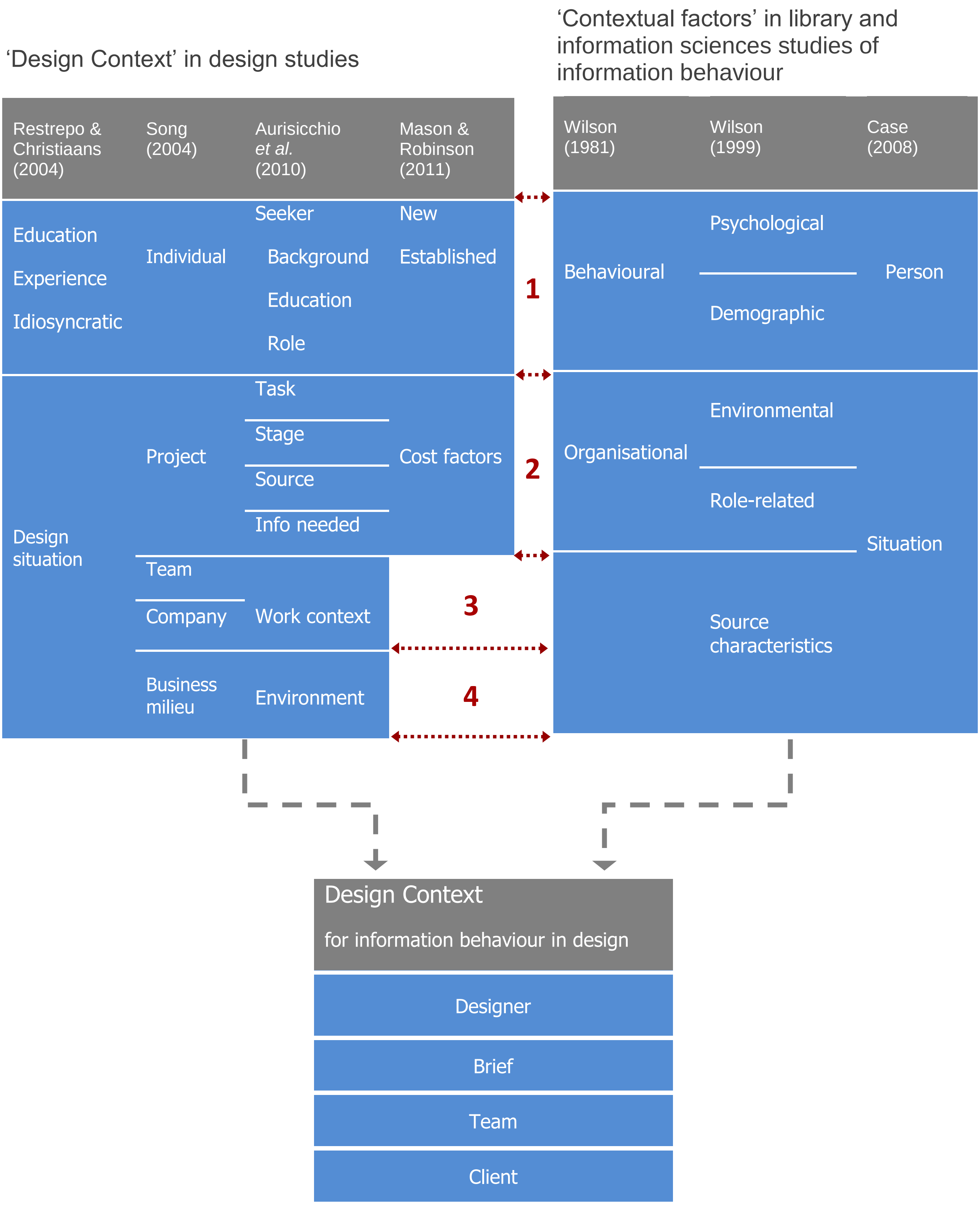


Figure 2.14 The synthesis process of 'Design Context' in information behaviour in design

2.7.2 Synthesis of Initial Information Framework

The initial set of information dimensions derived from the analysis and synthesis of literature in fields of design and library and information sciences formed the 'Initial Information Framework' for information behaviour in design. Figure 2.15 shows the process of synthesis of information behaviour facets (in library and information sciences) with information dimensions (in design), resulting in an integrated set of information dimensions for information behaviour in design.

The identified information dimensions in design included 'type', 'format', 'source' and 'attributes'. These were aligned with the three facets of information behavior identified as key in information sciences i.e. information 'need', 'seeking' and 'use'. The 'type', 'format' and 'attributes' dimensions were in line with the 'need' facet, while the 'source' dimension related to 'seeking' facet. The 'format' dimension was also in line with the 'seeking' facet, thus it was located in the borderline between need and seeking facets. However, the 'use' facet did not have a parallel in the identified information dimensions. Therefore in merging the two sets, 'use' was included as a dimension to the initial information framework in design. As a result, the proposed initial framework included five dimensions i.e. 'type', 'format', 'source', 'attributes' and 'use'.

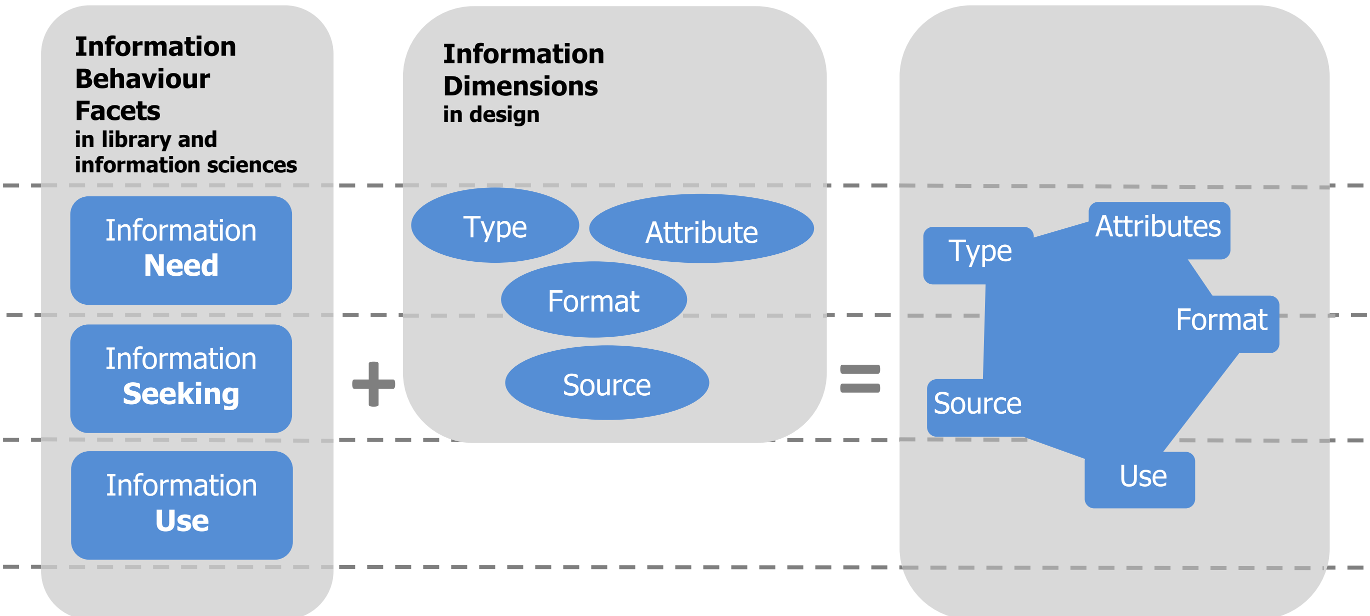


Figure 2.15 Synthesis of 'Initial Information Framework' for information behaviour in design

The five information dimensions identified for inclusion in the initial information framework were defined as below:

Source - how is the information sourced?

Type - why type of information is needed?

Format - what representation of information is needed?

Attributes - what are the qualities of the information needed?

Use - how is the information used?

2.8 Summary

This chapter provided the background to the research through reviewing the current contexts for information in design and analysis and synthesis of literature in information sciences and design. An illustrative overview and analysis of the models, theories, contexts and facets of information behaviour in the fields of library and information sciences (as the nesting field) and design identified gaps in existing understanding of information behavior in design. These gaps included lack of a holistic understanding of designers' information behaviour and the need to approach it in a systematic and integrated way. Based on this, the 'design context' and 'initial information framework' for information behaviour in design were outlined. Also, 'people information' and practicing designers were identified as the key focus of this research.

Chapter Three

Research Methodology

"What we know is determined by the available methods for knowing."
M. Scott Poole and Robert McPhee (1994, p.43)

A critical review of literature in Chapter Two highlighted a lack of a holistic understanding of designers' information behaviour and the need to approach it in a systematic and integrated way. Thus the research focused on developing a structure for better understanding, investigating and reflecting on designers' information behaviour and an initial information framework was outlined through the analysis and synthesis of relevant literature in library and information sciences and design.

The initial framework was then to be evaluated, refined and detailed through a series of studies following a research methodology and implementing appropriate methods. This chapter describes how this was planned and the methodology and strategy adopted for carrying out the research. The methodology and strategy were based on a critical review of a number of research strategies and methodologies in social sciences, information behaviour and design field. The methodology is composed of three key stages including *outlining the initial framework* through literature review, *refining, evaluating and detailing the framework* through four descriptive studies and finally *presenting the framework.* The structure of the chapter is illustrated in Figure 3.0.

Figure 3.0 Chapter Three structure

3.1 Research strategy and methodology

Gray and Malins (2004) define research as a process that embodies three major questions i.e. 'What', 'Why' and 'How'. Chapters One and Two addressed the what and why questions through investigating the research background, motivations, questions and identifying research gaps and the area of focus. This chapter focuses on addressing the 'how' question through identifying an appropriate methodology and methods for undertaking the research. Case (2008) addresses methodology as 'how we find out' and epistemology as 'how we know'. Before attempting to carry out studies of designers' information behaviour, it is essential to establish a research strategy and methodology, and identify the research epistemology in order to clarify how and in what way this research intends to 'find out' and 'know' about the designers' information behaviour.

3.1.1 Research strategies

In this section a number of general and design-specific research strategies i.e. research approaches, types and frameworks are reviewed. Based on this illustrative review, an overall research strategy is adopted for this PhD research in Section 3.2. The term strategy is used as a general umbrella term here covering some of the important approaches, perspectives, aspects and types of research. Some most frequently mentioned research strategies in social sciences and design literature are briefly reviewed below.

Research strategies could be classified based on various criteria. One major distinction in terms of the types of research is qualitative research versus quantitative research (Bryman and Teevan, 2005; Creswell, 2009). The nature of enquiry and the approach of each of these research strategies to data collection and analysis are quite distinctive and very different. Some distinguish these two types based on different approaches towards theory building (qualitative) or theory testing (quantitative) (Bryman and Teevan, 2005; Henn, *et al.*, 2006).

Another well recognised classification in research approach is the distinction between deductive and inductive research. Inductive research works from small facts and interpretations moving towards making theories and hypothesis based on them; from small to big. While deductive research applies an overall theory or assumption to a specific case; from big to small. These two approaches are sometimes informally referred to as 'top-down' and 'bottom-up' approaches. Case (2008, p.179) explains the notion of inductive research as research that "examines particular instances and reasons toward generalisation" and argues that most qualitative methods tend to be inductive. Grounded theory is one area where inductive research approach is applied. Deductive research on the other hand is explained as "applying a theory to a particular case in an attempt to test the theory" (Case, 2008, p.179) and is mainly associated with quantitative research methods (Bryman and Teevan, 2005).

One key area to be addressed in planning a research study and deciding the research approach, is the epistemological perspective. Epistemology is defined as "the theory of knowledge embedded in the theoretical perspective and thereby in the methodology" (Crotty, 2004, p.3). In social sciences, two major theoretical perspectives are frequently discussed, i.e. positivism and interpretivism.

Positivism has a tendency towards methods used in natural sciences and is linked with objectivism (Crotty, 2004; Gray, 2004) and quantitative research. This is while Interpretivism deals with building theories (Henn, *et al.*, 2006).

Another dimension in research design is clarifying research 'purpose', influencing the type of research carried out. Three types of research and research design have been identified based on their purpose i.e. 'exploratory', 'descriptive' and 'explanatory' (Robson, 2002; Yin, 2009). It is argued that there is a hierarchical order to these three types of research; exploratory research is the first level and is conducted in addressing a problem that has not yet been clearly defined. It is applied where an area still needs to be explored and theories or hypothesis need to be formed after collecting data regarding a phenomenon. Descriptive research, at the next level, goes one step further by describing different characteristics of a phenomenon. The most comprehensive form of research is the explanatory research where not only various aspects of a phenomenon are presented but also the 'causes' of events and how and why they happened are explained. Explanatory research is carried out when the research area has matured.

All the above were general research types and approaches mainly adopted from the field of social sciences. Below, three well-known and relevant frameworks of design research are reviewed. These three design research frameworks are selected based on their level of generalisability, and their relevance to the context of this research and its focus.

Frayling (1993) classifies art and design research into three areas of research 'into' design, 'through' design and 'for' design. Research into design is where design becomes the very subject of research and investigation. Research through design is where design is the vehicle to the research and a means of communication of results. In research for design, the end product is an artefact for which some process of research and investigation has been carried out.

Cross (1999) proposes a Design Research Taxonomy, suggesting design knowledge exists in people, processes and products. Design 'epistemology' concerns people and refers to studies of designerly ways of knowing and working. Design 'praxiology' concerns processes and refers to studies of design methodologies, strategies and techniques applied to the process of design. Finally, design 'phenomenology' concerns products and refers to explicit knowledge embodied in artefacts.

A more recent model, reflecting on a specialist filed, in line with progression of design into new areas and applications, is the Fallman's (2008) model of interaction design. Fallman proposes a model of interaction design research in three areas i.e. design practice, design studies and design exploration. These areas range from the realm of commercial design (design practice) to scholarly theoretical studies of design related to fields of design theory, philosophy, methodology and history (design studies) to a 'what if' approach to design research exploring boundaries and critiques of design (design exploration). Figure 3.1 demonstrates the Interaction Design Research Model by Fallman. This model is specifically important as it reflects on latest areas and segmentations in design practice and research. A summary of the three design research frameworks discussed here is presented in Table 3.1.

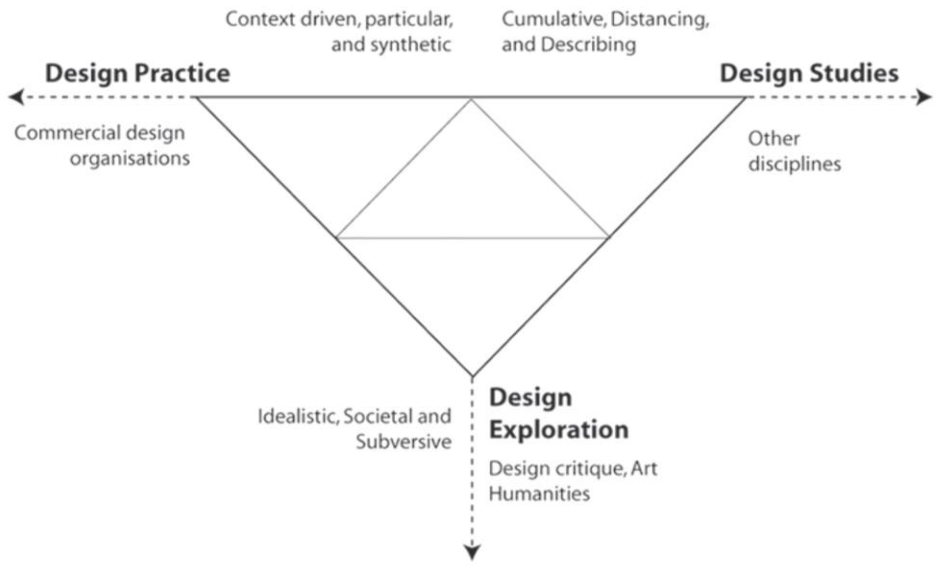


Figure 3.1 Fallman's (2008) Interaction Design Research Model

Table 3.1 Summary of three design research frameworks discussed

Frayling (1993) Classification of art and design research • Research INTO design • Research THROUGH design • Research FOR design
Cross (1999) Design research taxonomy • Design epistemology- study of designerly ways of knowing (people) • Design praxiology- study of practices and processes of design (process) • Design phenomenology- study of the form and configurations (product)
Fallman (2008) Interaction design research model • Design practice • Design exploration • Design studies

3.1.2 Research methodologies

In order to adopt an appropriate research methodology, a number of social sciences, information behaviour, and design research methodologies were reviewed. These were relevant to the nature and expected outcome of this research which was primarily in the field of design and also had a strong social sciences nature due to its investigation of human behaviour - designers' information needs and how they seek and use information.

In a comprehensive survey of research on information behaviour, Case (2008) proposes a general outline of research process featuring five main stages (Figure 3.2).

Case (2008) General Research Process

1. Imagining a research question
2. Determining what data are needed and designing a specific study to collect it
3. Choosing and implementing research methods
4. Analysing and interpreting observations
5. Considering the overall results

Figure 3.2 Case (2008) General Research Process

Robson (2003), in his book 'Real World Research', proposes a research methodology with five elements to social scientists and practitioner-researchers (Figure 3.3).

Robson (2003) Research Methodology in Social Sciences

1. The purpose of the study: exploratory, descriptive, explanatory
2. The research strategy: case studies, experiment, survey
3. The type of research being carried out: qualitative or quantitative
4. The data collection techniques: interviews, ethnography, checklist, etc.
5. The analysis approach: coding and clustering, qualitative analysis

Figure 3.3 Robson (2003) Research Methodology in Social Sciences

Both methodologies mentioned adopt a general social sciences approach. In addition, further two design research methodologies were reviewed, one featuring the 'sequence' and the other focusing on the 'elements'. Blessing and Chakrabati (2009) Design Research Methodology (DRM) is a widely accepted general design research methodology composed of four main stages (Figure 3.4, as cited in Cifter, 2011).

Blessing *et al.* (1995) Design Research Methodology

1. Research clarification
DRM starts with the identification of the success criteria, which points out the aim of the research.
2. Descriptive Study 1
The purpose of Descriptive Study 1 is to understand the criteria broadly in order to help the researcher to identify the influencing factors on the success.
3. Prescriptive Study
After understanding the influencing factors on the success criteria, a prescriptive study is carried out to develop a method or a tool to support the problem definition with reference to the results of the Study 1.
4. Descriptive Study 2
The aim of the 'descriptive study 2' is to test whether the support developed in the prescriptive study addresses the identified factors as proposed, as well as to see if it contributes to success.

Figure 3.4 Blessing *et al.* (1995) Design Research Methodology

In the field of design research, DRM (Blessing et al., 1995; Blessing and Chakrabati , 2009) has been adopted and adapted in various studies of design (Ahmed, 2000; Dong, 2004; Cardoso, 2005; Gupta, 2007, Cifter, 2011).

3.2 Adopting a research strategy

Various research strategies and viewpoints were reviewed in Section 3.1.1. This research is primarily qualitative and inductive. However, a quantitative approach is adopted in a survey study in order to collect design practitioners' and researchers' self reflections on information behaviour. Also, a deductive approach is adopted in the literature analysis stage through formulating an initial framework. From an epistemological standpoint, this research is primarily concerned with the behaviour of designers, dealing with qualitative data and relying on both subjective and objective measures of designers' practice, therefore it can be explained by constructivism. Thus an interpretivist theoretical approach is adopted. This research is a combination of exploratory and descriptive research as the existing literature about designers' information behaviour is scarce and research needs to be carried out in order to uncover new elements and structure (the information framework). It should be noted that the approach towards the study of designers' information behaviour in this research is 'descriptive' but not 'explanatory' in that it provides a detailed picture of various dimensions of information behaviour but does not aim to examine the reasons behind the behaviour and casual relationships. As discussed, explanatory research is carried out when the research area has matured, while this research area in design is still of an unexplored nature and needs to be clearly defined as a first step. Table 3.2 summarises the research strategy in adopting various approaches.

Table 3.2 Research strategy adopted for this research

Area	Existing Research Strategies	Adopted Research Strategy
General/ Social Sciences	**Quantitative** **Qualitative**	Primarily qualitative while integrating quantitative studies such as a survey
	Inductive **Deductive**	Primarily inductive while deductive in literature review
	Positivism **Interpretivism**	Interpretivism
	Exploratory **Descriptive** **Explanatory**	Descriptive + Exploratory Primarily descriptive but also exploratory
Design	**Research INTO design** **Research THROUGH design** **Research FOR design**	Research INTO design
	Design Epistemology **Design Praxiology** **Design Phenomenology**	Design Epistomology + Praxiology Primarily design epistemology (studying designers) but also partially studying processes
	Design Practice **Design Exploration** **Design Studies**	Design Studies + Exploration

3.3 Designing a research methodology

Case (2008) addresses designing a research methodology as 'designing investigations' and methods as 'techniques of observation and measurement'. Poole and McPhee (1995, p.43) interpret methods as "one's point of contact with the world" and emphasise the importance of selecting appropriate methods in order to carry out a valid and reliable investigation. After the review of a number of relevant social sciences and design research methodologies in Section 3.1.2, and based on the nature of the information behaviour study and its aims and objectives, a specific research methodology was designed. The general research methodology adopts an integrative approach to existing research methodologies where the general elements of DRM (Blessing *et al.*, 2009) and Case's stages of research process (2008) are applied and Robson's (2003) research methodology is also implemented in specifying research methods and techniques of data collection and analysis.

The study adopts a convergent methodology (Goodman *et al.*, 2006) through employing a number of research methods. The research triangulation (Jick, 1979; Creswell and Clark, 2007) approach is adopted in order to enable cross examination (Cheng, 2005) of the results of the studies. Thus, the initial framework outlined based on literature analysis and synthesis; is planned to be revised, evaluated and detailed in an iterative cycle through three types of complementary studies, i.e. interviews with designers, observations of designers and a survey with designers and design researchers. Studies vary in terms of breadth, depth, level of control, scope and generalisability (Henn *et al.*, 2006). Through using a variety of methods, approaches and participants along with the literature analysis and synthesis, validity and reliability (Gray, 2004) of research is hoped to be improved.

Creswell (2009) argues that mixed methods research provides the best information, thus such an approach is adopted in designing each of the three types of studies above and where possible, a number of complimentary methods are implemented in order to collect data through multiple rather than single channels. Each method has its own advantages and limitations in terms of reliability, validity and accuracy and thus its own ability to uncover 'non-obvious' dimensions of designers' information behaviour. The limitations of each method used will be discussed in detail in Chapters Four, Five, Six and Seven. Goodman *et al.* (2006) argue that using a convergent approach as such allows cross-checking of findings, improves the balance between advantages and disadvantages of various studies and methods of designers' information behaviour research, and avoids favouring any one interpretation by providing multiple views at different levels of objectivity. In line with this, two predominantly different methods in terms of level of objectivity are particularly adopted, including observation and self-reporting. The designing of the research methodology is composed of three key phases including 'outlining the initial framework', 'revising + evaluating + detailing the initial framework' and finally the 'presentation of the final framework'. Figure 3.5 presents the schematic research methodology adopted by this thesis.

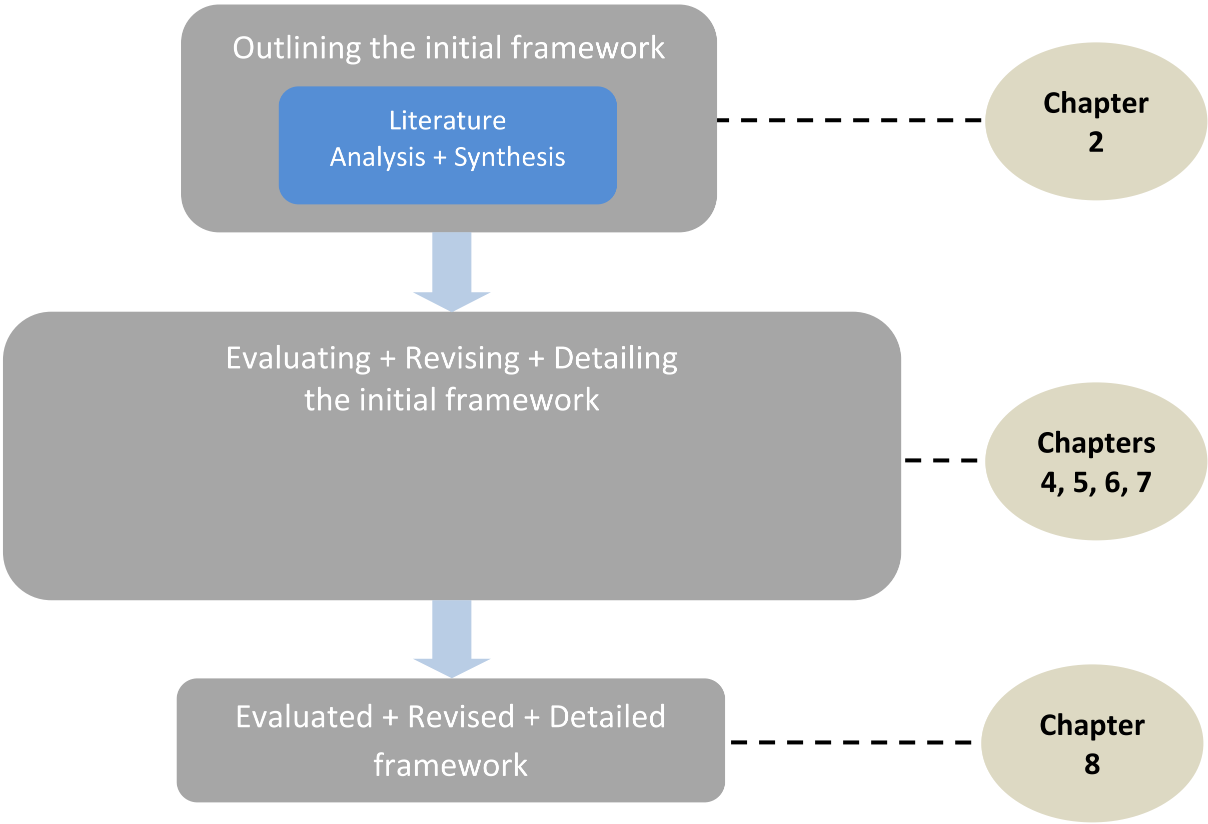


Figure 3.5 Research methodology in this research

3.3.1 Outlining the initial framework

The key aim of this research was to provide a better understanding of information behaviour in design, leading to a systematic way to address the key dimensions of information used in a design process, aiming to facilitate investigation, analysis and reflection on designers' use and requirements of information. Due to scarce existing knowledge on information behaviour in design, it was difficult to start with any measurable criteria or structure for studying designers' information behaviour. Therefore the research started with analysis and synthesis of literature in two fields, i.e. library and information sciences, and design, aimed at identification of such a structure. Literature analysis (Section 2.7) highlighted a lack of a holistic and systematic understanding of information behaviour in the field of design and the need for theory-supported comprehensive structures for study of information-related dimensions in design. Thus, in an integrative approach and through analysis and synthesis of relevant literature, an initial information framework was outlined. Also, based on the literature review, the research focused specifically on 'people information' as one key type of information used in the design process. The research also focused on 'practicing designers' as the key designers responsible for real world application of design.

This initial framework is then to be revised and evaluated as a criterion and structure to be used in the studies of information behaviour. A systematic approach is adopted for the design and development of the framework where, by mimicking the design process, the 'framework' is approached as the 'product' to be designed and developed, for which a design process needs to be planned. For this purpose, a model of design process is adopted. Cross (1995) identifies the Systematic Approach to Engineering Design by Pahl *et al.* (2007) as one of the most prominent and commonly implemented models of engineering design process. This model is adopted for a systematic approach to design of the information framework. Pahl *et al.* model of the engineering design, divides key stages of the design process into four parts summarised in Figure 3.6.

Pahl *et al.* (2007) Systematic Model of Design Process

1. Clarification of the task
Collection of information about the requirements and about the constraints

2. Conceptual design
Establishment of functional structures, the search for suitable solution principles and their combinations into concept variants/design alternatives

3. Embodiment design
Development of layouts and forms for the concepts, evaluation of them, determination of a preliminary layout, optimisation, definite layout

4. Detail design
Finalisation of design

Figure 3.6 Pahl *et al.* (2007) Systematic Model of Design Process

In adopting and adapting Pahl *et al.* model of design process to design and development of the information framework, a number of key stages are considered. Figure 3.8 shows the three stages of information framework design process derived from the Systematic model of Engineering Design Process (Pahl, *et al.*, 2000). As seen in stage one in Figure 3.6, the design action starts with identification of a need for a design solution or a concept and ends with a product that embodies the idea and addresses the need. In terms of the information framework, this first stage is the outlining of the initial framework based on analysis and synthesis of relevant literature. There are three key design steps in Pahl *et al.* (2000) model, i.e. Conceptual design, Embodiment design and Detail design.

The 'conceptual' design stage considers alternative concepts looking for the best solution and focuses on selection of criteria relevant to performance specifications of product (Erden, 2004). Applying this stage to the information framework design process, this stage would mainly translate into 'Refinement' stage where the initial framework concept is being constantly considered for alternative concepts. This would include selection, inclusion and reduction of 'dimensions' which are the criteria for performance specification.

The second design stage is 'embodiment' which centres around the function of the system and its analysis and evaluation in regard to its performance. In designing the information framework, this stage is called 'Evaluation', mainly focusing on the overall function of the framework as a whole in regard to its expected performance.

The last design stage is the 'detail' stage where the main criteria is maximising the performance and detailing the design. In the design and development process of the information framework, this stage is called 'Detailing' where the evaluated framework and its refined dimensions are provided with detail in terms of how each dimension breaks down into 'sub-dimensions[4]'. This also includes how the framework is populated based on defining sub-dimensions for each dimension of the information framework and then specifying the relevant sub-dimension for each dimension throughout the design process and its stages.

As in many models of design process, an 'iterative' aspect is introduced to the three design stages of the framework, i.e. 'refinement', 'evaluation' and 'detailing', where the whole three stages of the design cycle are to be repeated in an iterative cycle in order to constantly improve the design of the information framework through refining, evaluating and detailing it. For the purpose of this research the three terms 'refine', 'evaluate' and 'detail' are defined in Figure 3.7.

[4] 'Sub-dimensions' in this research are defined as various factors or elements classifying and categorising each of the dimensions of the information framework.

Refine:
To distil the dimensions of the framework through modification, inclusion and/or reduction of them
Evaluate:
To assess the framework as a whole, based on its capability to address information-related behaviour of designers in the design process
Detail:
To provide sub-dimensions for each dimension of the framework and to detail designers' information-related behaviour throughout the design process[5]

Figure 3.7 Three stages of design and development of the Information Framework

As it can be seen in the definitions of these three stages, the 'refine' and 'evaluate' stages both have aspects of assessment in them but they differ in that, the 'refine' stage is assessing the components (dimensions of the information framework) of the system and improving them, while the 'evaluate' stage is assessing the whole system (the information framework as a whole).

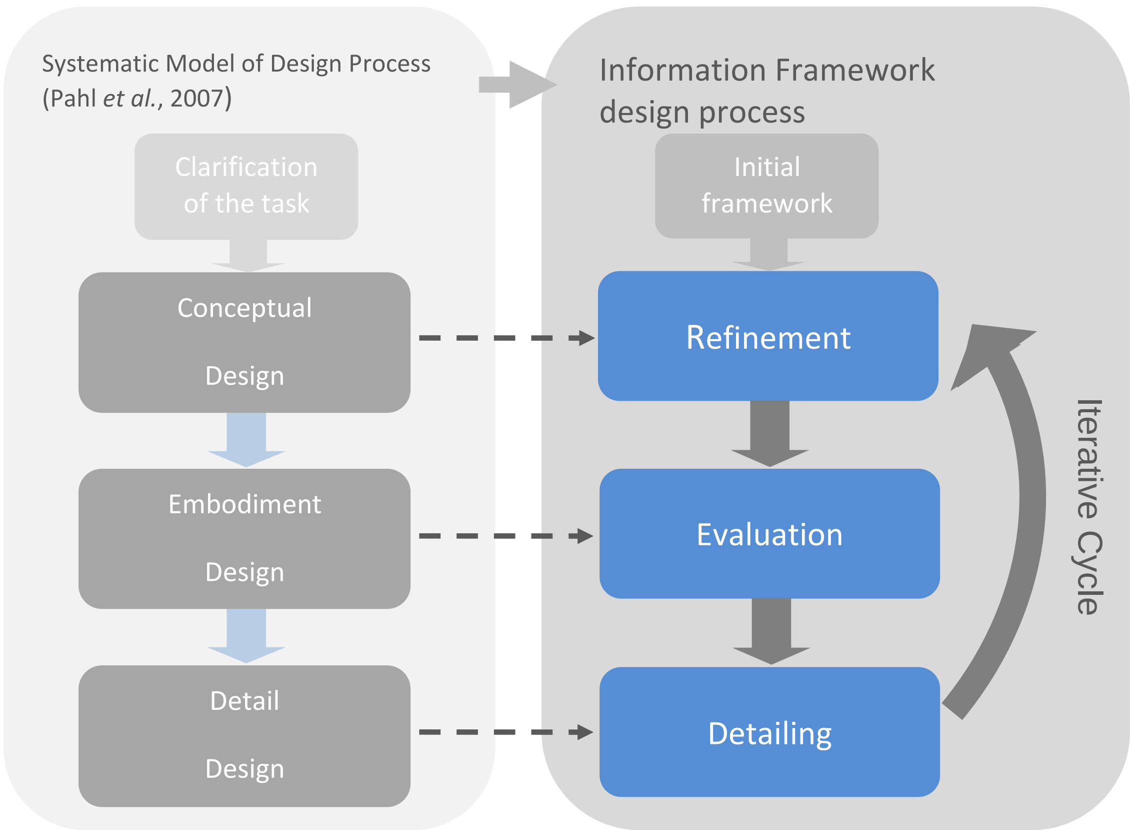


Figure 3.8 Information framework design process derived from Design Process model

[5] The Double Diamond Design Process model (Design Council, 2005) was adopted for this.

3.3.2 Iterative development of the framework

Through adopting a systematic design process model, the process for design and development of the initial framework is outlined in three iterative steps i.e. 'Refinement', 'Evaluation' and 'Detailing'. Research triangulation (Creswell and Clark, 2007) is adopted in order to enable cross examination of the results and three different yet complementary methods are applied and combined to study the same phenomenon. The three combined methods are both qualitative and quantitative in their nature and include an interview and questionnaire administered to nine design companies, observation of four design teams in two real-world design projects, and a survey of professional designers and design researchers. The phenomenon studied is the information behaviour of designers through implementing the information framework.

The initial information framework is used to study the information behaviour of designers in each study and is then revised, evaluated and detailed after each study. This refined, evaluated and detailed framework then goes through another round of refinement, evaluation and detailing in the next study and this iterative cycle is repeated four times, for each of the studies planned. This way, each study provides the input (framework) for the next study. Based on the nature of each study, various methods of data collection and analysis are used. Reflecting on selection of methods of data collection, Case (2008, p.178) says "multiple sources of evidence contribute to more compelling conclusions and are thus to be preferred". Therefore, a mixed methods research (Creswell, 2009) is adopted and where possible supportive or supplementary methods as a second data collection method are used to validate or corroborate the results.

Table 3.3 presents a breakdown of studies and relevant methods used in the second stage of the research. Each data collection and analysis method implemented in the study will be discussed in detail in the relevant chapters where issues regarding validity and reliability of methods will be addressed.

Table 3.3 Research strategies adopted for this research

	Study 1: Interview with designers	**Study 2:** Observation of designers	**Study 3:** Observation of designers	**Study 4:** Survey with designers & researchers
Type of research	Qualitative + Quantitative	Qualitative	Qualitative	Quantitative + Qualitative
Data collection methods	Semi-structured interview + Ranking questionnaire	Marginal participant observation + Online questionnaire (multiple-answer questions)	Recognised outsider observation + Online questionnaire (multiple-answer questions)	Online survey (open questions for comments & multiple-answer questions)
Data analysis methods	Qualitative + Statistical analysis	Qualitative analysis	Qualitative analysis	Statistical + Qualitative analysis
Number of participants	9	5 (1 project)	19 (3 teams)	Refinement: 89 Evaluation: 89 Detailing: 66

3.3.3 Refined + Evaluated + Detailed framework

The overall information framework and its dimensions are to be assessed. The dimensions of the information framework are to be assessed and then modified, included or reduced through 'refinement', while the framework itself is assessed through 'evaluation' stage. Both refinement and evaluation take place in an iterative cycle through four different studies. This means the 'refinement' and 'evaluation' results from the last of the four studies (i.e. survey with designers and design researchers), embodies and includes all the evaluations and refinements form the past three studies and reflects on those refinements and evaluations. Thus, the evaluation and refinement of the framework in the last study is considered the concluding refinement and evaluation of this research.

The framework is also detailed through four different studies, and each dimension is populated by a number of sub-dimensions in each study. These detailing results from each study are discussed and a conclusion is made on the detailing of the information framework based on the results from each of the four studies. The final outcome of the research based on literature review and the four descriptive studies, leads to a refined version of the information framework that has gone through four rounds of evaluation and detailing. It included seven key dimensions i.e. 'purpose', 'source', 'format', 'type', 'attributes', 'stage' and 'intensity'. The framework details designers' behaviour throughout the design process in regard to each of the seven dimensions of information. Thus, the seven dimensions are detailed for each of the four stages of the Double Diamond design process (Design Council, 2005) including 'Discover', 'Define', 'Develop' and 'Deliver'. The potential contribution of the information framework to studying information behaviour is then discussed in the context of design industry and design education and further work is outlined.

3.4 Summary

This chapter reviewed a number of relevant research strategies and methodologies from the design, information behaviour and social sciences fields. It explained how a research strategy was adopted and how a research methodology was designed. The chapter detailed each phase of the design methodology and provided a breakdown of various studies and methods used for data collection and analysis. Table 3.4 summarises the phases of the research methodology, studies and methods used in each phase and the results from each phase.

Table 3.4 Research phases, methods applied and study results in this research

Research Phase	Studies & Methods	Results
Phase 1: Outlining the initial framework	Literature Analysis + Synthesis	Initial information framework outlined including five dimensions
Phase 2: Iterative development of the framework	1. Interview with designers (interview + questionnaire)	- 'Purpose' dimension included - 'Use' dimension modified - Three dimensions detailed - Framework evaluated
	2. Observation of designers I (observation + questionnaire)	- 'Stage' dimension included - Six dimensions detailed - Framework evaluated
	3. Observation of designers II (observation + questionnaire)	- Seven dimensions detailed - Framework evaluated
	4. Survey of designers & design researchers (questionnaire)	- Three dimensions modified - Seven dimensions detailed - Framework evaluated
Phase 3: Refined + Evaluated + Detailed framework	Discussion and conclusion of the results from four studies	- Seven dimensions detailed - Framework evaluated - Framework contribution and further work identified

Chapter Four

Interviews with designers

"A designer doesn't think in numbers. What we do is an intuitive emotive thing. And I think basically all these (anthropometric) tools are given for scientists. Ergonomics is a science!"

Study interviewee – Creative Director, Product Design and Strategy Company, UK (2008)

Through analysis and synthesis of relevant literature in two fields i.e. library and information sciences and design, Chapter Two outlined an initial framework for better understanding, investigating and reflecting on designers' information behaviour. The initial framework identified five dimensions including information Source, Type, Format, Attributes and Use. Three research methods were selected in the Methodology Chapter in order to refine, evaluate and detail the framework through primary research. In order to achieve this, the initial five dimensions were to be refined and detailed and new dimensions were to be identified where applicable. The first of three triangulated research methods was interviews with designers. As a complimentary method, ranking questionnaires were also used alongside interview sessions. The structure of the chapter is illustrated in Figure 4.0.

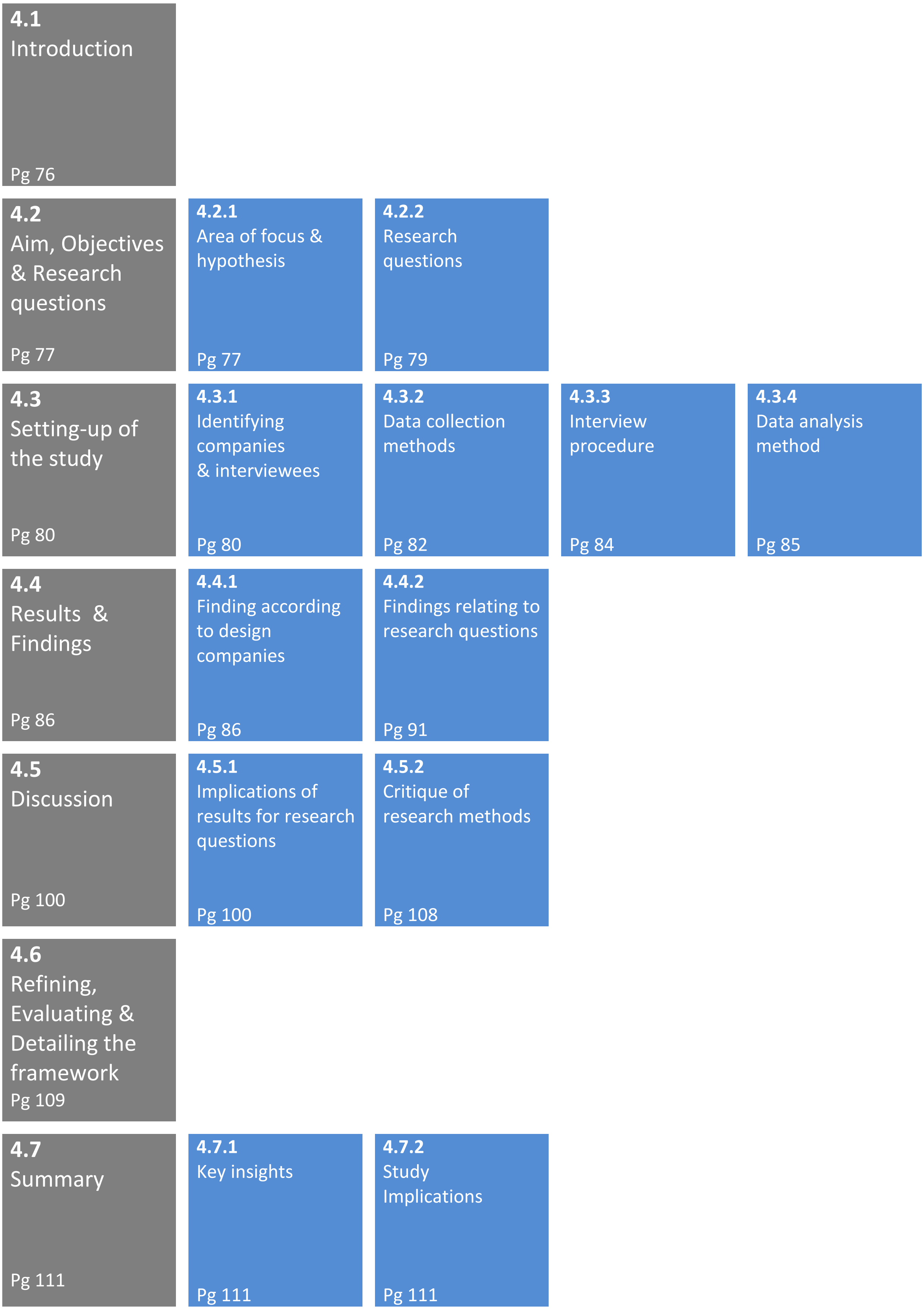


Figure 4.0 Chapter Four structure

4.1 Introduction

Using interviews and ranking questionnaire, this chapter addressed each of the five dimensions of the initial framework and further detailed them by identifying sub-dimensions to each. Also, the chapter collected designers' responses to five selected design support tools in form of comments and numerical ranking in order of preference. The designers were also asked to provide their suggestions for future tools. Through inclusion of a selection of tools and discussing them, the chapter aimed to enrich its investigation into designers' information behaviour and provide further insights and understanding. In order to explore all the above in good depth and to investigate and identify as many issues as possible, the chapter focused on one type of people information in specific, i.e. anthropometrics. Anthropometrics was selected as the focus of the chapter and all the above issues and dimensions were investigated in relation to this type of information specifically. This chapter also evaluated the initial framework and suggested refinements and modification to the initial framework dimensions. It led into a new refined version of the framework. The new refined framework also provided sub-dimensions for unmodified dimensions.

This chapter has five main sections, including 'Introduction', 'Setting up the study', 'Results and Findings', 'Discussions' and 'Summary'. The sections are presented in a chronological order and each builds on the previous sections of the study. Section 4.1 starts by summarising results of previous chapters (specifically Methodology and Literature Review), explains where this study sits in relation to the overall aim and direction of the research and the other chapters and summarises where the chapter is leading to. Section 4.1 outlines three key sub-sections; presenting the aim and objectives, focus of the study and hypothesis and research questions related to this section of the thesis. After clarifying the aim, objectives, research questions and focus of the study, Section 4.2 details the process of identification of companies and target interviewees, data collection methods adopted, the procedure interview sessions and data analysis method used. After setting the scene, Section 4.3 presents the results of the study in two different ways, first based on various data collected for each company and then based on the research questions. Building up on the findings and results, Section 4.4 discusses identified issues, aspects and key outcomes. Section 4.4 also discusses the limitations and specifications of the research methodology adopted. Finally, Section 4.5 finishes the chapter by summarising the key outcomes, presenting a new revised version of the information framework and summarising what evaluations, refinements and details have been added to the framework.

4.2 Aim, Objectives and Research questions

As the first study, interviews had a two-fold aim. The main aim of the interviews was to explore and investigate designers' information behaviour and its various aspects and identify relevant issues in regard to that, through talking to designers and discussing a range of questions with them. One specific objective addressing this was to identify any other dimensions that could further describe and help understand designers' information behaviour. Further to this, interviews also aimed to refine, evaluate and detail the initial framework by specifically addressing each of the five dimensions identified through literature review. Table 4.1 lists the aims and objectives of the study.

Table 4.1 Interviews study – Aims and Objectives

Aim	Objectives
1. Explore various aspects of designers' information behaviour	1.1 To discuss issues and problems designers have with existing people information
	1.2 To collect preferences and suggestions regarding existing people information tools
	1.3 To identify other dimensions for the information behaviour framework
2. Refine, evaluate and detail the initial information framework	2.1 To refine the five dimensions of the framework
	2.2 To evaluate the framework
	2.3 To detail the five dimensions of the framework

4.2.1 Area of focus and hypothesis

Following the literature review and outlining of the initial framework, the interview study was the first study to be conducted around information behaviour of designers. As the first study, interviews had a strong exploratory nature and one major aim of it was to discover and identify any unidentified aspects of information behaviour. Every research method, including interview, has certain resource limitations such as limited time (the amount of time interviewees and interviewer could spend on each session) and limited human resources. Being an exploratory study, the focus of interviews was mainly on 'depth' rather than 'breadth'. Therefore, in order to explore the most unexplored aspects of information behaviour, it was intended that the study adopt a 'specific' and ‘focused’ approach and explore various dimensions of one type of people information in depth rather than adopting a ‘general’ approach addressing various types of people information and issues relevant to all of them.

Chapter two identified various types of people information. Among various types of people information, anthropometrics was selected as the focus of the interview study. Anthropometrics is from within the physical branch of ergonomics dealing with body size, shape, strength, mobility, flexibility and capability to work measurements (Pheasant and Haslegrave, 2006). Selection of anthropometrics as the type of people information to be focused upon, had a number of reasons. In order to better describe these reasons, firstly, specifications of this type of information are briefly reviewed.

Ergonomic information in general, is considered a fundamental type of information to the design of products (Norris and Wilson, 1997) and recognised as beneficial in various stages of the design process (Peebles and Norris, 2003). It plays a significant role in informing designers about people characteristics. Anthropometrics in specific, is often regarded as the basis of a designer’s information (Moggridge, 2007), especially when designing physical products. Being a fundamental type of information compared to other information types, it was expected that anthropometrics was more widely used by designers and also had a higher level of use, being more referred to.

Anthropometrics is a physical type of people information. Compared to non-physical types of people information, there are more tools currently available representing this type of information to designers. This is partially due to immeasurable nature of non-physical information making it difficult to measure, represent and communicate in the format of a tool. This is while physical information on people is more explicit, visualisable, and capable of capturing, measuring and representing. Based on the above specifications of anthropometrics information, a number of reasons were identified for focusing on this type of information. Table 4.2 presents these reasons in relation to study objectives.

Table 4.2 Reasons for focusing on Anthropometrics, in relation to study objectives

Reason (for focus on Anthropometrics)	Study Objective/s (related to specified reason)
It was expected that more information would be available to discuss problems with existing information and to identify other dimensions of information behaviour. This was due to (expected) wider and higher level of use of anthropometrics information by designers.	1.1 To discuss issues and problems designers have with existing people information 1.3 To identify other dimensions of the information framewrok
Due to higher number and wider range of information tools currently available for this type of information, it was expected that more data would be available regarding the preferences and suggestions on tools and that the collected data would be richer and more diverse.	1.2 To collect preferences and suggestions regarding existing people information tools
Being (hypothetically) a more familiar and used type of information, it was expected that identifying sub-dimensions for each dimension of information framework would be better facilitated. It was also expected that the data collected would be more in-depth and diverse.	2.1 To refine the five dimensions of the framework 2.2 To evaluate the framework 2.3 To detail the five dimensions of the framework

By focusing on anthropometric information as the subject of investigation, the study adopted two hypotheses. The first hypothesis was that, being a fundamental type of people information, anthropometric information was more widely and frequently used. The second hypothesis was that existing anthropometric tools were currently used to some extent by practicing designers and were among their sources of people information; therefore it was useful discussing and exploring designers' relation to and use of those tools.

4.2.2 Research questions

Ten research questions were formulated to investigate designers' information behaviour in regard to anthropometric data. The research questions were in line with the study aim and objectives and were devised to address all the objectives. 'Type' was one of the five dimensions included in the initial information framework. However, a research question addressing the Type of information was not included, as the type of information was already specified and the whole study focused on 'one' type of information i.e. anthropometrics. Research question One addressed the 'design process'. Design process was not identified as a dimension of the initial framework, however it was identified as an important aspect in the context of information behaviour, specifically in relation to information ‘use’. Therefore one research question was allocated to outlining the design process used. Table 4.3 presents research questions in relation to the study objectives.

Table 4.3 Research questions in relation to study objectives

Research questions - addressed IN interviews	Objectives
1. What is the designers’ design process?	1.1
2. How do designers source anthropometric information?	2.3
3. What formats of anthropometric information do designers use?	2.3
4. What are the attributes of anthropometric information designers use?	2.3 + (1.1)
5. How is anthropometric information used by designers?	2.3
6. What are designers’ preferences in terms of existing anthropometric tools?	1.2 + (1.1 + 1.3)
7. What are designers’ suggestions in terms of future anthropometric tools?	1.2 (1.1 + 1.3)
Research questions - addressed POST interviews	**Objectives**
8. Could the initial framework help understand key aspects of designer’s information behaviour?	2.2
9. What dimension/s need to be refined?	2.1
10. What new dimension/s should be included?	1.3

4.3 Setting-up of the study

This section presents how the study was set up, including participant companies, methods of data collection, procedure of the study and methods of data analysis.

4.3.1 Identifying companies and interviewees

Design companies (versus freelancers) were identified as the target. This was due to higher number of designers based at design companies and their major role in design industry in general (Design Council, 2008). Practicing designers with medium/high management roles based in design companies were selected for interviews. This was in line with the overall focus of the research on experience designers as the key focus of information behaviour study. Nine UK-based design companies were selected based on their main focus (product and industrial design) and for prior experience of working on a people-centred design brief (eight out of the nine design companies had attended the DBA Inclusive Design Challenge[6], a major inclusive design contest in UK). Design companies with previous awareness, knowledge or experience of applying people-centred

[6] DBA Inclusive Design Challenge is a major inclusive design contest in UK.

design were primarily targeted for two main reasons. First, the overall aim of the study was focused on understanding designers' information behaviour in regard to people information, therefore designers with a previous people-centred design background were preferred as they could better provide feedback and evaluate the existing people information, what was missing, and what needed to improve. Thus, information dimensions and issues around them could be more thoroughly addressed. Second, it was assumed that companies involved with people-centred design processes, specifically inclusive design, were more likely to refer to anthropometric data sources. The nature of inclusive design practice demands better understanding of various users with various physical capabilities, hence needing anthropometric data more critically.

The size of the companies ranged from small (nine employees), medium (16-40 employees), to large (over 100 employees). The majority of companies in the study were small or medium sized enterprises. Interviewees' average number of years of experience was 14 years. Apart from two interviewees (with two and four years of experience) interviewees' years of experience ranged between 15 to 25 years. The two interviewees with less than five years of experience both had senior and specialist roles within the company (founding director and senior specialist).Table 4.4 presents a profile of each design company interviewed. The company's area of expertise, role of interviewee in the company and their years of experience in the field, are listed in Table 4.4.

Table 4.4 Profiles of design companies and the designers interviewed

Company ID	Specialist area	Interviewee position	Interviewee years of experience
A	Product Design	Managing director	15
B	Interior Design	Managing director	12
C	Product Design	Managing director	25
D	Product & Service Innovation	Senior human factors specialist	2
E	Healthcare Innovation & Design	Managing director	17
F	Industrial Design	Managing director	16
G	Product Design & Strategy	Creative director	19
H	Industrial Design	Founding director	4
I	Product design	Managing director	19

4.3.2 Data collection methods

Face-to-face interviews and ranking questionnaires were adopted as complementary data collection methods, so as to provide both qualitative and quantitative information. This was in order to prohibit future limitations in the analysis of the collected information (Fidel and Green, 2004).The interview and questionnaire were designed to answer the seven research questions (addressed IN the interviews). Interviews were planned to mainly answer research questions one to five and question seven in terms of detailing dimensions of the initial framework and suggestions for future tools. The questionnaire mainly focused on question six, collecting preferences on existing anthropometric tools.

❖ **Interview**

The interviews were conducted in a structured but open-ended manner. Questions were mainly about various dimensions of the framework and aimed to collect information regarding them. First, based on the identified research questions, a list of topics were drafted to be covered during the interview. These topics were then turned into interview questions considering format and order of questions. The content, format and order of interview questions was discussed with two other design researchers in order to find the best arrangements for questions and to avoid leading, generic or unclear questions. Finally, a pilot interview was conducted with one design consultancy prior to holding the nine interview sessions. Another researcher was present in the pilot interview session as the second interviewer. The pilot session proved helpful and resulted in the revision and further development of the interview techniques and the questionnaire arrangement. A list of the topics to be discussed and a brief breakdown of the session was sent to the design companies before the interview session. A copy of the interview questions is provided in Appendix A1.

❖ **Questionnaire**

Five anthropometric tools were presented to the designers, which they then graded through use of a ranking questionnaire. Two questions (research questions six and seven), one qualitative and one quantitative, were asked via the questionnaire. The designers were first asked to rank the five tools from one to five - where five was the highest - based on their own priorities for an anthropometric tool. They were then invited to orally comment on each tool and discuss their viewpoints and reasons for their ranking. This provided an opportunity to discuss and explore various aspects regarding designers' information behaviour. Questionnaires were presented to designers towards the end of the interview. A copy of the questionnaire is provided in Appendix A2. The criteria for the selection of the five tools were to cover a wide platform of sources, presentation formats, information details and also key attributes such as familiarity and accessibility of information and to provide a wide range of tools. These criteria were chosen in order to provide comprehensive information on designers' 'preferences' aspect of information, enriching discussions and providing insight into various dimensions of designers' information behaviour. The tools in the format of book, handbook and card were physically demonstrated to the interviewees. Various printed images of software tools were made available in the interview sessions. Table 4.5 provides a short description of the tools and their formats. A detailed visual representation of the tools can be found in Appendix A3.

Table 4.5 Anthropometric tools description

Tool	Tool description
Tool1 **Humanscale (cards)**	Humanscale (Dreyfuss, 1973) is a set of references in three volumes, each with two-sided pictorial selectors with rotating dials and accompanying manuals. The interactive card has dimensioned charts of human figures, with factual data that shows the human body in some postures. The main feature of the tool is its rotating analogue wheel interface.
Tool 2 **Older Adultdata (handbook)**	Older Adultdata (Smith *et al.*, 2000) is a handbook with many data tables and simple illustrations on each page incorporating data on age, sex, MEAN, SD, 5th percentile and 95th percentile of the various populations. It is one of a series of three books on Child, Adult and Older Adult data.
Tool 3 **Ergo-CES (software)**	Cambridge Engineering Selector (CES) software was originally developed in the Engineering Department of the University of Cambridge (University of Cambridge, 2000). CES was used here as a construction prototype tool to present some ideas on a prototype anthropometric data tool called Ergo-CES. As a software tool, Ergo-CES enables two-dimensional (2D) data visualisation and comparison through 'browse', 'select' and 'search' functions for relevant anthropometric data on products and people.
Tool4 **Bodyspace (textbook)**	Bodyspace (Pheasant and Haslegrave, 2006) is a book published in many editions and widely used in design schools. The book incorporates data and guidelines, and includes data for the UK population. It provides insights into the principles and practice of workspace design, anthropometrics, and so forth.
Tool 5 **Dined (website)**	Dined (Molenbroek, 2008) is an online web-based data source open for the use of public. The tool incorporates a number of key measurements with the selection of age and gender and visualisation of percentages in an interactive diagram. The tool has been developed by TU Delft University and the data was collected in the Netherlands.

4.3.3 Interview procedure

All the interviews took place in the design companies except one interview which took place in Royal College of Art, London. The interview sessions' duration generally varied between 60 to 90 minutes, depending on the tendency of interviewees to further explore and discuss the subject after the questions were all answered. Although the interviews were structured around a carefully pre-defined set of questions in a specific order, an open-ended strategy was adopted for conducting the interviews. Thus, due to the natural process of the interview and the flow of raised issues, the order and content of the questions could slightly change. This was in order to keep the interviews flexible and informal and provide a comfortable and friendly environment for the interviewees to discuss their opinions and share their thoughts. Most interviews consisted of one interviewer (the researcher) and one interviewee. However the pilot interview session and one other interview session was attended by another interviewer (Dr Hua Dong). Also, one session was attended by a design researcher as an observer (Dr Selami Cifter).

Interview sessions typically started with a brief introduction of the research project. Following that, the design process and issues regarding that were addressed in the general start off questions. In the next stage, specific detailed questions were asked regarding the source, format, attributes and use of ergonomics and anthropometric information. Then, the ranking questionnaire was presented to designers and their thoughts and feedback on the information tools presented in the questionnaire were explored in an open discussion. Also, designers' preferences on presented tools were documented through the ranking questionnaire. Following that, designers' suggestions for future information tools were collected. The interview ended with brief background questions regarding the academic background and professional experience of the interviewees. Interviews were all tape recorded with interviewees' permission. Notes were also taken throughout the interview, in order to highlight the major issues discussed. Upon completion, all interviews were fully transcribed in order to keep the originality of the content as much as possible and also in order to provide the most comprehensive raw data for further content analysis.

4.3.4 Data analysis method

Two types of data were collected in the interview sessions; qualitative and quantitative. Qualitative data was provided for analysis by transcribing the interviews together with the notes taken in the sessions. Quantitative data was collected in form of ranking numbers (from one to five) assigned to five tools in each interview session. The 'template approach' (Robson, 2002) was used in order to analyse the qualitative data from transcriptions and notes. Template approach is a coding and clustering (Dong, 2004) method and constitutes of two main stages of coding the data and then clustering the data of the same code into groups. Using the above method, the transcribed data from each interview was first coded with words or phrases derived from the interview questions and key identified topics of investigation, then the data from all interviews labelled with the same code were clustered together. For example, all the data labelled under 'format' were clustered together. The coding was based on the five identified dimensions of the information framework together with key topics of investigation.

For quantitative data on ranking of the tools, descriptive statistics was used and a number of calculations including mean, median and number of times a tool was ranked first and last were carried out.

4.4 Results and Findings

In total, nine interview sessions were held. Each interviewee also completed a copy of the questionnaire. Interviews provided information regarding various aspects of anthropometric information such as format, source, attributes, use and also suggestions on future anthropometric tools. Questionnaires provided information regarding the preferences on existing anthropometric tools. The findings are presented following two types of categorisation: first, findings regarding the design process, source, format, perceptions and current use of anthropometrics are presented for each design consultancy separately, providing an overall understanding of each design company's information behaviour. Tables 4.6 to 4.14 present a summary of the above aspects. Next, the findings are presented in the order of seven research questions, addressing source, format, preferences, suggestions, etc. Tables 4.15 to 4.23 present a summary of findings for each research question. More detailed information about the interviews can be found in a technical report (Nickpour and Dong, 2008a).

4.4.1 Findings according to design companies

In this section, findings regarding each company's design process, sources, formats, perceptions and current use of anthropometric information are summarised in separate tables for each company. A typical design (image) from each company is also included in the table.

Table 4.6 Design consultancy A

Expertise	Product design
Design process 	1. Contextual research 2. Experience mapping 3. Scenario building 4. Redefining the brief 5. Design & concept generation 6. Concept communication 7. Model generation 8. Design refinement
Sources of Information	Measuring people, Prototyping, Client's data, Benchmarking, Web search, Working with users
Formats of Information	Experimental, Guidelines, Standards
Perceptions of Information	Out of date, Irrelevant, Not useful, Not clear, Inaccurate
Current Use of Information	Limited and minimal use

Table 4.7 Design consultancy B

Expertise	Interior design
Design process 	1. Receive the brief 2. Study the plan of the building 3. Research the needs of the user group 4. Apply user specifications to interior arrangements 5. Change and plan the fitting inside interior 6. Choose from the range of produced items available in the market 7. Deliver and mount the interior
Sources of Information	Standard diagram of average person, Manufacturer templates
Formats of Information	Disability regulations, Experimental
Perceptions of Information	Out of date, Not inspiring, Irrelevant
Current Use of Information	Application of specific measurements for fittings inside the interior

Table 4.8 Design consultancy C

Expertise	Product design
Design process 	1. Receiving the brief 2. Concept design 3. Design development 4. Engineering and technical development 5. Variations and super-fine details 6. Monitoring the product throughout the production
Sources of Information	User feedback, Meet real users through the clients, Model making, Manufacturer's & client's data, Web search
Formats of Information	Experimental, Standards, Safety regulations
Perceptions of Information	Out of date, Complicated, Not appealing, Not dynamic
Current Use of Information	Very limited and minimal Focus on experimental information collection

Table 4.9 Design consultancy D

Expertise	Product & service innovation
Design process 	1. Research stage 2. Feasibility stage 3. Design stage 4. Risk analysis stage 5. Proof of Principle stage 6. Implementation stage
Sources of Information	Model making, Measuring & testing with people in the studio, Books, Ergonomist
Formats of Information	Experimental & intuitive, Guidelines, Standards
Perceptions of Information	Out of date, Irrelevant, Not useful, Hard to work with, Not specific
Current Use of Information	Not in-depth, Occasional For backing up design process

Table 4.10 Design consultancy E

Expertise	Healthcare innovation & design
Design process 	1. R&D driven 1.1 Strategic work 1.2 Technical R&D 2. Marketing driven 2.1 Design 2.2 Manufacturing
Sources of Information	Working with users & collecting data, Prototyping, Client's data, Measuring and testing
Perceptions of Information	Experimental, Standards
Attributes of Information	Not applicable, Out of date, Hard to work with, Not inclusive, Irrelevant
Current Use of Information	No use of formal anthropometrics information Direct application of user research when needed

Table 4.11 Design consultancy F

Expertise	Industrial design
Design Process 	1. Receiving the brief and engaging with client 2. Generate concept ideas and observational research 3. Selection, reviewing and proving out the chosen concepts 4. Detailed design 5. Manufacturing details and development
Sources of Information	Measuring and testing with the users, Prototyping, Videos from the focus groups, Web search, Ergonomist, One book
Formats of Information	Experimental, Standards & guidelines
Perceptions of Information	Out of date, Unreliable, Irrelevant, Easily misinterpreted, Unavailable
Current Use of Information	Very limited use of formal information Used mainly for inspiration and ideation

Table 4.12 Design consultancy G

Expertise	Product design & strategy
Design process 	1. Receive a package of data 2. General trend and consumer research 3. Conceptual themes 4. Sketch concepts 5. Detail design
Sources of Information	Model making & testing with people in the studio & outside, Asking experts, Client's data, Manikins in Auto CAD, 'Gut feelings'
Formats of Information	Experimental, Standards & legislation, Guidelines
Perceptions of Information	Out of date, Not appealing, Unreliable, Not valuable
Current Use of Information	No formal anthropometric information used All through experiment For justifying ideas and strong communication with client

Table 4.13 Design consultancy H

Expertise	Industrial design
Design process 	1. Research stage 2. Concept stage 3. Design development stage
Sources of Information	Prototyping & testing with users, Books, Web search, British Standards, Client's data
Formats of Information	Experimental, Standards & legislations
Perceptions of Information	Out of date, Not applicable, Needs to be processed & refined
Current Use of Information	For research and analytical purposes on inclusion potential

Table 4.14 Design consultancy I

Expertise	Product design
Design process 	1. Styling phase 1.1 Clarifying the brief with client 1.2 Industrial design 1.3 Presenting ideas back to client 2. Engineering phase 2.1 Detail design 2.2 Manufacturing detail
Sources of Information	Client's data and expertise, Model making & testing, Web search, Professionals' network
Formats of Information	Experimental, Legislation & standards
Perceptions of Information	Out of date, Confusing, Not easy to use
Current Use of Information	No use of formal anthropometric sources

4.4.2 Findings relating to research questions

In this section, findings and results of the interview and rankling questionnaire are presented in the order of research questions of the study. Tables 4.15 to 4.24 summarise the key findings regarding each research question. For Research Questions 2 to 5, the data regarding each dimension of framework is tabulated based on a breakdown of various items mentioned and frequency of their mention by different interviewees. This means the highest number an item could have would be nine (being mentioned by all nine interviewees). Thus, no matter how many times an item got mentioned by one interviewee throughout the course of an interview, it would still count as being mentioned once. The items most frequently mentioned are presented on the top of the list.

❖ **Research question 1 - What is the general design process?**

Table 4.15 presents a summary of the design process as stated by the interviewees from each design company.

Table 4.15 Design process of interviewed companies

Company ID	Design Process
A	1. Contextual research 2. Experience mapping 3. Scenario building 4. Redefining the brief 5. Design & concept generation 6. Concept communication 7. Model generation 8. Design refinement
B	1. Receive the brief 2. Study the plan of the building 3. Research the needs of the user group 4. Apply user specifications to interior arrangements 5. Change and plan the fitting inside interior 6. Choose from the range of produced items available in the market 7. Deliver and mount the interior
C	1. Receiving the brief 2. Concept design 3. Design development 4. Engineering and technical development 5. Variations and super-fine details 6. Monitoring the product throughout the production
D	1. Research stage 2. Feasibility stage 3. Design stage 4. Risk analysis stage 5. Proof of Principle stage 6. Implementation stage
E	1. R&D driven 1.1 Strategic work 1.2 Technical R&D 2. Marketing driven 2.1 Design 2.2 Manufacturing
F	1. Receiving the brief and engaging with client 2. Generate concept ideas and observational research 3. Selection, reviewing and proving out the chosen concepts 4. Detailed design 5. Manufacturing details and development
G	1. Receive a package of data 2. General trend and consumer research 3. Conceptual themes 4. Sketch concepts 5. Detail design
H	1. Research stage 2. Concept stage 3. Design development stage
I	1. Styling phase 1.1 Clarifying the brief with client 1.2 Industrial design 1.3 Presenting ideas back to client 2. Engineering phase 2.1 Detail design 2.2 Manufacturing detail

- ❖ **Research question 2 - How do designers source anthropometric information?**

Table 4.16 presents a breakdown of various sources of information mentioned by the interviewees and the number of times each source was mentioned.

Table 4.16 Sources of anthropometric information as mentioned by designers

Source of information	Frequency of mentions
Prototyping and rig building	(7)
Working with users; testing, measurement and feedback	(7)
Client's information	(6)
Internet search	(5)
Intuition	(4)
Experience	(4)
Own collected information	(4)
Experts and ergonomist	(3)
Observation and common sense	(3)
Books	(3)
Manufacturer information	(2)
3-D tools (Manikins in AutoCAD)	(1)
British Standards	(1)
Information tools	(1)
Benchmarking	(1)
Standard diagram of average person	(1)

- ❖ **Research question 3 - What formats of anthropometric information designers use?**

Table 4.17 presents a breakdown of various formats of information mentioned by the interviewees and the number of times each format was mentioned. As the table shows, formats were mainly distinguished and divided into two categories by the interviewees. The first format was 'formal' anthropometrics information, which was hardly used. The second format was 'informal' information, not obtained from an external source, which was heavily used. For each of the above, there was a major format mentioned by all interviewees.

Table 4.17 Formats of anthropometric information as mentioned by designers

Format of information	Frequency of mentions
Formal information	
Experimental	(9)
Informal information	
Standards & regulations	(9)
Guidelines	(4)

❖ **Research question 4 - What are the attributes of current anthropometric information?**

Use of anthropometric information currently available was reported as very limited and minimal by most companies and designers stated they mainly collected information from users directly. This situation led into a shift in the answers on research question Four. Thus the focus shifted on 'perceptions' of current information available and what was considered as unsatisfactory or problematic rather than the 'attributes' or qualities of current information used. The initial research question and the subsequent interview question, initially aimed to identify the attributes and qualities of the information designers used. Therefore the questions changed into:

What are the perceptions of current anthropometric information?

Table 4.18 presents a breakdown of various perceptions and issues mentioned in terms of current anthropometric information available.

Table 4.18 Perceptions on current anthropometric information available stated by designers

Perceptions of information	Frequency of mentions
"Out of date"	(8)
"Irrelevant"	(5)
"Unreliable"	(3)
"Hard to work with, not easy to use"	(3)
"Not valuable or useful"	(2)
"Uninspiring and not fascinating enough"	(2)
"Inapplicable"	(2)
"Unappealing"	(2)
"Easily misinterpreted"	(1)
"Unavailable"	(1)
"Confusing"	(1)
"Not specific"	(1)
"Complicated"	(1)
"Not dynamic"	(1)
"Not clear"	(1)
"Inaccurate"	(1)
"Not inclusive"	(1)
"Needs to be processed and refined"	(1)

Table 4.19 presents selected quotes from designers interviewed. Quotes from the interviewees addressed their perceptions of ergonomics, anthropometrics and the relevant issues regarding the use of such information in the design process. The quotes were selected based on their diversity and their representative value in

terms of various issues that were addressed by interviewees. Thus they were regarded as an illustrative (rather than exhaustive) list of key issues raised in the interviews. Some designers believed their typical projects did not demand anthropometric information, or that although ergonomics was a complicated science, it was actually common sense to them. Some also felt that ergonomics was not something they would often call specialists for (Quotes 1, 2, 3). Some designers stated that although they found referring to information very useful, they would not tend to use it very often (Quote 4). Some interviewees indicated a major distinction between the inherent approach of designers and the ergonomists (Quote 5). Most interviewees believed that the anthropometric information had to be very simple, fast and easy to work with, or that the existing information was not inspiring (Quotes 6, 7).

Table 4.19 Quotes addressing designers' perceptions of ergonomics and anthropometric information

Quote	Code
"We can do 99 per cent of our commissions on gut feeling and common sense genuinely!"	1
"There are certain top-line things to know; we need the tip of the iceberg!"	2
"We have got a reasonable idea of what is good and what is bad and that is based on our experience. So it is approaching [it] through twenty years of industry experience!"	3
"I would tend to rely on my experience and the discussion and feedback from the person who I am actually talking to."	4
"A designer doesn't think in numbers. What we do is an intuitive emotive thing. And I think basically all these (anthropometric) tools are given for scientists. Ergonomics is a science!"	5
"At least after ten minutes, I want to be getting something useful out of that [information], not spending half an hour and not finding anything, not to have to absorb every bit of it!"	6
"There is no inspiration in the available data right now, and aspiration is what gets the people excited."	7

❖ Research question 5 - How is anthropometric information used by designers?

Table 4.20 lists the designers' responses and issues they mentioned regarding the use of the anthropometric information and how this information was used.

Table 4.20 Use of anthropometric information as stated by designers

Use of information	Frequency of mentions
Limited and minimal use of existing information	(7)
All through experiment	(4)
Direct application of user research when needed	(3)
For backing up design	(1)
For justification & communication with client	(1)
For inspiration and ideation	(1)
For research and analytical purposes on inclusion potential	(1)
Not in-depth	(1)
Application of specific measurements for fittings inside the interior	(1)

❖ Research question 6 - What are designers' preferences regarding existing anthropometric tools?

Table 4.21 summarises the designers' preferences of the five anthropometric tools presented to them and their comments regarding each tool. The numbers in the 'Highest' cell show how many designers ranked the tool the highest (i.e. most preferred) and the numbers in the 'Lowest' cell show how many designers ranked the tool the lowest (i.e. least preferred). The 'Comments' cell presents comments made by interviewees on each data tool, and the 'Frequency' cell shows how many times each comment was mentioned by interviewees. The comments are organised in the order of most frequently mentioned.

Table 4.21 Designers' preferences and comments on the five anthropometric tools

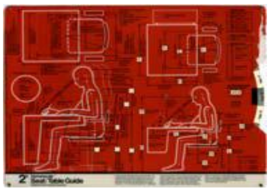
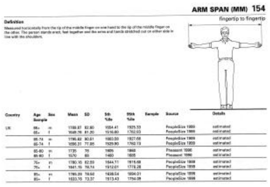
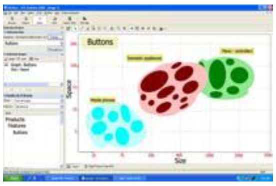
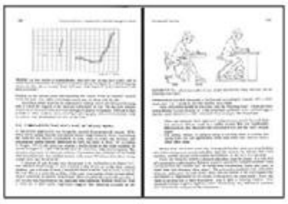
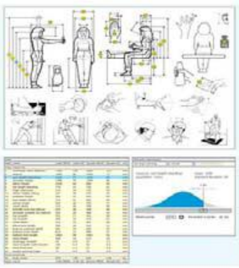
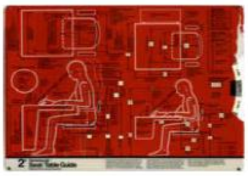
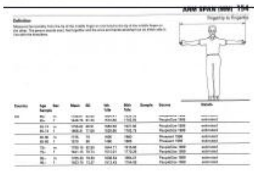
Anthropometric tool	Highest	Lowest	Comments	Frequency
 **Humanscale** Interactive card with a rotating wheel to enable selection of age and gender	2	3	"Holistic" "Outdated" "Irrelevant" "Interesting presentation" "Too much information" "Fascinating"	(2) (2) (2) (2) (1) (1)
 **OlderAdultData** Handbook with many data tables and simple illustrations	2	1	"Simple" "Easy to use" "Boring" "Unexplained" "Separated data"	(2) (2) (2) (1) (1)
 **Ergo-CES** Software enabling 2D data visualisation and comparison of data	5	0	"Complex" "Analytical" "Good features" "Unprofessional graphics" "Time-taking to work with"	(3) (2) (1) (1) (1)
 **Bodyspace** Book incorporating data and guidelines	0	6	"Too much text" "Academic" "Comprehensive" "Student-oriented" "Lacking colour" "Too scientific"	(3) (2) (2) (1) (1) (1)
 **Dined** Website enabling data selection and percentage visualisations	1	0	"Interactive" "Accessible" "Visually unprofessional" "Irrelevant data" "Useful features"	(3) (3) (2) (2) (1)

Table 4.22 presents selected quotes made by interviewees on the five anthropometric tools. Two quotes have been chosen for each tool, demonstrating the range and variety of positive and negative responses received from the designers interviewed. Selection of quotes was based on a review of all the comments made by the nine interviewees about each tool. The quotes were selected based on their representative value in terms of range and variety of positive and negative issues raised. In this, the below list of quotes has an illustrative rather than exhaustive perspective. As the study had a strong exploratory nature, reviewing a wide range of reflections on the five existing tools was considered helpful in bringing new insights and understanding of designers' information behaviour towards these sources of information.

Table 4.22 Designers' quotes on the five anthropometric tools

Anthropometric tool	Interviewees' Quotes
	*"How many products do we design where such data is relevant?"* *"I think there is something tangible about this tool that is immediately fascinating!"*
	*"What is this measurement? Is it in units or? What does it mean?!"* *"I'm crap at reading books and data! It just bores me!"*
	*"I do not think I would ever get involved in that level of data for what I do, It's a bit scary!"* *"It has a PowerPoint feeling which I don't like, not good quality professional graphics! However, it is quite comprehensive and diverse."*
	*"Every designer should read this book, and I should read it again. Well… if I have time!"* *"I hate it! This green book is like a math book and math is a big NO! I wouldn't bother text, I want pictures and sizes."*
	*"It's PC language, not Apple language; a Mac would do that better!"* *"This interactive graph is brilliant!"*

❖ **Research question 7 - What are designers' suggestions regarding future anthropometric tools?**

The designers were asked about their suggestions and ideas on effective and desirable means of presenting anthropometrics information. Table 4.23 presents each interviewee's suggestion regarding this.

Table 4.23 Designers' suggestions regarding future anthropometric tools

Company ID & Specialist area	Suggestions regarding future tools
A Product design	3D software simulating a person determined by age, gender and physical and mental capabilities
B Interior design	2D tool with an easily adjustable person to be dragged and dropped in various designed environments
C Product design	A 'PlayStation' version of a tool to simulate a person with specific age, gender and physical abilities in a specific position
D Product and service innovation	2D Software enabling documentation of consultancy's own collected data
E Healthcare and design	Software presenting a set of examples of best and worst practice products versus each other enabling comparison and seeing the percentile each fitted
F Industrial design	Ergonomic Facebook with confidential immediate access to millions of people
G Product design and strategy	Fully equipped up-to-date lab with adjustable products and services for test
H Industrial design	3D software simulating a flexible human body with changing figure, capable of producing new measurements of unmeasured body parts
I Product design	3D CAD model of person to be put into Auto CAD showing how the human and environment relate to the CAD modelling of the product
J Industrial design	2D software capable of adding and sorting already collected data to be shared by all designers

The main desired means of presenting anthropometrics information, suggested by four out of nine interviewees, was a 3D software capable of simulating human body in various positions based on variables such as age, gender and physical capabilities. One designer suggested such 3D software to be like a 'PlayStation version of a tool', while the other designer asked for a flexible human body capable of producing new measurements from unmeasured body parts. Designers also wanted to be able to put this 3D model into CAD modelling software such as AutoCAD or 3DMax in order to see how the human and environment relate to the CAD modelling of the product. A 2D knowledge management software, capable of adding and sorting consultancy's own collected data and adding new data to be made available to all designers in the company, was suggested by two different interviewees. A fully equipped up-to-date ergonomic lab with adjustable products and expert services for test and an 'Ergonomic Facebook' with confidential immediate access to millions of people were also some of the diverse ideas on effective means of presenting anthropometric information.

4.5 Discussion

In this section, the implications of results for each research question are addressed in the order of research questions. Also the appropriateness and limitations of data collection and analysis methods adopted for this study are discussed.

4.5.1 Implications of results for research questions

In this section, the results and findings regarding each research question are analysed and key issues are discussed. Limited and minimal use of existing anthropometric information through typical information routes and tools had a major influence on findings for various dimensions of information framework including Source, Format, Attributes and Use. On the other hand, the limited use of information through typical routes and designers' emphasis on collecting first-hand information, challenged some pre-conceptions and interestingly, brought into attention some critical points and issues.

❖ **Research question 1 - What is the general design process?**

Apart from Company E that described their design process in terms of their start point (Table 4.15), all other companies provided a quite detailed breakdown of their design process. Despite differences in terminology, many similarities were observed in stages of design process each company went through. Also, the logical order of stages was compatible. The start and end points of the process were also similar. The number of design process stages ranged between three to eight. Both 'mean' and 'median' in terms of number of design process stages among the nine design companies was five stages. The similarities in the stages of the process, their order and also start-end points, provided some evidence on possibility of adopting a general design process that could address and cover key stages of various companies' design process.

- **Research question 2 - How do designers source anthropometric information?**

When asked about their current sources of anthropometric information, designers hardly mentioned any formal sources or existing tool they would use as part of their design process. In other words, designers did not widely use the available sources (including tools a selection of which was presented to them in the interviews) although they were to a certain extent aware of them and, in many cases, had used some of those sources at some point in the past - mainly as novice designers. Many interviewees reported they had not used such data tools for a considerable time. Comments such as "*I don't think I have actually used an ergonomic chart for ten years or so.*" were common amongst the interviewees.

Instead, designers' key stated sources of anthropometric decisions could be put into two main categories of tacit and explicit. The explicit sources involved were practical and pragmatic methods of information collection. These included prototyping (model making, rig building, mock ups) and working with people (observation, testing, measuring, feedback). Clients and manufacturers were also an important source of information. As well as explicit sources, the majority of designers interviewed reported relying on tacit sources, giving them certain value and originality. These included designers' own acquired experience, intuition and common sense; the majority of the designers interviewed reported relying on these three tacit information sources as key source of information. Table 4.24 presents the current sources of information divided into two categories i.e. tacit and explicit. The tacit sources address the designer's inbuilt points of reference and the explicit sources address the specifications brought in based on the design brief. Apart from the key sources presented in Table 4.24, internet search, own collected information from previous projects, experts (ergonomists specifically) and books were among the other sources mentioned, in the order of frequency of use.

Table 4.24 Key sources of anthropometric information

Key Sources of information
Explicit
Prototyping (model making, rig building, mock ups)
Working with people (observation, testing, measurements, feedback)
Client’s information
Tacit
Intuition
Experience
Common sense

- **Research question 3 - What formats of anthropometric information designers use?**

Again, the fact that designers did not use any tools for anthropometric information did influence the format of information used extensively. The information was mainly implemented in the design process in an experimental format. And as the information was collected first-hand by designers themselves, no specific presentation format was considered or used. This was due to the fact that, being the collectors of information, designers did not need to communicate the information to another party. Therefore, there was no specific format for communicating or saving the information. However, designers mentioned that if they used any anthropometric information it would be mainly in the format of guidelines, and regulations. It should be noted that having the same frequency of mention for both experimental format and standards and guidelines, did not mean both formats were currently used equally.

- **Research question 4 - What are the attributes of current anthropometric information?**

Limited use of anthropometric information through formal routes and sources, made it difficult to discuss attributes of information that were being currently ‘used’. However, lack of use brought to attention another interesting dimension which was designers’ ‘perceptions’ of the existing information available and reasons why they did not consider using that. These perceptions directly related to qualities and attributes of information and proved helpful in rendering a realistic picture of information attributes in the order of essentiality and importance. The anthropometric information was considered just a "starting point". Most designers had largely negative and passive perception of the existing information. Table 4.25 addresses some of the main concerns from the design industry regarding the existing information. Being “out of date” was one issue mentioned by all nine interviewees. “Irrelevant”, “hard to understand and work with” and “unreliable” were some other major comments made repeatedly by many designers. Compared to designers’ own practical methods of collecting data, referring to anthropometric tools was considered as neither effective nor efficient way of working with information (Nickpour and Dong, 2008b).

In order to better analyse and organise various perceptions, qualities and attributes of anthropometric information stated by designers, a user-product analogy was applied where anthropometric information was considered the ‘product’ and designers were considered the ‘users’ of the product. The hierarchy of user experience (Cagan and Vogel, 2002) was then adopted to analyse different aspects of users’ experience in terms of ‘usefulness’, ‘usability’ and ‘desirability’ of the product. Figure 4.1 illustrates the hierarchy of user experience and its three levels. The bottom level of the hierarchy, usefulness, is about the value (exists because it can answer a need) and addresses issues regarding functionality of the product. The middle level addresses usability (exists because it can answer the need in an effective way) of the product. The top level addresses desirability (exists because it can answer the need in a desirable way) of the product to the user. This hierarchical model was used as the basis for identification, analysis and organisation of all aspects related to the current user-product relationship, where designers were users and anthropometric information was the product.

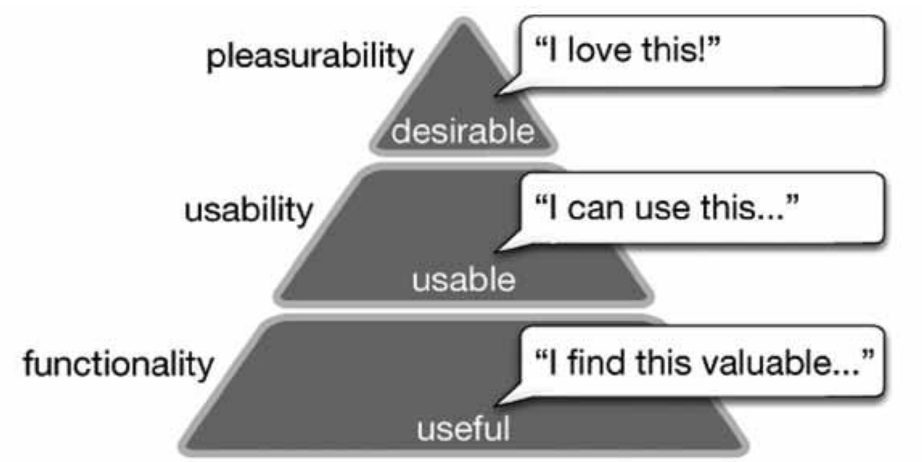


Figure 4.1 The Hierarchy of User Experience (adapted from Cagan and Vogel, 2002)

Apart from research question Four that directly addressed attributes of information, Questions 6 and 7 (asking for designers' preferences and suggestions on anthropometric information tools) also touched upon qualities of information and thus contributed toward specifying attributes that designers considered for anthropometric information. Therefore, the user experience hierarchy was populated using a collation of findings from Questions 4, 6 and 7. In order to populate the hierarchy, each quality was put under the relevant three categories of 'usefulness', 'usability' and 'desirability'. The populated hierarchy of user experience, representing relevant specifications and attributes at each level, helps clarify and categorise the attributes of anthropometric information most important to designers. Figure 4.2 presents the populated hierarchy based on the findings from interview and questionnaire (Nickpour and Dong, 2011).

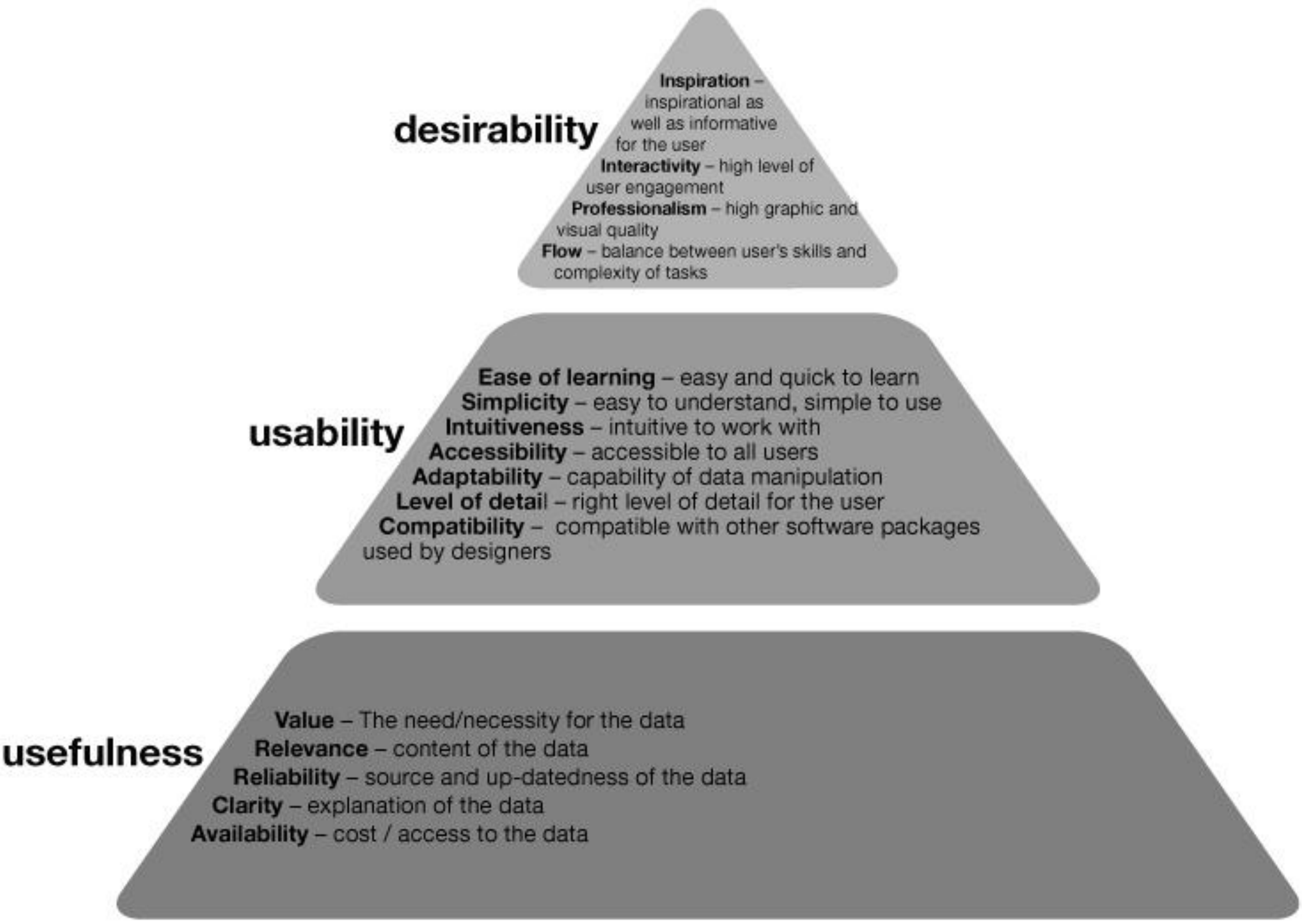


Figure 4.2 Hierarchy of User Experience populated by the key attributes of anthropometric information

Classification of attributes of information into three categories i.e. 'useful', 'usable' and 'desirable' helped highlight the fact that there are currently major issues with all three attributes of usefulness, usability and desirability of information. The results showed that there are currently considerable issues regarding the usefulness of information; many interviewees found the existing information irrelevant, out of date and unclear, and questioned its value in the design process. This vividly challenged the functionality of the anthropometric information for a designer, which is the 'necessary condition' for the use of such a product. This could prove helpful in understanding designers' information behaviour by knowing what attributes are key to them. Figure 4.2 also highlighted a number of issues regarding the usability and desirability of information and the way it was presented. Specifications such as intuitiveness, ease of access and use, simplicity and compatibility were high priorities and of great importance for designers in terms of the usability of the information. The right level of detail was also a key usability issue mentioned by designers. At the desirability level, the specific wants and wishes of practicing designers in working with information have yet to be fully explored and considered. Comments on existing tools showed that practicing designers expected high graphic quality and a rich visual communication which would be engaging and inspiring to them. This is an integral part of understanding designers and their specific needs.

- **Research question 5 - How is anthropometric information used by designers?**

Chapter Two identified 'Use' as a key dimension to be included in the information framework. However, existing literature on this dimension, in both areas of library and information sciences and design, was limited and not relevant and could not help break this dimension down into more specific criteria. Therefore, the question 'How the information is used?' remained vague and undefined compared to other dimensions of the framework. One of the aims of this study was to further explore the 'Use' dimension. It was hoped that through discussions and feedback from designers, 'Use' dimension could be further clarified and broken down into specific aspects. The range of responses regarding the 'use' of information (summarised in Table 4.20) was quite broad. 'Use' dimension could not be specifically summarised as responses were of different levels and types, each addressing various aspects. However, the diversity of responses helped distinguish between certain aspects of the use dimension. Comments such as 'limited and minimal' addressed the 'Level' of use, while comments such as 'for justification', 'for backing up' or 'for inspiration and ideation' interestingly unveiled a 'Role' aspect to the information and the 'Purpose' behind its use. This is while 'Purpose' or 'Role' was not an aspect or dimension included in the initial information framework. However, various designers at different stages of their interview brought up this aspect by mentioning why they would not use most anthropometric information and where they might use it. Communicating the information back to the client and backing up the design process were of specific interest as they were not considered typical purposes for information use, as conventionally mentioned.

- **Research question 6 - What are designers' preferences regarding existing anthropometric tools?**

Designers were divided in terms of their ranking of the tools resulting in tools receiving a combination of high and low ranking. The qualitative comments on each tool also had a considerable diversity and each tool received a combination of positive and negative comments. Thus, it was difficult to derive concrete conclusions regarding the tools based on adding up the ranking scores. However, some general conclusions could be drawn based on a review of the most and least preferred tools in Table 4.21. For example, Ergo-CES, the software enabling 2D visualisation and comparison of data, received the highest score. It was ranked first by 50 % of the designers. In contrast, Bodyspace, the ergonomics textbook, received the lowest score; it was ranked lowest by 60 % of the designers. The remaining three tools received a combination of contradictory rankings from the lowest to the highest. In some cases a feature considered as positive by one designer was regarded as distracting by another. However, features such as 'having too much text' and 'lacking colour and pictures' were considered unsatisfactory by all the designers. On the other hand, features such as being 'simple' and 'interactive' were specified as requirements by all the designers interviewed.

- **Research question 7 - What are designers' suggestions regarding future anthropometric tools?**

Various ideas were explored and suggested; 3D data representation was preferred against 2D data and designers expressed enthusiasm for simulations of people which might take into consideration variants such as age and gender, as well as users' physical and mental capabilities. However, some challenged their own suggested idea by questioning the feasibility of such complicated 3D human simulations and the subsequent level of complexity of such software. Most designers stated they would prefer a ‘simple’, ‘intuitive’, ‘highly visual’ tool which was ‘fast and easy to learn’ and ‘easy to work with’.

- **Research Questions 8, 9 and 10**

As stated in Section 4.1.4, the last three research questions were to be addressed after interviews. This was due to the fact that these questions related to all dimensions of the information framework and the answers to them were to build upon results of research questions 1 and 7 and the issues raised by them. Having provided the results and discussed the findings for the first seven questions, the last three research questions can now be addressed.

- **Research question 8 - Could the initial framework help understand key aspects of designer’s information behaviour?**

Reviewing designers’ responses to each and every dimension of the framework helped break down, distinguish and address various issues such as needs, seeking and use aspects of designers’ information behaviour. The various dimensions helped classify and categorise the big picture of designers’ approach toward anthropometric information and further break down that big picture into sections and dimensions. However, not being certain that all dimensions of information behaviour were ‘identified’ and ‘included’ in the initial framework was a hindrance. Although it was concluded that the framework helped identify many useful aspects of designers’ information behaviour, there was no guarantee, criteria or specification based on which the judgement could be reached that all aspects of information behaviour were fully covered and explored.

- **Research question 9 - What dimension/s need to be refined?**

As already discussed under research question Six in the same section above, the ‘Use’ dimension was considered too vague and undefined. This was partially identified in the literature review chapter, however, it was decided that some insights gathered through primary research methods may help further define and possibly detail this dimension. The wide range and various types of responses to ‘use’ question and inability to group and analyse all of them under one category, re-confirmed that this question was too vague and needed further clarification. The responses to the question however, helped identify a number of possible aspects to the initial ‘Use’ dimension. For example notions of ‘limited’ and ‘minimum’ by interviewees introduced a further aspect to information use that could be summarised as 'level' of use. Therefore it was recommended that the use dimension be replaced and refined into one or a number of more specific dimensions addressing various aspects such as 'Level of use' and 'Purpose'. For this purpose, a brief review of literature focusing specifically on the 'level' of use is recommended in both areas of design and information sciences.

❖ **Research question 10 - What new dimension/s should be included?**

The vague and under-defined dimension of use, interestingly helped bring into attention another aspect of information behaviour which was not explicitly addressed through the initial dimensions of the framework. Many interviewees, in response to 'use' question, came up with comments such as "*for backing up the design process*", "*for inspiration and ideation*" or "*for reporting back to client*". These responses were more closely addressing the question: 'WHY the information is used" rather than "HOW the information is used". These two questions of 'How' and 'Why' seem to have two totally separate areas of focus and each could address a different and independent aspect of information behaviour. Therefore, it is recommended that the 'Purpose' aspect and the question of 'Why designers use information' be further explored and studied and if applicable be included in the framework.

4.5.2 Critique of research methods

As the main adopted method for data collection in this study, interviews are known to have certain limitations. One key limitation of interviews in general, is the risk that they may be biased based on interviewers' own opinion and the possibility that interviewers would ask leading questions. In a one-to-one situation, the interviewer has the opportunity to influence the situation and there is consequently a danger of biasing the answers towards the interviewer's own opinions (Poulson *et al*., 1996). The tone of voice and style of the individual interviewer is also thought to have an effect on the interviewee (Yin, 2009). In order to minimise the effects of the above bias, the research questions were reviewed by two other researchers in a different field and their comments helped revise the questions. Also, a pilot interview session was held and in that session a second interviewer was present - as the supervisor - in order to observe and feedback on delivery of questions and how they were communicated to the interviewee.

Another inherent limitation of this study was the fact that the results and findings were all based on the designers' own reflections and articulations of their experience. 'Self reporting' as a technique, has certain limitations to it as many issues, behaviours and attitudes may be left 'unreported' by the interviewee for various reasons, while they actually do exist. In this way, and relying on the results of the interview method, not a complete representation of the situation could be provided. In order to address this limitation, two other data collection methods were also introduced into the PhD research. These included observation studies of designers in practice and a survey. Through observations, to be undertaken in the next two chapters of the research, it was expected that various dimensions of designers' information behaviour could be addressed, including those not necessarily reported by designers themselves in the interviews. For analysis of collected data the non-software 'template' method (Robson, 2002) was used. Although a number of software tools such as NVivo and NUDIST were available for content analysis, they were not used as they were mainly suited to large scale studies with big quantity of data.

4.6 Refining, Evaluating and Detailing the framework

Based on the results and findings of the study, the information framework was refined, evaluated and detailed. It was concluded that using the initial framework was consderably helpful in structuring, analysing and distinguishing designers' information behaviour and its various dimensions. One dimension was refined and suggested to be replaced; it was concluded that the 'use' dimension in the initial framework needed to be replaced by more clarified and specific dimension/s. 'Level' of use was suggested as one aspect to focus upon for further detailing the use dimension. One new dimension was suggested to be included. 'Purpose' or 'role' of information, addressing why designers use information, was suggested as an aspect worth being further looked into, as the initial dimension did not explicitly address it. The 'Source', 'Format' and 'Attributes' dimensions were detailed and populated based on the findings. Figures 4.3 and Table 4.25 present an overview of the transformations to the initial information framework and specify the changes made. The detailed dimensions are presented alongside refinements and changes suggested to certain dimensions.

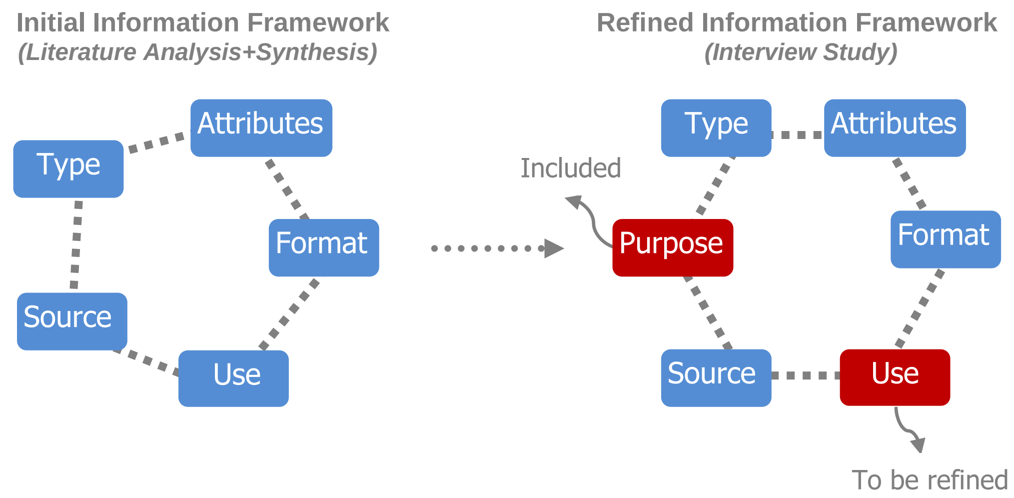


Figure 4.3 The initial Information Framework and the refined framework based on the findings from the Interview Study

Table 4.25 Changes made to framework dimensions based on Interview Study findings

Dimension	Changes	Result
Source	Detailed	***Explicit*** - Prototyping, People, Client ***Tacit*** - Intuition, Experience, Common sense
Type	Unexplored	-
Format	Detailed	***Formal*** - Standards & regulations, Guidelines ***Informal*** - Experimental
Attributes	Detailed	***Usefulness*** ***Usability*** ***Desirability*** 
Use	To be refined	To be explored - Consider 'level' of use
Purpose	Included	-

4.7 Summary

4.7.1 Key insights

This study showed that practicing designers' use of existing formal anthropometric information and tools (i.e. books, handbooks, software packages, online sources, etc) in design companies is currently very limited. The research also highlighted the dominant role of experimental methods in sourcing practicing designers with people information. Practicing designers perceive and evaluate such sources as more effective and useful compared to referring to existing anthropometric sources. Designers' opinions on ergonomics tools varied and it was difficult to achieve consensus in terms of designers' preferences on such tools. However, most desired and preferred tools had a number of information attributes in common which included, accommodating experiential information, seamless integration with other tools designers typically use, high visual and graphic qualities and intuitive and simple presentation of information. It was concluded that the problems with the existing anthropometric information, included not only lack of 'usability' and 'desirability', but also lack of 'usefulness'. The above situation makes it an imperative to get an in-depth insight into designers' information needs, seeking and use in order to provide them with better information and tools. Based on the designers' suggestions and preferences, there is potential for information tools to be designed and developed specifically for designers (Nickpour and Dong, 2010). This has to be done by carefully adopting designers' inherent information behaviour; needs, seeking and use - and by adapting existing information to fit that.

4.7.2 Study implications

This study built on the findings from the literature analysis chapter in two areas of library and information sciences and design. The initial information framework was implemented in this study and finally evaluated, refined and detailed. The next chapter will focus on refining, evaluating and detailing the information framework based on the second research method; observations. Based on the findings of this chapter, it was concluded that some refinements need to be made in the initial framework. Thus, before undertaking the observational studies in the next chapter, first, the suggested refinements by this chapter will be reviewed and applied where needed. For this purpose, a further sectional review and analysis of literature needs to be undertaken in the beginning of next chapter. The refined framework could then be used in the observational studies for another iterative cycle of refinement, evaluation and detailing.

Chapter Five

Observation of Designers - I

"The competent practitioners bring available knowledge [and information] to bear on practice situation."

(Schön, 1987, p. 34)

Through the use of interview and ranking questionnaire, Chapter Four refined, evaluated and detailed the initial information framework. Results from Chapter Four, helped detail the initial dimensions and provided sub-dimensions. Also, results suggested some refinements to the initial framework. These refinements included adding one new dimension and replacing one existing dimension. After conducting interview and ranking questionnaire (as the first of the three research methods), Chapter Five aimed to refine, evaluate and detail the framework in a second iterative cycle, through conducting observation together with self report follow-up questionnaire. In order to achieve this, Chapter Five focused on 'observation of designers in practice' while the focus in Chapter Four was on 'self-reflection of designers on practice'. Both chapters complemented each other.

Prior to undertaking the observational study in Chapter Five, the refinements suggested to the initial framework in Chapter Four needed to be reviewed. Thus, a further sectional review and analysis of literature was undertaken in the beginning of Chapter Five, focusing on information 'use'. The revised framework was then refined, evaluated and detailed using the observational study in this chapter. The structure of the chapter is illustrated in Figure 5.0.

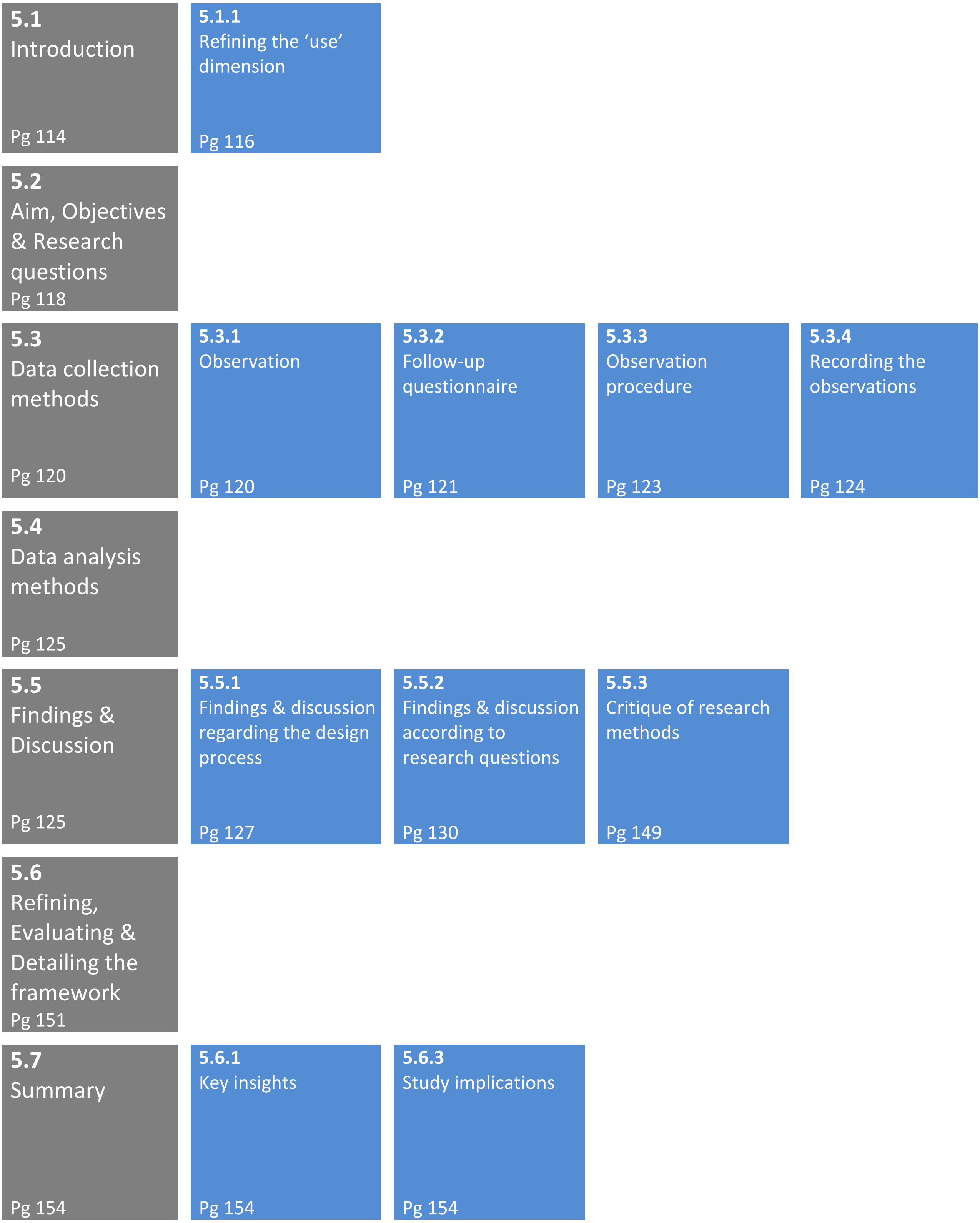


Figure 5.0 Chapter Five structure

5.1. Introduction

This chapter aimed to evaluate, refine and detail the information framework using the second complementary method i.e. observation. First, the refinements suggested to the initial framework in Chapter Four were implemented, leading to a new revised information framework. The new framework and each of its dimensions were then studied through observing designers in practice. In order to 'observe designers in practice' and refine, evaluate and detail the information framework, two real-world field studies were partaken. The first observational study is reported in this chapter and the second observational study is reported in Chapter Six. The study reported in this chapter includes observing the design process of one real-world design project. It aimed to collect data through first-hand field observation, adopting a specific type and level of observation and participation for the observer. Also, self-reporting follow-up questionnaires were conducted as a complementary data collection method. The designers were observed in terms of their information behaviour; observations were structured around the six dimensions of the information framework. Building on the observations and follow-up questionnaires and through discussion and analysis of the findings for each dimension, the refined information framework was evaluated and detailed. Also, after general discussions on findings from both observational studies in Chapters Five and Six, one new dimension was suggested for inclusion in the framework.

Zeisel (2006) suggests the observer could have two types of roles, either as a 'participant' or as an 'outsider'. The first observational study reported in this chapter adopted the 'Marginal Participant' approach where the observer was a 'commonly accepted and unimportant' (Zeisel, 2006) participant in the design project. In the second study (reported in Chapter Six), the 'Recognised Outsider' approach was adopted where the researcher was introduced to three design teams as a fly-on-the-wall observer.

Using participant observation (complemented by follow-up questionnaires) this study aimed to investigate, understand and document designers' information behaviour in a real-world setting, throughout the process of a real-world design project. The selected project for this purpose was a healthcare innovation design project initiated by the Design Council and the Department of Health (Design

Council, 2008). A team made up of a design consultancy and a manufacturer were assigned a brief to tackle healthcare issues in UK hospitals, specifically Healthcare Associated Infections (HCAI), through redesigning two products used in hospital wards i.e. commode and bed-side chair. The manufacturer was a large-scale company with two representatives actively engaged in the project (the company director and the lead designer). The design consultancy was a medium-sized establishment with three representatives actively involved in the project (one managing director, one senior designer and one designer). Altogether, five participants from the design consultancy and the manufacturing company were directly involved with the project.

The team was challenged to propose a concept that could effectively reduce risks of infections, increase usability and also be manufactured and used in UK hospitals through a viable pricing and procurement process. Some general findings and insights on existing situation were initially provided to the design team through the 'brief' document from the Design Council. Arrangements were made for the design team to be able to visit hospitals and conduct primary user research. Also, the team was asked to present their work in progress at regular intervals to an Expert Reference Group and Advisory Board for advice and feedback. The whole design process took six months from the initiation of the project (preliminary team meetings) until the delivery of working prototype (November 2008 – April 2009).

While the core design team included designers from the design consultancy and the manufacturer company, a second team as the 'research partner' was also formed in order to provide support to the core team in terms of user research and to provide the people information specified as needed by the design team. The research partner had a supporting rather than decision-making role in the design process, as they did not have an involvement in the decisions taken regarding the direction or focus of the project or what research needed to be undertaken, but rather 'presented' the people information requested by the design team to them. The researcher was introduced to the core team as one member of the research team and the 'marginal participant' approach was adopted for observation. This gave the researcher the opportunity to actively observe designers' information behaviour while not being seen as an outsider or intruder. This helped limit the possible effects on designers' own information behaviour in a normal context. Also, adopting a responsive rather than active and decision-making participatory approach, helped keep the researcher's involvement objective. Typically the manufacturer company had knowledge in manufacturing for the healthcare industry and relevant standards, also testing facilities for material investigations and pressure mapping. Further to that, the manufacturer had knowledge in physical ergonomics and bio-mechanics regarding the comfort aspect of use. The design consultancy brought in aesthetics and materials knowledge, as well as experience of the furniture market. The research team offered support in user-centred approaches and methods, and intended to provide insights from the identified users as requested by designers. The researcher was involved in the project studying designers' information behaviour, particularly in regard to people information.

5.1.1 Refining the 'use' dimension

The Interview Study findings suggested that the 'use' dimension in the initial framework needed to be refined and replaced by more clarified and specific dimension/s. 'Level' of use was suggested as one aspect to be focused upon for further detailing the use dimension. Here, the relevant literature on detailing of the information use in design is briefly analysed.

Information use may be the least studied and understood of the information behaviour facets and dimensions (Vakkari, 1997). There is considerably little body of research available on what and how of information use stage compared to what and how of information seeking and information needs. In design, similarly, there is considerable lack of research and understanding of information 'use'. This is partially due to the fact that historically, design has been mainly driven by output, focusing on delivering an end product that embodies certain qualities rather than focusing on the process through which that end product has been designed (Lawson, 2006).

Although not widely studied or conventionally recognised in design, information use (and understanding its nature and various aspects) is gaining increasing importance in studying design. This is partially due to the current lack of knowledge and understanding of this aspect of design. Design researchers, practitioners and educators are becoming aware of the importance of understanding how information used by the designer in the design process, informs and inspires their design solutions. Thus there is increasing interest in investigating and understanding this aspect further. There are also increasing concerns by design researchers and educators regarding consequences of approaching design process as a Black-Box. In his book 'How Designers Think', Lawson (2004) suggests the design process needs to be further studied and 'demystified'.

Information use has various aspects and dimensions through which it could be analysed and studied. One key aspect is the 'level' of information use and various methods and formats in which the information is used. McGinley and Dong (2009) claim that the level of use of user information varies through different stages of the design process and that the information is implemented in various ways throughout a design process. They suggest that "user data typically follows a path where the information needs peak and trough, as priorities in the development change" McGinley and Dong (2009). For this purpose, McGinley and Dong adopt the double diamond design process model and present a hypothetical example of fluctuations in people information needs throughout the stages of design process (presented in Figure 5.1). However, McGinley and Dong do not provide data supporting the above hypothesis; further studies are needed to address this hypothesis.

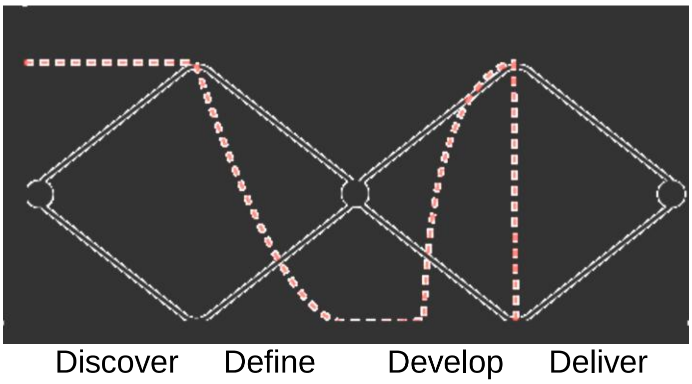


Figure 5.1 Double Diamond design process model plotted with McGinley and Dong's suggested level of user information use

Dahlin *et al.* (2005) suggest three key dimensions when studying work team information use; 'Range', 'Depth' and 'Integration'. They define 'range' as the diversity of the information used, 'depth' as the extent to which the information was explored completely, and 'integration' as the quality of the structuring of the rationale based on the information used. It is suggested that the distinctions between range, depth, and integration highlight different aspects of information use (Dahlin et. al, 2005). Pelz (1978) classifies information use in three categories including 'Instrumental use', 'Conceptual use' and 'Symbolic use'. 'Instrumental' use is when the information is directly applied to solve a problem, while in 'conceptual' use the information is not directly used for problem solving but via making inferences. In 'symbolic' use, a more figurative meaning is applied to the information and somehow distorts findings beyond their intended use (Pelz, 1978). The 'range' and 'depth' dimensions suggested by Dahlin *et al.* (2005) cover diversity and level of detail of information used. However, beside range and depth of information use, it is also important to address 'frequency' of information use and how often it is used throughout the design process. Thus it is suggested to use the three aspects of 'range', 'depth' and 'frequency' addressing how diverse, in-depth and frequently the information is used. For this purpose, these three aspects are covered under the 'Intensity' dimension. The 'Intensity' dimension, covering 'range', 'depth' and 'frequency' is therefore suggested to replace the 'use' dimension in the initial framework. This refined dimension is further studied in the study in this chapter.

5.2 Aim, Objectives and Research questions

Given the 'self-reporting' nature of previous studies, it was crucial for the framework to be studied through an 'in-situ' approach in the next step. The aim, objectives and research questions in the Design Bugs Out study were generally in line with that of the previous study (Chapter Four). However, methods used for addressing the objectives and questions varied. Due to its observatory nature, the aim of the Design Bugs Out study was two-fold, both general and specific; it was general in the sense that it aimed to observe designers' overall information behaviour and all its relevant issues, and it was specific in that it aimed to particularly refine, evaluate and detail the already outlined information framework. Table 5.1 presents a breakdown of the aim and objectives in the Design Bugs Out study.

Table 5.1 Aims and Objectives of the Design Bugs Out observational study

Aim	**Objectives**
1. Observing various aspects of designers' information behaviour	*1.1 To identify other dimensions for the information framework*
2. Refining, Evaluating, and Detailing the information framework	*2.1 To refine the six dimensions of the framework*
	2.2 To evaluate the framework
	2.3 To detail the six dimensions of the framework

Nine research questions were formulated investigating designers' information behaviour in the Design Bugs Out project, specifically in regard to people information. The research questions were in line with the study aim and objectives and were carefully devised to address all the objectives. The first six questions addressed each dimension of the information framework and were to be addressed throughout the observation stage. Questions seven, eight and nine were to be addressed after the observation was carried out. Table 5.2 presents research questions in relation to the objectives of the study.

Table 5.2 Research Questions for the Design Bugs Out study in relation to study objectives

Research Questions - addressed WHILE observing	**Objectives**
1. Why do designers use people information?	2.3
2. How do designers source the people information?	2.3
3. What types of people information designers use?	2.3
4. What formats of people information designers use?	2.3
5. What are the attributes of the people information designers use?	2.3
6. What range and depth of people information is used and how frequently?	2.3
Research Questions – addressed POST observation	**Objectives**
7. Could the framework help understand key aspects of designers' information behaviour?	2.2
8. What new dimension/s should be included?	1.1
9. What dimension/s need to be refined?	2.1

5.3 Data collection methods

The purpose of this study was to investigate designers' behaviour in regard to people information. It was assumed that designers, like other information users, would have two types of information behaviour; 'perceived' and 'actual'. The Design Bugs Out study mainly focused on investigating the 'actual' information behaviour but also aimed to address the perceived behaviour. This was in order to prohibit future limitations in the analysis of the collected information (Fidel and Green, 2004) and also to enable comparisons and reflections on any potential differences between the results of the 'observed' versus 'reported' behaviour of designers. Thus, for the Design Bugs Out study, observation was adopted as the primary data collection method and follow-up questionnaire as the complementary method in order to provide comprehensive information on both information behaviour aspects. The study was divided into two sections based on the methods used. In the first stage of the study, designers' actual information behaviour was studied through observation. In the second stage, designers' perceived information behaviour was studied through the use of self-reporting questionnaires.

5.3.1 Observation

Being mainly a descriptive study, direct observation was used as the primary method for capturing the actions of the designers (Robson, 2002). Jordan and Henderson (1995) argue that direct observation is a valuable method as it acts as a shared source and helps to overcome the gap between what people say they do and what they actually do. This was a major consideration for adopting observation as the key method, as the previous study had primarily focused on what 'designers said they did'. Also, it is argued that the use of observational methods could reduce the amount of assumptions the researcher makes about the behaviour of real users (designers in this case) (Keates and Clarkson, 2003). Zeisel (2006) lists the key qualities of observation method as being 'empathetic', 'direct', 'dynamic' and 'variably intrusive'. In being intrusive, Zeisel argues that as a dynamic phenomenon, the observation method allows the researchers to vary their level of intrusiveness in the project. Based on this, he suggests there are various roles a researcher could adopt in an observational setting. Zeisel (2006) categorises these roles into four main types including 'Secret outsider', 'Recognised outsider', 'Marginal participant' and 'Full participant'. These categories were in line with Robson's (2002) classification of observations, ranging from 'Participant observer' to 'Participant-as-observer'.

Apart from the observer's role, observational methods could be classified based on other factors such as their nature, purpose, level of pre-structure and the type of information collected. Robson (2002) describes two key types of observation structure-wise, including 'formal' and 'informal'. Informal observation is less structured and prescriptive and gives the observer a higher level of freedom in terms of what information they collect and how they collect it. Formal observation, however, imposes certain level of structure and pre-defined direction in terms of what has to be observed and how. Robson argues the former method is complex and needs a more in-depth analysis and synthesis role from the observer while the latter is more reliable and valid but at the same time may be limited in terms of exploration and completeness. He classifies the former as mainly qualitative and the latter as quantitative. The approach to observation in this study was largely formal, yet at the same time informal; the observer was specifically looking for information regarding the six dimensions of information framework, at the same time the observation process was fully open to document any unidentified behaviour or attitude. Addressing different levels of observer participation, Robson (2002, p. 321) says "while the pure-observer typically uses an observation instrument, the participant observer is the instrument." In the Design Bugs Out study, the 'Marginal Participant' role was adopted where the observer participated in the design project as an identified but unimportant 'team member'. It was hoped that this would largely limit the 'being observed' effect on designers and would thus have the least interference with the natural flow of the real-world design project.

5.3.2 Follow-up questionnaire

Questionnaires provided designers with the opportunity to reflect on the process they had gone through in the Design Bugs Out project and report back on their people information behaviour in terms of various dimensions of the information framework. In order to complement findings from the observation of designers and their information behaviour throughout the Design Bugs Out project, follow-up questionnaires were conducted with the key designers involved in the project. This was in order to collect designers' own reflection and self-report on their information behaviour in the project and facilitate analysis and comparison of findings from the self-report and observation. One designer from the design consultancy and one designer from the manufacturer company were asked to complete the questionnaire after the project had come to an end. The two designers were selected on the basis of their key role in Design Bugs Out project.

Bernard (2002) identifies the highest level of structure in ethnographic interviews as 'structured interview'. He describes one type of structured interviews in ethnography as being questionnaires which may be self-administered by the study participant where respondents are given the same choices of responses to select. The benefit of such structured technique is the reliability and validity of the results. Following the same logic and aiming at the most reliability and validity in designers' self-report data, questionnaires were provided to designers with given choices. Fixed questions were combined with open ended questions resulting in close ended questions with multiple choices in which participants were also allowed to select an "Other, please specify" response. It gave the participant the chance to provide a response category (in this case, sub-dimension) not listed, which helped to increase rigour, inclusivity and precision and provided the researcher with a more robust response.

The questionnaire was designed in an electric format and was made available online. The online format was preferred to hard copy format or face to face interviews as it gave designers the highest level of flexibility to respond in their own time, was more convenient to send and collect and was also in line with the online platforms designers used on a daily basis. The questionnaire asked designers to reflect back on the Design Bugs Out project design process and report their information behaviour by answering to questions on each dimension of the information framework. The questionnaire was organised in a chronological order, based on stages of the design process. For this purpose, the Design Council Double Diamond model (Design Council, 2005) was adopted. In the questionnaire, it was made specifically explicit that the focus of all questions was on people information. A copy of the full questionnaire is provided in Appendix B1.

5.3.3 Observation procedure

The observer was introduced to the design team as the research partner, at the initiation stage of the project, at the same time with introduction of other team members and formation of the design team. This helped create a better acceptance of the observer as a team member, rather than an outsider. The team members were made aware of the role of the research partner in general and the nature of their involvement in the Design Bugs Out project. It was also explicitly mentioned that the whole process of the design project might be used for research purposes. However the team members were not specifically made aware that their information behaviour was being observed. This was in order to avoid making the designers self-conscious of their information behaviour and influencing it in any way.

As the core design team consisted of members from both the design consultancy and the manufacturer company based at different locations, keeping constantly in touch was a major consideration for the team. Thus, a detailed project plan was devised by the design team including milestones and deadlines and dates for weekly face-to-face meetings in order to report on progress made on each side, communicate findings, and develop and discuss the impact of these findings in a fuller picture. The weekly meetings were considered critical to the project progress and key decisions were made in them including major direction and specifications of the research, assigning roles and deciding the areas of focus for each team member until the next meeting. These meetings were usually held in the design consultancy office and the observer was expected to attend these meetings as a research partner to the design team. Also, email and phone conversations were intensively used as another channel of communication. Apart from meetings held between team members and phone and email correspondence, a number of visits, workshops and observational sessions were carried out by the team, where the observer also attended and observed as a team member. All these various types of team activities were treated as an observation session with an observational context.

5.3.4 Recording the observations

Zeisel (2006) suggests a list of observation recording devices including notation, preceded checklists, maps, photographs, and videotapes and movies. Considering the role and level of involvement of the observer in the Design Bugs Out project (marginal participant) and also the length of observation period (throughout the project, lasting approximately six months) it was crucial to adopt a consistent, comprehensive yet manageable approach to data collection and choose appropriate methods and devices for recording the various types of observation sessions that were held. Having adopted a 'participant observer' approach, using obtrusive recording devices such as a video-camera and voice recorder needed careful consideration and was largely avoided in most cases. Use of video and audio recording for observation is generally considered heavily time-consuming and labour-intensive in terms of collection and the analysis of raw data (Robson, 2002). This was particularly important considering the long observation period in the Design Bugs Out study. Thus, considering the nature of the study in all the above, notation and checklists were used as primary recording tools for the observation, accompanied by photographs and videos if and where appropriate. This was alongside but separate from all the material and documentations produced in the process of the Design Bugs Out project. These documents were produced by various team members, mainly for the purpose of internal communication among the design team or for external communications with the clients, experts or media. These included emails, meeting minutes, short or long reports, full versions or extracts from various secondary sources including expert reports and internet content, images and videos, and PowerPoint presentations. All the above were also recorded and documented for the purpose of further review, reflections and analysis of the designers' information behaviour.

In recording informal observations, it is suggested to start with a descriptive observation, explaining the setting and then to analyse the well-described setting in order to come up with explanations and frameworks detailing the events and acts. Whitehead (2005) suggests a set of comprehensive categories for informing observation that is focused, descriptive and selective. Also, Spradley's model for descriptive observation (1980) suggests nine dimensions including *Space, Actors, Activities, Objects, Acts, Events, Time, Goals and Feelings* for the descriptive observation of a setting. However, such framework or categories were not used in observing the Design Bugs Out project as the observation was largely formal and already followed a certain agenda in terms of what needed to be observed. In this case, the six dimensions of the information framework gave structure to the observation and guided the sessions by outlining what aspects of designers' information behaviour had to be observed. The agenda in every observation setting was to seek answers to research questions one to six (outlined in Section 5.2.1), leading to a 'category system' for the observation (Robson, 2002).

5.4 Data analysis method

Observation data was collected in various formats including notations, checklists, meeting minutes, emails and research presentations and reports. The 'template approach' (Robson, 2002) was used in order to analyse the data, being mainly quantitative. The collected data from various sources was processed in two main stages of coding the data and then clustering the data of the same code into groups. Using this technique, the collected data from various observation sources was first coded with words or phrases derived from the six framework dimensions and their sub-dimensions, then the data labelled with the same code were clustered together. The data collected from follow-up questionnaires was collated and organised in the order of each information dimension.

5.5 Findings and Discussion

Both findings and discussion sections were principally structured around the six research questions. The typical approach to presentation of 'findings' and 'discussion' in this chapter would have been to first present the 'findings' for the design process and research questions in a separate section and then provide the 'discussion' about them in a separate following section. This could prove difficult for the reader to follow. Therefore, in order to provide a useful and easy to follow way to address each research question, both findings and discussion for each research question and also the overall design process are presented successively in a section called 'Findings and Discussion'. Below, first the overall findings from the two research methods i.e. observation and follow-up questionnaire are presented. Then the findings and discussion for the Design Bugs Out overall design process and the six research questions are presented.

❖ Observation

The entire Design Bugs Out project lasted for six months from the formation of design team to the delivery of the final working prototype. Throughout this period, the observer was engaged with the project, directly in touch with the design team, and actively observing the designers' information behaviour. However, the level and frequency of the observer's involvement with the team and the project did vary throughout various stages of the design process. This was due to the working culture of the design consultancy and the manufacturer, the vibrant, divergent and convergent nature of the design process and different levels of focus on end-users throughout the process. This directly influenced the involvement of the observer since the observer's role as the research partner, was specifically to cover the user research and insight aspect and respond to people information needs of the design team. The observations were mainly documented in the format of notes and informal fieldwork journals.

❖ Follow-up questionnaire

Following the completion of the Design Bugs Out project, a follow-up questionnaire was devised to collect designers' reflections on their information behaviour throughout the project. The questionnaire was structured around the six dimensions of the information framework and asked designers to respond to questions regarding each dimension reflecting back on each stage of the Design Bugs Out project. In order to reduce and simplify the stages, facilitate easier responding and have a uniform structure for analysis, rather than breaking down the design process to all stages and activities as outlined in Table 5.4, the Double Diamond design process model (Design Council, 2005) was adopted as a uniform structure to analyse the stages of the design process. Designers were asked to self-report answering to questions for all four stages of the Double Diamond design process, i.e. 'Discover', 'Define', 'Develop' and 'Deliver'. In responding to questions for each dimension of the information behaviour framework, designers could select from a range of sub-dimensions and could also add any other sub-dimension under "Other, please specify" option. Two designers with key roles in the project were selected to complete the questionnaire. One designer from the design consultancy and the other from the manufacturer company completed the self-report questionnaire. The full version of the follow-up questionnaire is included in Appendix B1. Also, the full responses of designer A (from the design consultancy) and designer B (from the manufacturer company) to the questionnaire are provided in separate tables in Appendix B2. The findings from the self-report questionnaires are presented in the 'Findings according to Research Questions' section.

5.5.1 Findings and discussion regarding the process

Chapter Two identified the 'design process' as a key underlying context for information behaviour, bringing structure and understanding into the study of designers' information behaviour; it was believed that every information behaviour act happens in the context of a design process of a sort. As a key contextual element, Chapter Four investigated designers' design process through the nine interviews with design companies. In line with that, the design process was also studied and analysed in the Design Bugs Out project in order to provide a comprehensive and consistent understanding of the design process, this time through the observation of a real-world design activity. In order to present the results in a meaningful and useful way, first a brief chronological overview of the Design Bugs Out project design process is presented and then the findings are presented in the order of research questions.

- **Findings**

Although there was no explicit decision or specification made by the Design Bugs Out team on general stages of the design process, a detailed stage by stage project plan was drafted and agreed by all team members at the initiation stage of the project. Table 5.3 presents stages of the design process in detail, based on the project Gantt chart, devised by the design team. The order and staging is as defined by the design team and in some cases there was some difference in terms of order of undertaking activities. However, the overall order and sequence of stages was observed to happen as planned.

Table 5.3 The Design Bugs Out project Gantt chart (as drafted by the design team)

Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
Consultation Hospital visits User forum Focus group	Project development Brief development Design phase I Schematic modelling Feasibility phase I	Presentation Design development I Mock up phase Feedback phase	Design development II CAD data (prototype) Cost analysis	Presentation work Prototype production	Prototype due

The commode and bed-side chair were the two products to be re-designed by the Design Bugs Out team. Between month one and month three of the Design Bugs Out project, much of the research was focussed on identifying various people involved (called stakeholders) and capturing end-user requirements. The team identified a range of stakeholders including carers, visitors, nurses, cleaners, infection control specialists, tissue viability specialists, and procurement personnel. Due to the nature of the project, opportunities for experimental methods were extremely limited. These were typically designers' preferred means of engaging with users to test prototype products and experiences (Nickpour and Dong, 2008b). The research team's role was to capture people information as specified by designers on their behalf. The people information was gathered through both primary and secondary research. In some cases, due to the sensitive nature of the subject and the ethical implications, gaps existed in the primary information available which could not be addressed through observing end-users or working directly with them. In such cases the research team adopted simulation and role-play where applicable. Weekly meetings were held frequently and findings and their impact on the holistic picture were communicated and discussed.

A number of studies and activities were mainly undertaken by the research team. These included benchmarking of current products to understand the market, observational research through visits to different wards within hospitals, interviews with recent patients and hospital carers, and user workshop with recent patients and hospital staff including nurses and occupational therapists. On the basis of research, the two design briefs were further detailed and key product requirements and user needs were identified. The briefs were further developed through expert panel consultation organised by the client. In the development and detailing phase, a second round of interviews and questionnaires were undertaken relating to specific issues and detailed questions on products and their use. A list of the studies conducted to capture people information and identify relevant issues, and a brief description of each study is provided in Appendix B3. In parallel to field studies, secondary user research was also carried out using various available sources.

❖ Discussion

The Design Bugs Out project provided both detailed and holistic view of a real-world design process and the order and detail of various stages and activities undertaken throughout this process. The Design Bugs Out was a unique project with an exhaustive process specific to its combination of brief, the client and the design team. However, the detailed stages and activities of the Design Bugs Out project were broadly in line with stages of a typical design process and could be categorised and clustered into phases of a generic model of design process. The Double Diamond design process was adopted as the generic design process model (discussed in detail in Chapter 2) for this purpose. Table 5.4 shows the merger of the two generic and specific design processes. In order to do this, the Design Bugs Out project stages (based on the Gantt chart in Table 5.3) together with the activities and studies undertaken throughout the project (Appendix B3), were structured into the Double Diamond model of design process.

Structuring the design project based on the four-stage Double Diamond model proved helpful in that it facilitated a holistic understanding of the overall process and its various phases. It also helped identify, distinguish and analyse various aspects of designers' information behaviour throughout the four stages. Looking at the four overall stages allowed an indication of when, what and how the purposes, sources, types, formats, attributes and intensity of people information was. Thus, the results and findings for research questions one to six (based on the six dimensions of information framework) will be discussed following the four stages of design process, i.e. Discover, Define, Develop and Deliver.

Table 5.4 Stages of the Design Bugs Out project based on the Double Diamond model of design process

DISCOVER	DEFINE	DEVELOP	DELIVER		
Month 1	Month 2	Month 3	Month 4	Month 5	Month **6**
Hospital visits Product & process analysis Stakeholder interview Exploratory workshop Project development	Brief development Design Phase I Detailed questionnaire Schematic modelling Feasibility phase I Presentation Expert Consultation	Design development I Work-in-progress workshop Mock up testing Feedback phase Design development II	CAD data (prototype) Cost analysis Presentation work Prototype production		

5.5.2 Findings and discussion according to research questions

In this section, both findings and discussion are presented consecutively for research questions one to nine. Research questions one to six addressed the six dimensions of the information framework, seeking details to designers' behaviour relating to each dimension. Research questions seven to nine addressed general aspects of the framework and were to be answered after the Design Bugs Out study was carried out. For research questions one to six, first the findings from observation and self-report questionnaire are presented. Findings from observed information behaviour of designers together with designers' reflection on their own information behaviour (follow-up questionnaires) provided insight and understanding into various dimensions of the information framework and raised a number of issues regarding each dimension. These are discussed in this section.

In presenting the findings for each research question, the 'observed' behaviour (based on observation carried out by the researcher) and the 'reported' behaviour (based on follow-up questionnaire completed by designers) are both provided in one table. For both 'observed' and 'reported' behaviour, each item has been allocated a 'frequency' number which shows how many times the item has been mentioned by designers or observed by the researcher. The items have been arranged in the order of the highest to lowest frequency for the 'observed' behaviour. The numbers in the 'observed' column specify how many times an item was observed in designers' information behaviour, this could vary between '-' (meaning the item was not observed) and any number above zero, depending on frequency of an observed item. The highest number in the 'reported' column could be two as altogether, two designers participated in the self-report questionnaire task. Thus, number two means both designers mentioned an item, number one means one designer mentioned it and '-' means the item was mentioned by none of the designers in the follow-up questionnaire. In order to make it easier to identify items mentioned by both designers in the 'reported' column, the cells with number two have been highlighted.

In reporting the results of the observation and in order to address each dimension in a comprehensive yet useful and comparable way, the collected data for each research question (addressing one of the six dimensions of the information behaviour framework) was distilled in three progressive steps and the results of each step was presented in a separate table. Out of the three tables including the observed data for each research question, the first two tables have been moved to the Appendix B4 and only the last table has been included for each research question. This table presents the results of the 'observed' behaviour compatible with results for 'reported' behaviour.

Figure 5.2 shows the three steps of distilling collected data from observation of designers in the Design Bugs Out project. First, an initial detailed table was populated for each research question based on the researcher's observations. This table was structured around all the activities and stages outlined in Table 5.4. Then in the second step, the populated table was re-structured around the four stages of the Double Diamond design process model and the findings were presented in the order of Discover, Define, Develop and Deliver stages. Finally, in order for the results from 'observed' behaviour to be compatible with 'reported' behaviour from the questionnaires, the table was re-populated with observed behaviour as coded in the questionnaire. Findings and discussion for research questions one to nine is presented in this section.

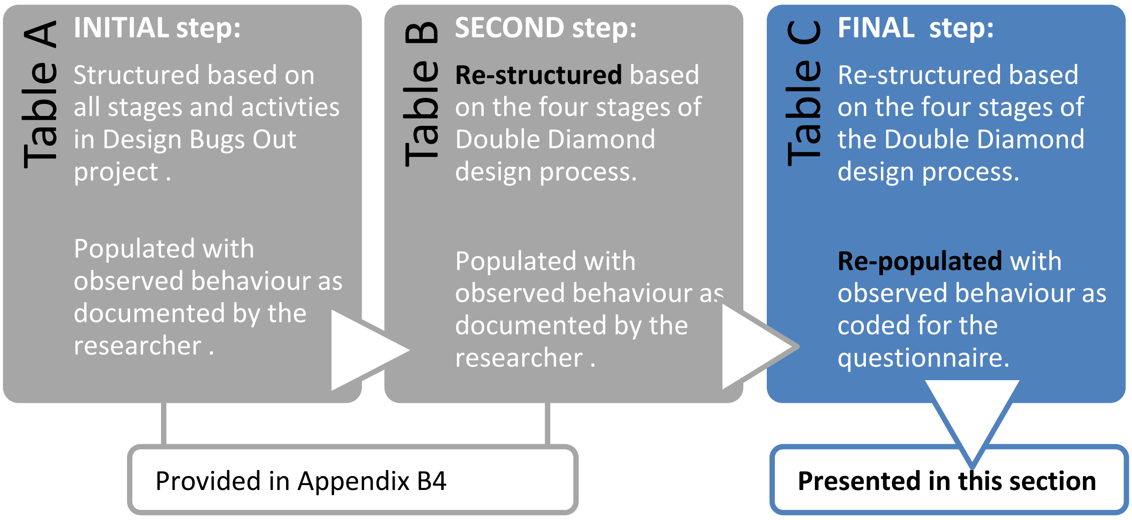


Figure 5.2 The three steps and three tables for progressive distilling of collected data from observation of each dimension of designers' information behaviour in the Design Bugs Out study

❖ Research question 1 - Why do designers use people information?

The 'Purpose' was a new information dimension suggested for inclusion from Chapter Four. Reasons behind use or investigation of people information were diverse and not limited to one or two aspects. Designers' motivations for use of information did vary largely based on stages of the research and as the design process proceeded. Table 5.5 presents designers' reasons for use of people information as 'observed' by the researcher and 'reported' by designers respectively.

Table 5.5 OBSERVED + REPORTED 'Purpose' of people information use in the Design Bugs Out project

Stage	PURPOSE of people information use/investigation	OBSERVED frequency	REPORTED frequency
DISCOVER	Insights & Understanding	8	2
	Inspiration & Ideation	6	1
	Information & Specification	4	-
	Challenge existing thinking	1	-
	Confirmation & Support	-	1
	Empathy	-	1
DEFINE	Information & Specification	9	1
	Communication & Discussion	3	2
	Confirmation & Support	2	1
	Insights & Understanding	2	1
	Evaluation & refinement	1	1
	Inspiration & Ideation	-	2
	Empathy	-	1
DEVELOP	Evaluation & refinement	6	2
	Information & Specification	3	1
	Empathy	1	1
	Insights & Understanding	-	1
	Inspiration & Ideation	-	1
	Communication & Discussion	-	1
	Confirmation & Support	-	1
DELIVER	Communication & Discussion	2	1
	Confirmation & Support	2	1
	Evaluation & Refinement	-	1

Discussion

A wide range of motivations and purposes for use of people information was observed. Clustering the use purposes gave an indication of why designers used people information at each stage and how their reasons and motivations varied considerably from one stage to another. Beginning with 'Discover' stage, the purpose of people information use was more general, looking for understanding, insight and inspiration. This slightly shifted towards more specific purposes in the 'Define' and 'Develop' stages, looking for specification, detailing the understanding, feedback and evaluation. This shift from general to specific purposes for people information use was in line with the nature of each phase and development of the design process, thus expected and already addressed in relevant literature. However, observations brought into attention two other purposes for use of people information, not usually addressed. These were 'communicating the process' with client and audience, and 'supporting argumentation and complementing design decision'. This was specifically highlighted, observing designers' information behaviour in the 'expert panel' meeting and how they presented their process and product to the expert panel using people information. In the 'Develop' phase, the purpose of information use was mainly to detail the design, evaluate the design and get feedback. Again, in the 'Deliver' phase, use of people information was highlighted for the purpose of 'communication' and 'support for final design'.

- **Research question 2 - How do designers source the people information?**

Designers sourced people information from a range of resources, suppliers and activities, throughout the Design Bugs Out project. The brief had a strong user-driven innovation angle thus encouraged adopting a user-centred approach; capturing people information. This was also facilitated by the client. The two products the design team had selected, varied considerably in terms of designers' level of 'familiarity' and previous experience and expertise. Therefore the design team used different sources of information for each product. In addition to this, the client also provided some information at the beginning of the project on various key aspects of design. This was mainly some background information and was provided as original reports and guidelines. Table 5.6 presents designers' sources of people information as 'observed' throughout the project by the researcher and as 'reported' by designers respectively.

Figure 5.3 Observation as one main source of information in the Discover stage of the Design Bugs Out study – hospital ward, nurse cleaning of commode and bedside chair

Table 5.6 OBSERVED + REPORTED 'Source' of people information used in the Design Bugs Out project

Stage	SOURCE of people information used	OBSERVED	REPORTED
DISCOVER	Internet	3	2
	User research (observation, testing, focus group)	3	1
	Books, manuals, handbooks	2	2
	Other projects - from other projects	2	1
	Client	1	2
	Specialists & experts in the field	1	1
	Colleagues, friends, etc.	1	1
	Own intuition, experience, common sense	1	1
	Journals	-	1
DEFINE	User research (observation, testing, focus group)	5	1
	Previous stage - from previous stage	3	2
	Own intuition, experience, common sense	1	2
	Specialists & experts in the field	1	1
	Guidelines, standards, regulations	-	2
	Other projects - from other projects	-	2
	Client	-	1
	Colleagues, friends, etc.	-	1
	Books, manuals, handbooks	-	1
	Internet	-	1
	Journals	-	1
DEVELOP	Other projects - from other projects	2	1
	Previous stages - from previous stages	2	1
	Colleagues, friends, etc.	1	1
	Books, manuals, handbooks	1	1
	Specialists & experts in the field	-	2
	Own intuition, experience, common sense	-	1
	Client	-	1
	Guidelines, standards, regulations	-	1
	Specific user data tools	-	1
DELIVER	Own intuition, experience, common sense	1	-
	Other projects - from other projects	1	-
	Previous stages - from previous stages	2	-
	Internet	-	1
	Specialists & experts in the field	-	1
	Client	-	1
	Colleagues, friends, etc.	-	1
	User research (observation, testing, focus group)	-	1

Discussion

A wide range and variety of sources were used in the Design Bugs Out project. The brief had a strong people-centred nature and suggested a human-centric approach. This approach was further encouraged and facilitated by the client through provision of particular sources of information. There were two considerable sources of information, both facilitated by the client, that were particularly used in the Design Bugs Out project. The first source included user engagement and ‘capture’ of first-hand people information through observation and ethnographic sources and primary research. This was encouraged, facilitated and supported by the client throughout the process. However, this proved difficult as despite client’s support, designers’ access to observation environment was limited due to ethical issues and sensitive nature of the target environment (hospital wards). The second source was provision of an ‘expert panel’ for design team as a source of information to report to and get insights and feedback from. These both highlighted the role and impact of the client on designers’ information behaviour in respect to sources of information, and their overall approach towards consulting information resources. It is argued that if not widely facilitated by the client, the sources of people information consulted could have been significantly different in their nature and scope. The client also provided some textual information in the format of long scientific reports at the ‘Discover’ stage which was not considered relevant or useful by designers and was scarcely used.

The Design Bugs Out was an example of a real-world design project where prior design knowledge (specifically regarding one product) was limited, availability of existing knowledge was restricted, and opportunities to compile new data both time-consuming and difficult to arrange. Level of ‘familiarity’ and previous knowledge and experience in a field, together with level of ‘accessibility’ of a source were two major factors that noticeably influenced the sources designers consulted.

Out of the two products the design team were commissioned, the commode was a new product territory for which the design team had no previous design experience and no prior information they could refer to. Also, existing information on commodes was limited and not relevant, therefore designers tended to consult more primary sources of people information and capture new people information. However, lack of access and the labour-intensive process of collecting primary information proved a major obstacle. Also, early literature review in the ‘Discover’ phase, was observed to have limited effect, as again, much of the information found was not relevant to design.

On the other hand, having worked on many furniture design briefs across various industries, the design team had considerable experience and confidence in their knowledge and understanding of the bedside chair. Therefore they tended to consult fewer external sources, of a less variety and level of depth and not rely heavily on primary information collection. Thus, despite the user-centred nature of the project, designers relied heavily on prior knowledge and experience from other projects and also their own intuition and experience.

Despite the 'accessibility' obstacle, user involvement was the major source of information in early stages of the design process i.e. 'Discover' and 'Define'. Internet search was also used widely in the first stage of the design process. 'Experts' and 'users' were the two people information sources, quite specific to the project.

❖ **Research question 3 - What types of people information designers use?**

Designers investigated and used various types of people information in the Design Bugs Out project. This largely depended on the purpose of information use, the sources consulted, and the stage of the design process and the activity at which they investigated the information. Table 5.7 presents the variety in the types of people information used throughout the Design Bugs Out project as 'observed' by the researcher and 'reported' by designers respectively.

Table 5.7 OBSERVED + REPORTED 'Type' of people information used in the Design Bugs Out project

Stage	TYPE of people information used	OBSERVED	REPORTED
DISCOVER	People experience & context of use (interaction)	8	1
	People needs	5	2
	People problems (facing the potential user)	5	2
	General - Statistical general info on people	3	-
	People behaviour	1	2
	People capability – physical	1	1
	People emotions, aspirations & personality	1	1
	Personal - Specific information on individuals	1	1
	People dimensions (physical)	-	1
DEFINE	People experience & context of use	9	1
	People needs	5	2
	People problems (facing the potential user)	4	2
	People capability – cognitive	1	1
	People capability – physical	1	1
	People dimensions (physical)	1	1
	General - Statistical general info on people	1	1
	People diversity	1	1
	People behaviour	-	2
	Personal - Specific information on individuals	-	1
	People emotions, aspirations & personality	-	1
	People capability – sensory	-	1
DEVELOP	People dimensions (physical)	4	2
	People capability – physical	4	1
	People experience & context of use (interaction)	2	-
	People problems (facing the potential user)	1	1
	General - Statistical general info on people	-	2
	People behaviour	-	1
	Personal - Specific information on individuals	-	1
	People needs	-	1
	People capability – cognitive	-	1
	People capability – sensory	-	1
DELIVER	General - Statistical general info on people	1	2
	People needs	1	2
	People behaviour	1	2
	People problems (facing the potential user)	-	2
	People emotions, aspirations & personality	-	2
	People capability - physical	-	2
	People dimensions (physical)	-	1
	Personal - Specific information on individuals	-	1
	People capability - cognitive	-	1
	People capability - sensory	-	1
	People experience & context of use	-	1
	People diversity	-	1
	People socio-economic status, lifestyle & trends	-	1

Discussion

In the 'Discover' stage, the type of people information sought was more general, contextual and qualitative with a focus on user needs and problems, user interaction with products and context of use. This was in order to give designers insights, help them understand the context and decide major design directions.

However, as the project moved into 'Define' stage, the people information type required by designers shifted towards more specific and detailed information about user-product interaction and user needs and problems as designers needed to gather detailed specifications on various aspects. This was critical to design team as they needed this information to be made available to them immediately in order to proceed with their creative process of ideation and conceptualisation as the key activity at the front-end of the project. However, this proved challenging as retrieval, processing and communication of detailed and specific primary people information was time-consuming and could at times delay designers' swift process of ideation and design progression. Also, designers expected this type of information to be communicated to them in a greatly summarised, easily digestible and engaging format. This introduced another conflict in terms of designers' information behaviour and their desired 'formats' of information. This will be discussed in more detail in research question Four. The above issues were of critical importance having in mind that the fuzzy front-end of design process, specifically 'Discover' and 'Define' stages, were when designers most heavily relied on and used people information to support and enrich their creative process.

Moving into 'Develop' stage, it was observed that the type of people information used shifted towards more specific detailed physical and anthropometrics information. In the 'Deliver' stage, the type of information used was related to the nature and purpose of presentation and reporting back and included two types i.e. statistical general information on users and overall summarised information on user needs and problems. One key observation regarding the type and source of people information used in the Design Bugs Out project was the fundamental role of user engagement and the contextual types of information driven out of user involvement. Although a major challenge in terms of arrangements and authorisation, this type of information brought an in-depth and holistic level of understanding of all stakeholders and their dynamic and complex context, thus helped the design team define and refine the problem and relevant design specifications.

❖ **Research question 4 - What format of people information designers use?**

Observations confirmed that a wide range and diversity, yet at the same time, certain formats of information were used throughout the Design Bugs Out project. Designers used a mixture of formats of people information in different stages of the design process in order to investigate, enquire or use information. In some cases, the research team also presented the findings from user research in certain formats to which designers responded differently. This further assisted identification of designers' preferred formats for presentation and use of people information. Informed by observations and follow-up questionnaire, Table 5.8 presents various formats of people information used throughout the Design Bugs Out project as 'observed' by the researcher and 'reported' by designers respectively.

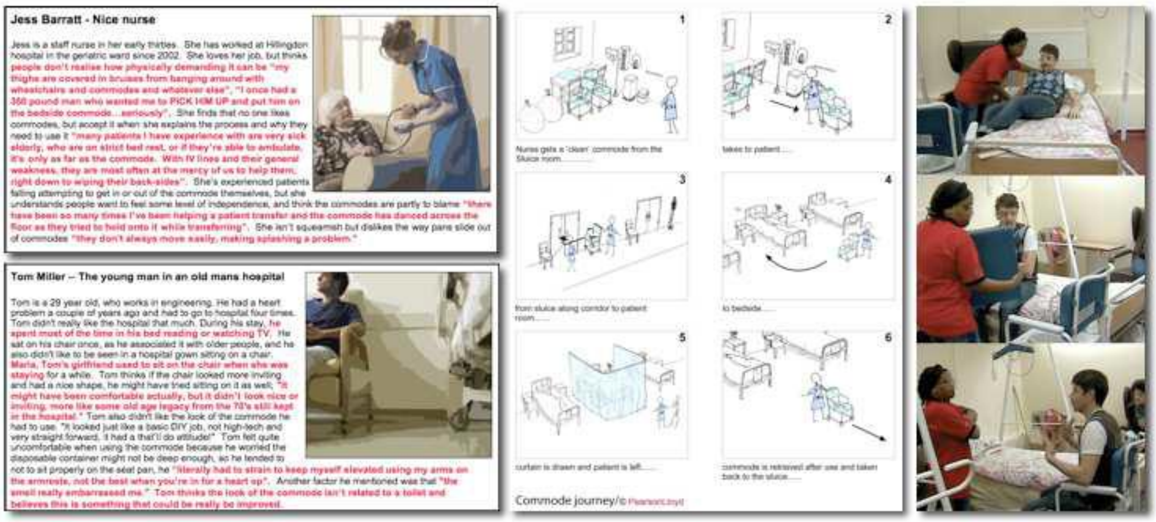


Figure 5.4 A range of formats used to communicate the information

Table 5.8 OBSERVED + REPORTED 'Format' of people information used in the Design Bugs Out project

Stage	FORMAT of people information used	OBSERVED	REPORTED
DISCOVER	Video	4	1
	Qualitative	4	1
	Info-graphics; graphs, maps, diagrams	4	1
	Persona & Scenario	4	1
	Quotes & Anecdotes	3	1
	Photographic records	3	-
	Written report (key points & summary)	3	-
	Processed (edited, structured or analysed)	2	1
	Raw (not edited, structured or analysed)	2	1
	Numerical & statistical	2	1
	Quantitative	2	-
	Case studies	-	1
DEFINE	Info-graphics; graphs, maps, diagrams	5	1
	Numerical & statistical	4	1
	Persona & Scenario	2	2
	Written report (key points & summary)	2	-
	Photographic records	2	-
	Quantitative	1	1
	Audio - oral	1	-
	Qualitative	-	1
	Database & Data tables	-	1
	Raw (not edited, structured or analysed)	-	1
	Processed (edited, structured or analysed)	-	1
	Quotes & Anecdotes	-	1
	Case studies	-	1
	Transcripts	-	1
DEVELOP	Raw (not edited, structured or analysed)	2	-
	Info-graphics; graphs, maps, diagrams	2	-
	Photographic records	1	1
	Database & Data tables	1	1
	Numerical & statistical	1	1
	Quantitative	1	1
	Persona & scenario	1	-
	Written report (key points & summary)	1	-
	Audio - oral	1	-
	Quotes & Anecdotes	-	1
	Case studies	-	1
	Qualitative	-	1
	Processed (edited, structured or analysed)	-	1
DELIVER	Info-graphics; graphs, maps, diagrams	2	1
	Quotes & Anecdotes	1	1
	Photographic records	1	1
	Numerical & statistical	-	1
	Case studies	-	1
	Quantitative	-	1
	Processed (edited, structured or analysed)	-	1
	Persona & Scenario	-	1
	Qualitative	-	1
	Written report	-	1

Discussion

Certain formats such as 'Anecdotal' overlapped with information 'types' and thus were considered to be moved to that dimension. It was apparent after initial meetings, that conventional reports were not appropriate for the designers and made minimal impact on their process. The researchers re-thought their approach and began to present information in more visual and illustrated ways. Basic info-graphics was the most used format for documentation and communication of people information across all the four stages, specifically largely implemented in the 'Discover' and 'Define' stages where the use of people information was generally at its highest. The term info-graphics was used in its broad term (Quesenbery, 2003) as information visualisations used to communicate a complex concept or set of information in a simple form and was found to be one valuable and useful format of information to designers. Qualitative people information as one general format of information was widely used in 'Discover' phase, as understanding and insight was key at that stage. Unstructured raw formats of information including video highlights and quotes and anecdotes proved extremely helpful in the front-end of the project where more insight and understanding was needed. As the idea generation developed into the 'Define' stage, more specific people information in format of numeric and statistical information was collected to further inform and detail the design concepts. As it can be observed in Table 5.8, variety and frequency of use of information formats declined as the project moved into 'Develop' and 'Deliver' phases. Formats of people information used in each phase were directly linked to and influenced by the 'Purpose' of its use. This would range from communication with others to informing designers' own creative processes. The formats used in 'Deliver' stage specifically reflected the communication and argumentation purposes when presenting the final design back to the client.

It was immediately realised that the design team were most interested in information formats specifically and clearly reflecting actual and multiple use scenarios in hospital environment. This proved challenging having restricted access to users and their environment, nevertheless, formats such as multiple use scenarios and photographic records proved effective in engaging the design team and helping them develop understanding of the issues. Exploring and examining the most effective formats to communicate the rich, detailed and unstructured information with the designers, the research team took the initiative to embody the findings of user research into a specific format i.e. 'persona', in order to report back their findings to design team. Being a generally well-received technique for presentation of people information in design, it was expected that the design team would benefit from this format of information. However, personas were not as effective as expected and were regarded by the design team as not valuable or useful. This could be due to lack of 'familiarity' of the design team with this method and the fact that they had not used such format before and did not see the value of it. This brought some new insights regarding importance of format in designers' information behaviour and its role in taking up of the content of information by designers.

Another conflict observed was between the 'formats' and 'types' of people information desired by designers. The raw, rich and unstructured people information collected through ethnographic research was expected to be communicated to designers in a quick, easily digestible, greatly summarised yet precise format that would also engage and inspire them. This demanded a great level of abstraction, editing and structuring, which risked the loss of the richness of raw information and its important details. The challenge therefore was how the raw, rich people information could be quickly, precisely and effectively communicated in an engaging and inspiring format which could keep the original qualities of raw, unstructured information.

- **Research question 5 - What are the attributes of the people information designers use?**

The various types and formats of people information used in each stage of the Design Bugs Out project had certain attributes and qualities. Observations highlighted certain qualities of people information through identifying attributes of people information that designers liked and positively responded to and also qualities that designers did not like or responded negatively to. Table 5.9 presents various attributes of people information as 'observed' by researcher based on designers' use and response to people information presented to them and also attributes as 'reported' by designers.

Table 5.9 OBSERVED + REPORTED 'Attributes' of people information used in the Design Bugs Out project

Stage	ATTRIBUTES of people information used	OBSERVED	REPORTED
DISCOVER	Accessibility of information	3	1
	Visual representation	3	1
	Importance	3	-
	Open-endedness - open to interpretation	3	-
	Right level of detail	3	-
	Clarity	2	2
	Validity & reliability	2	1
	Openness - showing the raw data	2	-
	Simplified into nuggets of information	1	1
	Relevance	1	1
	Accuracy	1	-
	Ease and speed of use	-	2
	Intuitiveness	-	2
	Simplicity	-	1
DEFINE	Importance	4	1
	Right level of detail	4	
	Validity & reliability	3	1
	Accuracy	2	2
	Ease & speed of retrieval, search and use	2	-
	Relevance	1	1
	Visual representation	1	1
	Accessibility of information	1	-
	Openness (showing the raw data)	1	-
	Intuitiveness	-	1
	Up-to-datedness	-	1
	Open-endedness - open to interpretation	-	1
DEVELOP	Relevance	2	1
	Accessibility of information	2	-
	Openness (showing the raw data)	2	-
	Ease of search and access	1	-
	Importance	1	-
	Validity & reliability	-	2
	Accuracy	-	2
	Up-to-datedness	-	2
	Intuitiveness	-	1
	Clarity	-	1
	Ease and speed of use	-	1
	Accessibility of information		1
	Right level of detail	2	1
	Completeness		1
	Ease and speed of access & search		1
DELIVER	Importance	2	-
	Validity & reliability	1	2
	Relevance	1	1
	Right level of detail	1	1
	Visual representation	1	1
	Accuracy	1	1
	Clarity	-	2
	Intuitiveness	-	2
	Accessibility of information	-	1
	Ease and speed of use	-	1
	Up-to-datedness	-	1
	Simplified into 'nuggets' of information	-	1
	Simplicity	-	1

Discussion

People information used throughout the Design Bugs Out project had many attributes and qualities. Here, the key attributes are discussed which were observed to be critical to that specific information and to the task it was used for.

Among the identified attributes important to designers, 'right level of detail' was observed to be a common quality across all stages. 'Accessibility' was a major attribute in 'Discover' and 'Develop' stages where people information needs were high and information played a key role in identifying directions and specifying details. For these purposes, most of the time, some primary information was required and thus the accessibly of information was key.

'Value' was another attribute observed to be on top of the list in all stages. This highlighted the conflicts sometimes arising between designers' and researchers' interpretation of 'value' of information. Designers generally tended to look for specific information to precisely address their enquiry agenda - either qualitative or quantitative.

Designers also wanted this information to be immediately accessible, otherwise they would consider it not valuable (in line with being inaccessible). As Fidel and Green (2004) argue, accessibility is more of a subjective perception that covers attributes such as value. Overall, a clear conflict of key information attributes was observed throughout the Design Bugs Out process. Attributes such as 'ease and speed of retrieval, search and use' were difficult and sometimes contrary to come together with attributes such as 'accuracy', 'right level of detail' and 'richness of information'. Also having fully summarised information simplified into nuggets was not always in line with raw, rich and unstructured attributes of observatory people information.

- **Research question 6 - What range and depth of people information is used and how frequently?**

Through exploratory interviews with designers, Chapter Four had suggested the initial 'Use' dimension needed to be more specifically defined and addressed more in-detail. Through a review of literature at the beginning of this Chapter, the 'Use' dimension was substituted with 'Intensity'. Intensity dimension broke down into three categories i.e. 'Range', 'Depth' and 'Frequency' of use of information. These altogether provided a specification of 'Intensity' of information use in a design activity or stage. Observations confirmed different levels of intensity of people information use in various stages of the Design Bugs Out process. The Design Bugs Out study, provided a first opportunity to document, investigate and analyse designers' use of information by focusing on range, depth and frequency of the people information they used. Through observing fluctuations of these three parameters, it was hoped that the Design Bugs Out study could help a.) Identify how useful these categories were in defining 'Intensity' dimension and b.) How their combination could work out to present an overall evaluation of intensity of information use. In order to assess and communicate the level of each category, there needed to be a way to measure each category and a rating unit. This assessment and rating needed to be done by the observer through their own subjective assessment. However, referring to the other dimensions of information behaviour observed and documented throughout the Design Bugs Out project, facilitated a more objective assessment. The semantic differential scale (Brace, 2004) was adopted as the guide to assess and rate the 'range', 'depth' and 'frequency' of information use. The semantic differential scale for each category is presented in Table 5.10. Table 5.11 presents the intensity of people information used as both 'observed' by the researcher and 'reported' by designers. This was assessed and documented using the semantic differential scale. The average for 'range', 'depth' and 'frequency' of various activities in each stage of the design process is calculated and presented in Table 5.11. The overall rating of Designer A (from the design consultancy), Designers B (from manufacturer company), the researcher, and the average calculated for overall intensity are also presented in Table 5.11.

Table 5.10 The semantic differential scale for the three categories of 'Intensity' dimension

INTENSITY of information use	***Rating***					
Range of information	1 least diverse	2	3	4	5	6	7 most diverse
Depth of information	1 least in-depth	2	3	4	5	6	7 most in-depth
Frequency of information use	1 least frequent	2	3	4	5	6	7 most frequent

Table 5.11 OBSERVED + REPORTED 'Intensity' of people information use in the Design Bugs Out project

Stage	INTENSITY of people information use	OBSERVED average	OBSERVED	REPORTED (A +B)	Average
DISCOVER	Range	3.8	4	2 + 5	4.13
	Depth	3.8	3	1 + 2	
	Frequency	4.8	5	4 + 5	
DEFINE	Range	4	5	3 + 7	4.07
	Depth	4.4	6	4 + 7	
	Frequency	3.8	4	3 + 7	
DEVELOP	Range	3.6	3	3 + 3	4.30
	Depth	5.2	6	4 + 6	
	Frequency	4.2	3	3 + 5	
DELIVER	Range	1.8	3	5 + 6	1.91
	Depth	2.3	3	2 + 3	
	Frequency	1.8	2	5 + 7	

Discussion

Observations confirmed different intensity of use of people information in various stages of the Design Bugs Out design process. As the first opportunity to document, investigate and analyse designers' use of information, breaking down the intensity dimension into three categories was useful. It proved helpful for assessing the level of information use and addressing it in a more detailed and comprehensive way. However, it proved challenging to measure each category by quantifying it in an objective way for each stage or activity - particularly in relation to other stages and activities. It was also difficult to allocate a weighting to each of the three aspects in order to work out an overall evaluation of intensity dimension as there was not enough evidence for one aspect/aspects having different weighting in terms of information intensity. Also, self-reporting of intensity of information use by designer A and designer B (from design consultancy and the manufacturer company) resulted in some considerably different high and low ratings. This also caused concerns over calculating average for self-reporting ratings of intensity dimension. Overall, the semantic differential scale was found helpful yet not fully suitable as a quantifying system.

It was observed that the 'depth', 'range' and 'frequency' of people information use where not necessarily in line in all phases and stages and that they could vary significantly. The information intensity began high and continued at this level through the 'Discover' and 'Define' stages. With better understanding, a refinement of queries occurred which led to a reduction in the volume of information needed. During the 'Develop' and 'Deliver' stages, concepts were developed in form of prototypes requiring testing. Hence people information intensity peaked again for questioning and assessment of suggested designs, before the 'Deliver' phase, at which point all people information had to be in place.

- **Research question 7 - Could the framework help understand key aspects of designers' information behaviour?**

Use of information framework in Design Bugs Out project allowed a holistic and detailed view of designers' information behaviour in the context of the design process. The framework created a guideline for observing, documenting and analysing various aspects of designers' approach towards people information. It helped enhance studying of information behaviour in two ways; first through creating a big picture understanding of behaviour regarding each specific dimension throughout the whole design process and second through creating a high-level understanding of the overall behaviour in a specific stage of the design process by linking all dimensions, collating collected data and exploring interrelations in between dimensions. Observations also showed a high level of interrelation between the framework dimensions; in some cases, analysis of designers' behaviour in regard to a number of dimensions helped highlight some conflicts, potential challenges and questions to be addressed. Collecting data on each dimension throughout the four stages of design process, gave an indication of when and how information sources, types, formats, attributes, intensity and purposes for using information changed. These six dimensions covered the three key facets of information behaviour i.e. information needs, seeking and use.

- **Research question 8 - What new dimension/s should be included?**

Design process was introduced as a contextual element in the observation of the Design Bugs Out project. The various phases and stages in the Design Bugs Out project played a significant role in the 'what and how' of the team's information behaviour. The 'stage' aspect, addressing chronological dimension of information, was an influential factor in determining the designers' information behaviour. It was observed that 'stage', like other framework dimensions such as 'purpose' and 'intensity', had a significant impact on designers' information behaviour and major differences were observed in information behaviour based on the stage of the design process. Therefore, rather than being a background contextual element to the framework, 'stage' could be considered as a core dimension of the framework that covered the chronological aspect of the design process and the 'when' aspect of the information behaviour. The inclusion of 'stage' as an additional dimension was planned to be further investigated and examined in the second observational study.

❖ **Research question 9 - What dimension/s need to be refined?**

Refinement of 'use' dimension proved helpful in that it identified different aspects of information use and detailed its various elements. The three aspects i.e. range, depth and frequency seemed to cover the use dimension well. Thus, no more refinement was suggested for 'use' dimension.

In line with use dimension, the other five dimensions seemed to be working well in addressing key information behaviour and did not need refinement.

5.5.3 Critique of Research Methods

The specifications and limitations of the observation method in general and participant observer method in specific were briefly discussed in section 5.3.1. The role of participant observer in the Design Bugs Out study was realised through formation and introduction of a supplementary 'research team' alongside the core design team. This in itself could be interpreted as introducing an additional element to the common design process in the real-world practice and thus result in changing the typical dynamics of the design process. The fact that in a real-world situation a 'research team' largely does not exist to support people information needs of designers, may distinguish the Design Bugs Out from a typical real-world design process. Furthermore, being a design project with a specifically user-centric angle, it could be argued that overall, there was more emphasis on and support for people information, its supply and its use compared to a typical design project. The role of the 'client' and the 'research team' was of particular importance here in encouraging and facilitating wider uptake of people information.

The level and frequency of observer's involvement with and access to the design team and the project in general, did vary throughout various stages of the design process and was not the same in all stages. This was due to various reasons including the different levels of focus on end-user and people information throughout the process, the working culture of design consultancy and the manufacturer, and the vibrant - divergent and convergent - nature of the design process. This could introduce some limitations in terms of rigour and consistency of data collection throughout the study. In particular, there was gradual decrease in involvement and limited access to the design team in later stages of the design process. However, this was to a certain extent inevitable as the role of the participant observer, as a member of the research team was to provide people information to design team, and as the design process proceeded, this need seemed to lessen therefore less involvement and input was needed. This expected lack of direct involvement was compensated to certain extent in the Develop and Deliver stages of design process through weekly meetings and team updates from both the design consultancy and the manufacturer.

The role of the research team by default, could have a considerable impact on 'format' dimension as they were the collectors and presenters of people information as specified by designers. Among all dimensions of information behaviour observed, it could be argued that the 'format' dimension was potentially most influenced by the behaviour of the research team as opposed to the behaviour of the core design team themselves. Although designers were quite specific in terms of what 'type' and 'source' of people information they required, they were not necessarily as specific regarding the 'format' they wanted the information presented to them. This was mainly due to the fact that in most cases the research team collected the information and decisions regarding how to present it depended on them in the first place. This in turn, helped identify relevant factors influencing the choice of information format, such as 'familiarity'. However, this could at the same time introduce some complications regarding analysis of results on 'format' and clarifying to what extent it was determined by the designers as opposed to the researchers.

5.6 Refining, Evaluating and Detailing the framework

Use of six dimensions of information framework helped create a holistic yet comprehensive and detailed picture of information behaviour in the Design Bugs Out project and facilitated investigation, analysis and reflection on designers' approach towards people information throughout the Design Bugs out project. The replacement of 'use' dimension with 'intensity' and breaking it down to three aspects i.e. Range, Depth and Frequency proved useful.

Also, inclusion of 'Purpose' as the new dimension proved to cover one important aspect of designers' information behaviour and was considered as successful. A seventh 'Stage' dimension was recommended to be included to the framework explicitly addressing 'when' and 'at what stage' designers sought and used information. The 'stage' dimension was to cover the design process and its phases. Design process was primarily addressed as a contextual constituent to the information behaviour framework. 'Purpose', 'source', 'type', 'format', 'attributes' and 'intensity' dimensions were detailed and populated by findings. Figure 5.3 and Table 5.12 present an overview of the transformations to the information framework and specify the changes made. The detailed dimensions are presented alongside refinements and changes suggested to certain dimensions.

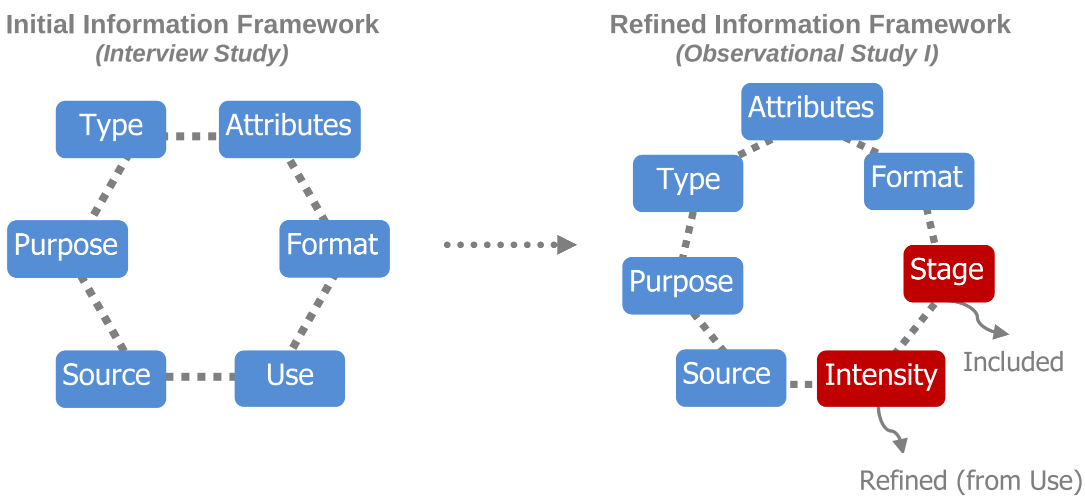


Figure 5.5 The initial Information Framework based on Interview Study and the refined framework based on the findings from the Observational Study I

Table 5.12 Changes made to framework dimensions based on Observational Study I findings

Dimension	Changes	Result	
Purpose	Detailed	Stage:	Discover *Insight & understanding, Inspiration & ideation, Information & specification* Define *Information & specification, Communication & discussion* Develop *Evaluation & refinement, Information & specification, Empathy* Deliver *Communication & discussion, Confirmation & support*
Source	Detailed	Stage:	Discover *User research, Previous experience, Internet, Books* Define *User research, Previous stage, Intuition* Develop *Other projects, Previous stages, Specialists* Deliver *Previous stages, Other projects, Intuition*
Type	Detailed	Stage:	Discover *Experience & context of use, Needs, Problems* Define *Experience, Needs, Problems* Develop *Dimension, Physical capability, Experience, Statistics* Deliver *Statistics, Needs, Problems, Behaviour*
Format	Detailed	Stage:	Discover *Qualitative, Info-graphics, Video, Quotes & anecdote* Define *Info-graphics, Numerical, Persona & scenario* Develop *Info-graphics, Raw* Deliver *Info-graphics, Photographic records, Quotes*
Attributes	Detailed	Stage:	Discover *Accessibility, Right level of detail, Value, Presentation* Define *Importance, Level of detail, Validity* Develop *Accessibility, Relevance, Validity, Accuracy* Deliver *Importance, Validity, Clarity*

Use → Intensity	Refined + Detailed	Stage:	Discover *Range* 3.65 (on a scale of 1 to 7) *Depth* 2.65 (on a scale of 1 to 7) *Frequency* 4.65 (on a scale of 1 to 7) Define *Range* 4.50 (on a scale of 1 to 7) *Depth* 4.95 (on a scale of 1 to 7) *Frequency* 4.40 (on a scale of 1 to 7) Develop *Range* 3.30 (on a scale of 1 to 7) *Depth* 5.10 (on a scale of 1 to 7) *Frequency* 4.10 (on a scale of 1 to 7) Deliver *Range* 3.65 (on a scale of 1 to 7) *Depth* 2.40 (on a scale of 1 to 7) *Frequency* 3.90 (on a scale of 1 to 7)
Stage	Included	*Discover, Define, Develop, Deliver*	

5.7 Summary

5.7.1 Key insights

Findings confirmed both conflicts and interrelations between various dimensions of the information sought and used by designers throughout the design process. There was conflict of demands in regard to some aspects of information, specifically there was some divergence between 'format', 'type' and 'attributes' of people information designers sought. Some significant interrelations were also observed between various dimensions of framework in particular 'purpose' with 'source' and 'type', also 'type' with 'format' and 'qualities'. Discover and Define stages of the design process were when the people information was most heavily sourced and used, this suggests more focus is needed on designers' information behaviour (explicitly people information) at the front-end of the design process.

5.7.2 Study implications

This study was the first of two observational studies planned to refine, evaluate and detail the information framework. Through observing a team of designers responding to a real-world design challenge, the refined information framework from the Interview Study in Chapter Four was further studied and investigated. This resulted in detailing of six dimensions and suggesting one new dimension to be included. 'Stage' as the new dimension suggested for inclusion, will be further studied in the next chapter. The next chapter will present the second observational study and its findings. Also, in order to complement the observational study in this chapter, the next chapter will focus on three groups of designers with a 'recognised outsider' role. The refined framework will be used in the next chapter for another iterative cycle of refinement, evaluation and detailing.

Chapter Six

Observation of Designers - II

"The logical nature of the act of designing is largely independent of the character of the thing designed."

Archer (1969)

Two separate real-world field studies were partaken in order to observe designers' information behaviour. Chapter Five reported the first study that aimed to 'observe designers in practice'. Through observing the design process of one real-world design project, Chapter Five refined, evaluated and detailed the information framework. The 'use' dimension was refined and changed into 'intensity' dimension and 'stage' was suggested for inclusion as a new dimension. In a third iterative cycle, after the Interview Study in Chapter Four and the first Observational Study in Chapter Five, this chapter presents the second real-world observational study that included observation of three teams of designers responding to one design brief in the context of a design competition. In line with Chapters Four and Five, the aim of this study was also to refine, evaluate and detail the information framework. The newly included 'stage' dimension was also to be further investigated and evaluated. Both studies in Chapter Five and this chapter aimed to collect data through first-hand field observations. However each study adopted a different type of observation and different level of participation for the observer. Alongside observations of designers, in order to complement the results of observation, a selection of designers participating in the study were also asked to fill in a self-reflecting follow-up questionnaire addressing all dimensions of the information framework. Building on the observations and follow-up questionnaire and through discussion and analysis of the findings for each dimension, the refined information framework was evaluated and detailed. Thus Chapter Six resulted in a further refined information framework including seven dimensions i.e. 'purpose', 'source', type', 'format', attributes', 'intensity' and 'stage'. The structure of the chapter is illustrated in Figure 6.0.

Figure 6.0 Chapter Six structure

6.1. Introduction

This chapter presents the second real-world observational study that included observation of three teams of designers responding to one design brief in the context of a design competition. Chapter Five reported the first observational study using the 'immersion' technique in order to investigate designers' information behaviour in real-world design practice. The first study adopted the 'Marginal Participant' approach where the observer was a 'commonly accepted and unimportant' (Zeisel, 2006) participant in the design project. In the second study presented and discussed in this chapter, the 'Recognised Outsider' Zeisel (2006) approach was adopted where the researcher was introduced to the three design teams as a fly-on-the-wall observer. As a complementary data collection method, follow-up questionnaires were also conducted with a number of designers observed in the study. This was in order to complement and enhance the findings and analysis of designers' observations. Designers in each team were observed in terms of their information behaviour, observations were structured around the seven dimensions of the information framework.

The findings based on the observation and self-report questionnaires were analysed and discussed and the framework was refined, evaluated and detailed in a third iterative cycle.

The second observational study also aimed to investigate, document and analyse key dimensions of designers' information behaviour in a real-world design context through implementing the information behaviour framework. The selected real-world project for this purpose was a design competition through which three teams of designers were observed responding to one design brief. The 24-hour Challenge was a design competition with certain specifications including its very fast and intense nature, focus on people-centred design, and focus on the process as well as the end product. The key specification to the 24-hour Challenge design process was that each design team was joined by a potential end-user called the 'design partner' who had a type of physical impairment. Thus, each design team had the opportunity to work closely with a design partner from the world of disability. Design teams were encouraged to base stages of their process on the user they were specifically allocated to work with. The 24-hour Challenge was a people-centred design practice in that the potential user was considered the key and fundamental to the process and outcome of the design. The aim of the design challenge was to inspire and educate professional designers in inclusive design practice and show how engagement with older and disabled people could be a direct route to product and service innovation (HHC, 2011). The whole design process lasted about 24 hours starting with designers receiving the brief and ending with them presenting their product or service proposal to a group of judges and the audience. Also, the 24-hour Challenge aimed to shift focus away from only the end product to the process through which the end product was generated and developed. These specific elements made the 24-hour Challenge a good case for observing and studying designers' behaviour in terms of people information, as there was some emphasis and support for focusing on people as potential users and also on process as well as end product. Having direct access to one potential user throughout the design process provided the opportunity to observe the designers' people information behaviour in a situation where the user was fully accessible and engaged with the design process.

Three teams of designers were observed in the 24-hour Challenge study. Each team had between five to seven members and altogether, 22 designers working in three teams were observed for a period of 17 hours.

6.2 Aim, Objectives and Research questions

The 24-hour Challenge, was the second of two observational studies planned and undertaken aiming to evaluate, refine and detail the information behaviour framework through 'observation' of designers in a real-world context. The aim, objectives and research questions in the 24-hour Challenge study were in line with that of previous studies, however, methods used for addressing the objectives and questions varied due to its 'in-situ' approach. Similar to the Design Bugs Out study, the aim of the 24-hour Challenge study was two-fold, both general and specific; it was general in the sense that it aimed to provide a basis for real-world understanding of designers' overall information behaviour and all its relevant issues, and it was specific in that it aimed to particularly refine, evaluate and detail dimensions of the already defined information framework. Table 6.1 presents a breakdown of the aim and objectives of the 24-hour Challenge study.

Table 6.1 Aims and Objectives of the 24-hour Challenge observational study

Aim	Objectives
1. Observing various aspects of designers' information behaviour	*1.1 To identify other dimensions for the information behaviour framework*
2. Refining, Evaluating and Detailing the information framework	*2.1 To refine the seven dimensions of the framework*
	2.2 To evaluate the information framework
	2.3 To detail the seven dimensions of the framework

Nine research questions were formulated investigating designers' information behaviour in the 24-hour Challenge study, specifically in regard to people information. The research questions were in line with study aim and objectives and were carefully devised to address all the objectives. The first six questions addressed each dimension of the information behaviour framework and were to be addressed throughout the observation stage. 'Stage', as the seventh and the newly included information dimension, was used to structure and lead the observation of the 24-hour Challenge. Thus, data on each dimension was collected based on the stages of the design process. Questions seven, eight and nine were to be addressed after the observation was carried out. This was because an overall understanding, reflection and analysis of the design project as a whole, was needed in order to address them and this could not be achieved until the project was fully finished. Table 6.2 presents the Research Questions in relation to study objectives.

Table 6.2 Research Questions for the 24-hour Challenge study in relation to study objectives

Research Questions - addressed WHILE observing	Objectives
1. Why do designers use people information?	2.3
2. How do designers source the people information?	2.3
3. What types of people information designers use?	2.3
4. What formats of people information designers use?	2.3
5. What are the attributes of the people information designers use?	2.3
6. What range and depth of people information is used and how frequently?	2.3
Research Questions – addressed POST observation	**Objectives**
7. Could the framework help understand key aspects of designers' information behaviour?	2.2
8. What new dimension/s should be included?	1.1
9. What dimension/s need to be refined?	2.1

As a real-world design project, the 24-hour Challenge was special in that it engaged end-users in the design process and provided direct access to them throughout the whole design process. This provided a unique opportunity to observe and analyse certain aspects of people information behaviour.

6.3 Data collection methods

Designers like other information users, would have two types of information behaviour; 'perceived' and 'actual'. In line with the Design Bugs Out study, the 24-hour Challenge study also aimed to look into both, this was in order to prohibit future limitations in the analysis of the collected information (Fidel and Green, 2004). Observation and follow-up questionnaire were adopted as the complementary methods in order to provide comprehensive information on both perceived and actual information behaviour of designers. The study was divided into two sections based on the methods used. In the first stage of the study, the actual information behaviour was studied through observation. In the second stage, the perceived information behaviour was studied through questionnaire. This provided designers with the opportunity to reflect on the process they had gone through in the 24-hour Challenge and report their information behaviour following the dimensions of information framework.

6.3.1 Observation

Observational methods could be classified based on their nature, purpose, level of structure and role of observer. Similar to the Design Bugs Out study, the 24-hour Challenge study also adopted a formal-informal observation method, looking for data on the seven dimensions of information framework in particular yet open to any unidentified aspect or dimension in general. Unlike the Design Bugs Out study, the 'recognised outsider' role (Zeisel, 2006) also known as 'pure-observer' (Robson, 2002) was adopted for the observer in the 24-hour Challenge study. This was selected to best fit the nature and the purpose of the study and its specifications. Due to very short running period of the project, no level of observer involvement was planned for or allowed. This was in order to have the least influence possible on the natural flow and the process of team work. The observer was introduced to teams at the beginning of the process, as a researcher spending time with them throughout the project in order to collect data for a design study. No more detail or specific information on the purpose of the observation was provided as this could make observants further conscious of being observed, resulting in distancing them from their natural information behaviour. The team leaders were the key contacts and the main link for the observer to connect with the team members. As a known and trusted member of the team, team leaders created the link between the observer and observants by briefly introducing the observer to other team members at the beginning of the project. This was in order to create a sense of comfort and trust and reduce any potential discomfort or unease in team members regarding presence of the observer.

6.3.2 Follow-up questionnaire

Self-reporting questionnaires provided designers with the opportunity to reflect on the process they had gone through in the 24-hour Challenge study by answering to questions regarding the six dimensions of information behaviour framework. The questionnaire followed the same logic, type, structure and format of the questionnaire in the Design Bugs Out study. A combination of fixed and open ended question types was used. The close ended questions with multiple choices also allowed an "Other, please specify" response giving the participant the chance to provide a response category not listed. More detail about the questionnaire can be found in Section 5.3.2. Considering the number of team members (between five to seven), the plan was for at least three designers from each team to complete the follow-up questionnaires after the 24-hour Challenge had fully come to an end. A copy of the 24-hour Challenge self-report questionnaire is included in Appendix C1.

6.3.3 Observation procedure

'Stage' was already introduced as the seventh dimension of the information framework, in line with that, the Double Diamond design process model (Design Council, 2005) covering four main stages of the design process was adopted as a framework to structure the observations in a chronological order. The designers' information behaviour was observed and later analysed in line with these stages as the 24-hour Challenge proceeded. The three design teams were located in various sections of one building. Throughout the 24 hours from the beginning to the end of the project, the researcher observed three teams of designers constantly. As the three teams were working concurrently, it was not possible to observe the whole design process for one team, therefore the observer kept moving constantly in between the three design teams, observing the progress of the design process and recording it. Careful consideration was given to making this transition as invisible and unnoticeable as possible to the team members. This was facilitated by the very intensive nature of the project and team work where in most cases the team were so heavily engaged with the design process that they did not notice the constant joining or leaving of the researcher and soon got used to it.

6.3.4 Recording the observations

As in the Design Bugs Out study, notation and checklists were used in order to record the observations. The 'outside observer' approach together with the fast and intense nature of the study made it both possible and imperative to use obtrusive yet quick recording devices for photographs and audio-video recordings. This helped document various team activities in situ to be studied and analysed later. Due to time-pressured nature of the process, the teams mainly used big sheets of paper to decide, record and communicate their process and realise their thinking at various stages. This helped recording the observation as these sheets could then be photographed for later analysis. No external framework for recording the observations was used as the observation was largely formal and led by the seven dimensions of the information framework. The information framework gave structure to the observation and guided the sessions by outlining what aspects of designers' behaviour had to be observed. The agenda in every observation setting was to seek answers to research questions One to Six (outlined in Section 6.2).

6.4 Data analysis methods

Observational data was recorded in both visual (photographs and short videos) and textual (notes and checklists) formats throughout the 24-hour Challenge study. This data was then clustered and interpreted using the template approach (Robson, 2002). This method was detailed in Section 4.3.4. The collected data from various sources was processed in two main stages i.e. coding the data and then clustering the data of the same code into groups. The data collected from follow-up questionnaires was also collated and organised in the order of each information dimension.

6.5 Findings and Discussion

In order to provide a useful and easy to follow way to present findings and discussion for research questions, both findings and discussion for each research question and also the overall design process, are presented successively in a section called "Findings and Discussion". Below, first the overall findings from the two research methods i.e. observation and follow-up questionnaire are briefly discussed. Then the findings and discussion for the 24-hour Challenge design process and the seven research questions are presented.

❖ **Observation**

Five design teams participated in the 24-hour Challenge competition out of which three teams could be observed throughout the process. Observation of the other two teams was not possible as one team was working offsite and another team did not agree to be observed throughout the whole process. Altogether, 19 designers working in three teams of designers were concurrently observed for a period of 17 hours during two days. Each team had between five to seven members with a varied balance of female and male designers. The competition was aimed at professional designers and all teams had a design leader. Team A included five members (one female and four males). Team B included seven designers (four males and three females) and Team C included seven designers (three males and four females). Table 6.3 presents some general information regarding each team.

Table 6.3 General information on three teams participating in the 24-hour Challenge

Team	No. of Members	Previous experience of working together	Design Partner
A	5	No	Young male Wheelchair user
B	7	No	Middle aged female Visual impairment
C	7	Yes (four out of seven)	Middle aged male Blind

❖ **Follow-up questionnaire**

Three designers from Team A, three from Team B and four designers from Team C completed the follow-up questionnaire reflecting on their information behaviour throughout the 24-hour Challenge. The questionnaire was similar to the questionnaire devised for the Design Bugs Out study and questions were structured around the seven dimensions of the information framework. For this purpose, the Double Diamond design process model was used to detail the 'stage' dimension with four sub-dimensions i.e. Discover, Define, Develop and Deliver. Altogether ten designers from Teams A, B and C completed the questionnaire.

6.5.1 The 24-hour Challenge design process

Each team had their own unique and slightly different approach to the design process. Some teams developed a general process and high-level plan of action. Team A summarised their general process into three key stages including the 'Agenda' (deciding what clearly they would do and what their research approach would be), 'Who + Why' (deciding who should be included as their target user for their product and why) and 'How' (deciding how to design for the user and how to break down the team responsibilities). Team B did not have a high-level plan and followed a detailed set of actions. Team C had five general stages including 'Main themes', 'Values', 'Contexts', 'Questions' and 'Ideation'. Table 6.4 presents a breakdown of phases and activities each team went through. The list was created based on both observation of the process and the documented process each team had. The phases and activities were structured into the four stages of the Double Diamond design process (Design Council, 2005). All teams had an overall time plan generally outlining their stages, actions and deadlines. This was part of every team's planning and process documentation which they mostly followed. However, certain stages took considerably longer than initially planned. This was the case for all three teams and was considered a typical pattern in a time-pressured process. Figures 6.1, 6.2 and 6.3 show different stages of Teams A, B and C design process respectively.

Figure 6.1 Team A - The Define stage of the team's design process, 24-hour Challenge

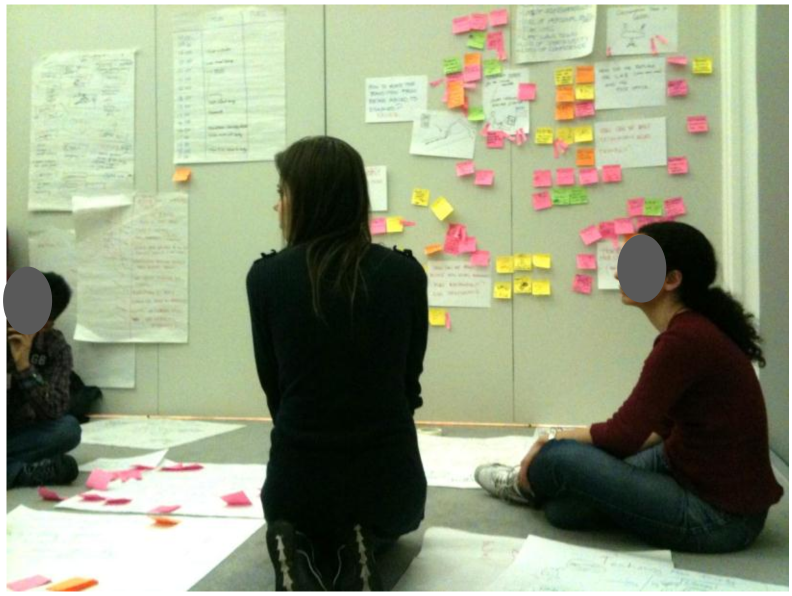


Figure 6.2 Team B - Deciding criteria for selection of ideas, 24-hour Challenge

Figure 6.3 Team C - Concept development stage, 24-hour Challenge

Table 6.4 Teams' activities in the 24-hour Challenge structured into the Double Diamond model

	Team A	Team B	Team C
DISCOVER	Immersion + Observation Daily life Opportunities Theme Map Insights Deadlines Signs Idea generation and selection	Observation of Design Partner Explore the theme Check routes with user Problems / current solutions + consequences + social impact User quotes (DP) Scenario Persona Design questions/dilemmas/issues What DP likes Idea generation around research questions	Observation of user (DP)[7] User experiences (DP) User problems (DP) Scenarios Exploring the theme Opportunities User persona (DP) Recreate an experience Challenges Insights Questions
DEFINE	How? We are going to.. Agenda Who and Why? Motivations	Deciding criteria for selection of ideas Voting and shortlisting Showing ideas to DP Discussion Final idea selection	Idea generation (Write down own ideas) Sketches of various ideas Documentation of range of ideas Structuring ideas Discussion of ideas Looking for underlying ideas Idea selection
DEVELOP	Strategy Concept development Game company	Task break down Team work	Teamwork
DELIVER	Presentation	Presentation	Presentation

7 Design Partner

6.5.2 Findings and discussion according to research questions

Findings from both observations of the three design teams together with the self-report questionnaires completed by a number of members from each team are briefly presented and discussed here according to research questions one to six. These research questions addressed the six dimensions of the information framework, seeking details to designers' behaviour in terms of each aspect. 'Stage' as the seventh dimension, was used to structure and lead study of the other six dimensions. In analysing the findings regarding each dimension, both observed and self-reported results were first gathered and presented for each design team in separate tables. These tables are presented in Appendix C2. The separate findings from Teams A, B and C for each dimension were then collated in one table. In each table, frequency of both 'observed' and 'reported' sub-dimensions were reported. Each sub-dimension was allocated a frequency number which showed how many times it was observed by the researcher or mentioned by participating designers. The sub-dimensions were arranged in the order of the highest to lowest frequency for the observed behaviour. The numbers in the 'observed' column specify how many times an item was observed in designers' information behaviour - collated sum from Teams A, B and C. This could vary between "-" (meaning the item was not observed) and any number above zero, depending on the frequency of an observed sub-dimension. The highest number in the 'reported' column could be ten as altogether, ten designers (from Teams A, B and C) participated in the self-report questionnaire task. Thus, number ten means all designers mentioned a sub-dimension, and "0" means the sub-dimension was mentioned by none of the designers in the follow-up questionnaire. In order to make it easier to identify designers' highly mentioned sub-dimensions, the cells with number ten in the 'reported' column together with the top three cells were highlighted.

❖ Research question 1 - Why do designers use people information?

Having a design partner as a permanent member of each team, meant that the teams could constantly iterate and refine their understanding and ideas as they progressed. The role the design partner played varied based on the stage of the design process the team was at. It was observed that the design partner was more actively and frequently involved in the Discover and Develop stages of the process. This was when the teams were trying to identify problem areas and gain an insight and understanding of the existing situation, and also trying to assess their initial ideas and receive some feedback from their design partner. The design partner was the main source of people information for all teams. Table 6.5 presents designer' reasons for use of people information as observed and reported for each stage of the 24-hour Challenge.

Table 6.5 OBSERVED + REPORTED 'Purpose' of teams' use of people information in the 24-hour Challenge

Stage	PURPOSE of people information use/investigation	OBSERVED frequency	REPORTED frequency
DISCOVER	Insights & Understanding	12	10
	Empathy	11	7
	Inspiration & Ideation	9	10
	Information & Specification	7	6
	Communication & Discussion	5	4
	Confirmation & Support	3	3
	Evaluation & Refinement	1	2
DEFINE	Inspiration & Ideation	13	8
	Insights & Understanding	10	8
	Communication & Discussion	9	6
	Information & Specification	7	6
	Empathy	7	4
	Confirmation & Support	3	5
	Evaluation & refinement	3	5
DEVELOP	Evaluation & refinement	13	9
	Confirmation & Support	10	5
	Information & Specification	9	4
	Communication & Discussion	9	4
	Empathy	5	1
	Insights & Understanding	5	4
	Inspiration & Ideation	3	5
DELIVER	Confirmation & Support	14	8
	Communication & Discussion	11	7
	Evaluation & refinement	8	7
	Empathy	7	1
	Insights & Understanding	4	6
	Information & Specification	3	2
	Inspiration & Ideation	2	2

Observations demonstrated direct contact and interaction with the end-user brought empathy and deep understanding to designers involved in the project. As confirmed by both observed and reported behaviour, the major purpose of people information use at Discover and Define stages of the design process was 'gaining insight' and 'inspiration and ideation'. As the teams proceeded to Develop and Deliver stages of the design process, purpose of people information use changed to 'evaluation and refinement' of ideas.

❖ **Research question 2 - How do designers source the people information?**

Design teams' sourcing of people information was diverse however heavily focused; one main aspect of the 24-hour Challenge was having one end-user as the design partner. The specific physical, sensory and cognitive capabilities, demands and wishes of the design partner were intended to be the source of inspiration, discovery and ideation for each design team. Again, the role of the brief and the client were highlighted in designers' approach towards sourcing of people information; the brief had a strong user-centred approach and the client (the organising committee) had provided the opportunity for each design team to work closely with one end-user throughout the design process. Table 6.6 presents designers' sources of information as observed and reported in the 24-hour Challenge.

Table 6.6 OBSERVED + REPORTED 'Source' of people information used in the 24-hour Challenge

Stage	SOURCE of people information used	OBSERVED	REPORTED
DISCOVER	User research (observation, testing, focus group)	12	9
	Own intuition, experience, common sense	9	7
	Internet	5	3
	Other projects - from other projects	3	2
	Client	3	4
	Specialists & experts in the field	2	2
	Colleagues, friends, etc.	2	0
	Books, manuals, handbooks	0	0
	Specific user data tools	0	0
	Guidelines, standards, regulations	0	0
	Journals	0	1
DEFINE	User research (observation, testing, focus group)	10	7
	Own intuition, experience, common sense	8	6
	Previous stage - from previous stage	6	6
	Internet	5	3
	Colleagues, friends, etc.	4	2
	Other projects - from other projects	2	2
	Specialists & experts in the field	2	1
	Client	1	3
	Books, manuals, handbooks	0	1
	Guidelines, standards, regulations	0	0
	Specific user data tools	0	0
	Journals	0	0
DEVELOP	User research (observation, testing, focus group)	12	5
	Own intuition, experience, common sense	7	3
	Previous stage - from previous stage	5	6
	Colleagues, friends, etc.	5	3
	Other projects - from other projects	4	3
	Client	3	3
	Internet	3	2
	Specialists & experts in the field	2	1
	Books, manuals, handbooks	0	0
	Guidelines, standards, regulations	0	0
	Specific user data tools	0	0
	Journals	0	0
DELIVER	Previous stage - from previous stage	11	8
	User research (observation, testing, focus group)	4	3
	Own intuition, experience, common sense	4	4
	Client	3	3
	Colleagues, friends, etc.	3	2
	Internet	3	1
	Other projects - from other projects	3	0
	Specific user data tools	0	1
	Specialists & experts in the field	0	1
	Books, manuals, handbooks	0	0
	Guidelines, standards, regulations	0	0
	Journals	0	0

User research was the top source of information in the Discover, Define and Develop stages; team members stated that their people information was obtained from the 'design partner' in their group. Only in the Deliver stage, the main source was stated as the information gathered from the previous stages of the research. This was expected, considering the nature of the 24-hour Challenge as the Deliver stage was when the teams presented their design proposals back to the judges and the audience. User research, intuition, experience and common sense, and previous stages were the key sources of information across all stages.

❖ **Research question 3 - What types of people information designers use?**

The people information used in the 24-hour Challenge was contextualised and designers used it to refer to their insights gained from directly working with their design partners. All teams spent some time with their design partners before they received the brief. This included experiencing aspects of the design partner's daily life and observing how they were limited due to their specific physical condition. This led the teams down a more physical obstacle based route to start with. However, it was observed that the teams attempted to also include emotional effects and address behaviour and attitude changes in the public in order to develop a solution that would combine all issues. Table 6.7 presents the variety and frequency observed and reported in types of people information used throughout4-hour Challenge.

Table 6.7 OBSERVED + REPORTED 'Type' of people information used in the 24-hour Challenge

Stage	TYPE of people information used	OBSERVED	REPORTED
DISCOVER	People problems (facing the potential user)	14	10
	People needs	12	9
	People experience & context of use	9	8
	People behaviour	9	7
	People capability - sensory	8	8
	People capability - physical	6	6
	Personal - Specific information on individuals	6	0
	People socio-economic status, lifestyle & trends	4	4
	People diversity	4	3
	People capability - cognitive	3	4
	People dimensions (physical)	2	5
	People emotions, aspirations & personality	2	8
	General - Statistical general info on people	0	0
DEFINE	People capability - sensory	10	7
	People capability - physical	10	8
	People experience & context of use	8	9
	People problems (facing the potential user)	8	8
	People behaviour	7	7
	Personal - Specific information on individuals	6	5
	People needs	5	8
	People emotions, aspirations & personality	5	7
	People capability - cognitive	5	5
	People diversity	5	3
	People dimensions (physical)	4	3
	People socio-economic status, lifestyle & trends	4	3
	General - Statistical general info on people	1	0
DEVELOP	People experience & context of use	10	8
	People capability - sensory	10	4
	People emotions, aspirations & personality	9	8
	People capability - physical	9	6
	People needs	8	6
	Personal - Specific information on individuals	7	5
	People problems (facing the potential user)	5	5
	People behaviour	5	5
	People capability - cognitive	4	2
	People socio-economic status, lifestyle & trends	3	3
	People dimensions (physical)	3	3
	People diversity	3	2
	General - Statistical general info on people	1	0
DELIVER	People emotions, aspirations & personality	9	7
	People needs	9	5
	People behaviour	9	5
	People problems (facing the potential user)	9	2
	People experience & context of use	8	7
	Personal - Specific information on individuals	8	6
	People diversity	7	4
	People socio-economic status, lifestyle & trends	6	7
	People capability - sensory	6	5
	People capability - physical	3	3
	People capability - cognitive	3	3
	General - Statistical general info on people	3	1
	People dimensions (physical)	0	1

People ‘problems’, ‘needs’ and ‘experience and context of use’, were among the key types of information mentioned in all four stages. People ‘emotions, aspirations & personality’ was highly ranked by designers as one type of information used. This could be due to high level of empathy and understanding facilitated through close encounter of the teams with their design partners. Also, people ‘physical and sensory’ capability was ranked highly as the design partners (one using a wheelchair and two with visual impairments) had specific capability limitations in that regard. Outcome of the Deliver stage was group presentations pitching the teams’ proposals for products and services, rather than product or service prototypes. Thus the type of information used at this stage was reflecting the aims of the presentations and focused on emotions, aspirations, experiences and socio-economic structures. This again highlighted the link between the two information dimensions ‘Purpose’ and ‘Type’.

- **Research question 4 - What formats of people information designers use?**

The 24-hour Challenge had a specific user engagement format in which the teams had the chance to work directly, continuously and closely with their design partners. This considerably influenced the ‘format’ of people information used. Due to the time-pressured nature of the process, design teams mainly relied on their overall insights and raw information directly gained from their design partners. These included direct discussions with and observations of the design partner. The information was recorded in pictorial, video or audio format. Informed by observations and designers’ self-report questionnaires, the information sought and used was reported as mainly qualitative and the design teams did not have a quantitative approach towards the information. Table 6.8 presents various formats of people information used in the four stages of the 24-hour Challenge.

Table 6.8 OBSERVED + REPORTED 'Format' of people information used in the 24-hour Challenge

Stage	FORMAT of people information used	OBSERVED	REPORTED
DISCOVER	Qualitative	10	3
	Raw (not edited, structured or analysed)	9	6
	Persona & Scenario	8	8
	Photographic records	8	7
	Audio - oral	7	6
	Quotes & Anecdotes	5	4
	Video	4	4
	Case studies	3	2
	Info-graphics; graphs, maps, diagrams	3	1
	Processed (edited, structured or analysed)	2	1
	Quantitative	1	1
	Numerical & statistical	0	0
	Written report (key points & summary)	0	0
	Transcripts	0	0
	Database & data tables	0	0
DEFINE	Qualitative	8	2
	Quotes & Anecdotes	7	5
	Persona & Scenario	6	5
	Photographic records	5	6
	Audio - oral	5	6
	Video	5	5
	Raw (not edited, structured or analysed)	5	5
	Case studies	4	3
	Processed (edited, structured or analysed)	2	1
	Info-graphics; graphs, maps, diagrams	2	0
	Transcripts	0	1
	Written report (key points & summary)	0	0
	Quantitative	0	0
	Numerical & statistical	0	0
	Database & data tables	0	0
DEVELOP	Persona & Scenario	8	5
	Qualitative	8	2
	Photographic records	7	6
	Video	7	6
	Quotes & Anecdotes	6	3
	Audio - oral	4	4
	Raw (not edited, structured or analysed)	3	3
	Case studies	3	2
	Info-graphics; graphs, maps, diagrams	0	1
	Quantitative	2	2
	Processed (edited, structured or analysed)	1	1
	Database & data tables	0	0
	Numerical & statistical	0	0
	Transcripts	0	0
	Written report (key points & summary)	0	0
DELIVER	Photographic records	6	5
	Qualitative	6	2
	Video	5	5
	Quotes & Anecdotes	5	3
	Persona & Scenario	3	5
	Processed (edited, structured or analysed)	3	2
	Case studies	3	1
	Info-graphics; graphs, maps, diagrams	3	0

	Audio - oral	2	3
	Raw (not edited, structured or analysed)	2	2
	Quantitative	1	0
	Database & data tables	0	0
	Numerical & statistical	0	0
	Transcripts	0	0
	Written report (key points & summary)	0	0

Photographic records, video, and persona and scenario were among the top formats of people information. Based on observation, qualitative information was highly used in all four stages, however designers did not report it as a highly used format of information. This could be due to the difference in terminology and perception. Also, quotes and anecdotes were observed as a highly referenced format of information across all four stages, while most designers reported its use in the Discover and Define stages of the design process.

- **Research question 5 - What are the attributes of the people information designers use?**

The various types and formats of people information used in each stage of the 24-hour Challenge had certain attributes and qualities. Observations highlighted certain qualities of people information through identifying what attributes of people information designers liked and worked with. Table 6.9 presents various attributes of people information observed and reported through the 24-hour Challenge.

Table 6.9 OBSERVED + REPORTED ‘Attributes’ of people information used in the 24-hour Challenge

Stage	ATTRIBUTES of people information used	OBSERVED	REPORTED
DISCOVER	Ease and speed of use	7	3
	Relevance	6	7
	Validity & reliability	6	5
	Ease and speed of access & search	6	3
	Clarity	5	5
	Right level of detail	5	4
	Open-endedness - open to interpretation	4	2
	Accessibility of information	4	2
	Simplicity	3	4
	Intuitiveness	3	3
	Accuracy	3	3
	Up-to-datedness	3	3
	Completeness	3	2
	Openness - showing the raw data	2	3
	Importance	2	3
	Non-scientific & nontechnical language	2	1
	Visual representation	1	3
	Simplified into nuggets of information	0	1
	Cost	0	0
DEFINE	Relevance	6	9
	Clarity	6	8
	Simplicity	6	5
	Importance	5	6
	Accuracy	5	3
	Up-to-datedness	5	1
	Validity & reliability	3	3
	Right level of detail	3	3
	Completeness	3	1
	Non-scientific & nontechnical language	2	1
	Open-endedness - open to interpretation	2	1
	Ease and speed of use	2	0
	Ease and speed of access & search	2	0
	Intuitiveness	1	3
	Openness - showing the raw data	1	2
	Visual representation	1	1
	Accessibility of information	1	0
	Cost	0	1
	Simplified into nuggets of information	0	0
DEVELOP	Relevance	6	6
	Importance	6	5
	Accuracy	6	3
	Right level of detail	5	3
	Ease and speed of use	5	3
	Simplicity	4	5
	Completeness	4	2
	Clarity	3	5
	Validity & reliability	3	2
	Accessibility of information	3	2
	Non-scientific & nontechnical language	3	2
	Intuitiveness	2	3
	Open-endedness - open to interpretation	2	2
	Simplified into nuggets of information	2	1
	Visual representation	0	1

	Openness - showing the raw data	0	1
	Cost	0	0
	Up-to-datedness	0	0
	Ease and speed of access & search	0	0
DELIVER	Validity & reliability	7	4
	Importance	6	2
	Visual representation	6	1
	Relevance	5	8
	Simplicity	5	6
	Clarity	5	5
	Right level of detail	5	5
	Open-endedness - open to interpretation	3	5
	Up-to-datedness	3	1
	Accuracy	3	0
	Simplified into nuggets of information	2	3
	Openness - showing the raw data	2	2
	Intuitiveness	2	1
	Completeness	2	0
	Non-scientific & nontechnical language	0	3
	Accessibility of information	0	2
	Ease and speed of access & search	0	0
	Cost	0	0
	Ease and speed of use	0	0

As reported by designers, the three key attributes of people information across all stages were 'relevance', 'clarity' and 'importance'. 'Simplicity' was ranked highly in the last two stages of the design process. 'Validity & reliability' was considered important at the first stage and 'right level of detail' and 'open-endedness' were in the last stage of the design process.

Observations identified 'relevance', 'clarity', 'importance' and 'simplicity' as key attributes overall. 'Validity & reliability' and 'ease and speed of use and access and search' were specifically key in the Discover stage. 'Validity & reliability' together with 'visual representation' were key in the Deliver stage. Altogether, based on both observation and designers' self report, the top attribute across all stages was 'relevance'. This was followed by 'clarity' and 'importance'.

❖ **Research question 6 - What range and depth of people information is used and how frequently?**

Observations confirmed different depth, range and frequency of people information use across the four stages of the 24-hour Challenge design process. As for the Design Bugs Out study in Chapter Five, the semantic differential scale was adopted as the guide to assess and rate the 'range', 'depth' and 'frequency' of information use. The semantic differential scale for each category is presented in Table 6.10. Both 'observed' and 'reported' intensity of people information used in the 24-hour Challenge is presented in Table 6.11.

Table 6.10 The semantic differential scale for the three categories of 'Intensity' dimension

INTENSITY of information use	*Rating*						
Range of information	1 least diverse	2	3	4	5	6	7 most diverse
Depth of information	1 least in-depth	2	3	4	5	6	7 most in-depth
Frequency of information use	1 least frequent	2	3	4	5	6	7 most frequent

Table 6.11 OBSERVED + REPORTED 'Intensity' of people information use in the 24-hour Challenge

Stage	INTENSITY of people information use	OBSERVED average[8]	REPORTED average	REPORTED median	Average
DISCOVER	Range	4.66	3.60	4.0	4.13
	Depth	5.33	5.50	6.0	5.41
	Frequency	6.00	5.50	6.0	5.75
DEFINE	Range	3.00	3.30	3.0	3.15
	Depth	5.00	5.50	5.5	5.25
	Frequency	5.66	5.60	6.0	5.63
DEVELOP	Range	4.33	3.89	4.0	4.11
	Depth	4.33	4.89	5.0	4.61
	Frequency	5.00	5.22	6.0	5.11
DELIVER	Range	4.00	3.80	3.5	3.90
	Depth	3.33	3.90	4.5	3.61
	Frequency	4.00	4.20	4.5	4.10

[8] Observed average was calculated through summing up the observed value for teams A, B and C and dividing it into three.

Both means and medians for designers' self reported values were calculated. The mean and median for reported intensity were also generally close. Also mean was calculated for observed values. Finally, the average was calculated for observed and reported values. However, it proved challenging to objectively allocate a value to each category based on researcher's observations. Also, no specific weighting could be suggested for allocation to each of the three categories i.e. 'range', 'depth' and 'frequency' in order to work out a calculation of the overall 'intensity' based on its three categories.

It was concluded that the 'range' of people information explored had an overall constant value across all four stages with quite higher value in the Discover and Develop stages. Both observation and self-reports demonstrated a continual decline in 'depth' of information as the design process proceeded. The 'frequency' of information use was quite high and constant in the first two stages of the design process while it declined towards the Develop and Deliver stages. As the final deliverable in the 24-hour Challenge was a proposal - rather than a final detailed product or service - this decline in frequency of use of people information could be expected.

- **Research question 7 - Could the framework help understand key aspects of designers' information behaviour?**

The refined information framework with its seven dimensions allowed a holistic yet detailed understanding of designers' approach to and use of people information throughout the 24-hour Challenge. The time-pressured nature of the project (running for 24 hours in total) highlighted one major benefit of the framework as a structuring tool for quick and efficient direction of observation of design activities and efficient identification of directions and points of focus. Use of the information framework enabled cross comparisons and evaluations both in terms of how one dimension of the information evolved and changed throughout the design process and how the overall information behaviour was defined based on all dimensions in each stage of the design process.

❖ **Research question 8 - What new dimension/s should be included?**

The findings from the first observational study in Chapter Five suggested that rather than being a background contextual element to the framework, 'stage' could be considered as one dimension of the framework. The inclusion of 'stage', as a new dimension, was to be further investigated and examined in the 24-hour Challenge study. Observations were led based on the stages of the design process and it was concluded that inclusion of the 'stage' dimension as a major aspect influencing other dimensions such as 'type', 'purpose' and 'format' was helpful and useful. Apart from the 'stage' dimension, inclusion of no other dimension was considered as needed or suggested based on the findings from the 24-hour Challenge study.

❖ **Research question 9 - What dimension/s need to be refined?**

'Use' dimension was refined in the previous chapter (Chapter five) and changed into 'intensity'. Although this change proved helpful in further breaking down the intensity dimension, the objective evaluation of its three categories proved challenging and raised issues of validity and reliability. Thus, rather than refining the intensity dimension, the measurement system for its categories could be considered for refinement. No issues regarding the need for refinement of other dimensions were observed or brought up and these dimensions were working well in addressing key information behaviour aspects. It could be argued that the time-pressured nature of the 24-hour Challenge study might have had an impact on refinement of the framework in terms of allowing for issues with existing dimensions or potential new dimensions to emerge. This will be discussed in Section 6.5.3.

6.5.3 Critique of research methods

The specifications and limitations of observation method in general were briefly discussed in Section 5.3.1. The 'recognised outsider' (Zeisel, 2006) also known as 'pure-observer' (Robson, 2002) was used as the specific observation method in the 24-hour study. This method had certain limitations such as the recognisable role and presence of the researcher in the team activity and risking influencing the natural process and interaction between the team members. This is also known as the Hawthorne effect, when the subjects of observation know they are being observed and thus often change the way they act. A number of actions were detailed in Section 6.2.1 in order to reduce this effect such as developing tasks for the observer so that the team members begin to see the observer as other people with something to do rather than simply observing them. Another potential problem for recognised observer is the lack of trust in their role and purpose of their observation, no matter how honestly, ethically and clearly they communicate it to the observant. However, it should be noted that as an overall limitation of this method, recognised observers may affect action in unknown ways, which due to being unknown are also very difficult to address and avoid.

The short and time-pressured nature of the 24-hour Challenge could be seen as introducing some bias in the results and findings of the study; as in the real-world practice of design, projects would normally have a longer lifespan. However, it could be argued that the time-pressured nature of this design practice allowed for the 'key' issues and aspects in terms of designers' information behaviour to emerge and directed the focus on the most fundamental areas.

Also, it could be argued that the study was not long enough to allow substantial issues to emerge that might have led to changes or refinements to the framework, and that consequent to this, the study might have had an artificial design context. However, this study should be seen as one specific observational context with certain characteristics and limitations. As already mentioned, the 24-hour Challenge aimed to shift the focus away from the end product to the process through which the end product was generated and developed. This specific element, together with the emphasis on and support for working with people as potential users, made the 24-hour Challenge a good case for observing and studying designers' behaviour in terms of people information, in an intensive and focused way. Having direct access to one potential user throughout the design process provided the opportunity to observe the designers' people information behaviour in a situation where the user was fully accessible and engaged with the design process. This was one unique characteristic of the 24-hour Challenge which added value in terms of detailing the information framework.

Thus, the overall value of the 24-hour Challenge study, in terms of evaluating and detailing the framework is not to be questioned. Also, it is known that in the real world, it is very difficult - if not at all possible - to identify and participate in a design practice which has all the 'typical' characteristics.

Furthermore, the specifically user-centred angle of the brief and the fact that each team was allocated a 'design partner' to work with closely could also introduce elements of abnormality into observation of a typical design process. However, as in the Design Bugs Out, the user-centred focus of both studies could help highlight various aspects of people information behaviour. Also, in analysis of results from the 24-hour Challenge, it would have been interesting to separately analyse each team's observed and self-reported information behaviour and address the differences between each teams' information behaviour using the information framework. However, this was not the focus of this study.

Due to the short period of time available, the final deliverables of the teams were design proposals mainly including principles and general specifications of the design rather than detailed specifications of product or service. Thus, it could be argued that the 24-hour Challenge did not fully represent a complete design process from the beginning to end as the 'end product' was still a product or service proposal that lacked full embodiment, detailed design and implementation. However, looking at the double diamond model of design process, all four elements of the process; Define, Design, Develop and Deliver could be clearly identified in the 24-hour Challenge design process, so it was a complete process in itself. The 24-hour Challenge could be argued to be the first iteration cycle of design process heavily focused on defining and designing rather than developing and delivering the concept.

6.6 Refining, Evaluating and Detailing the framework

The 'intensity' dimension replacing the 'use' dimension, was evaluated and detailed for a second time and proved helpful in addressing the three constituting categories of intensity, i.e. 'diversity', 'depth' and 'frequency'. However, no specific weighting could be allocated to each category in order to define an overall value for 'intensity' as a general factor. Also, objective quantification of the 'intensity' dimension represented issues of validity and reliability. 'Stage' as the seventh dimension of the framework was used to structure the observations and provide a basis for detailing the framework. This proved useful.

The overall framework was evaluated in terms of its helpfulness to address key aspects of information behaviour. Apart from the 'stage' dimension, the other six dimensions of the framework i.e. 'purpose', 'source', 'type', 'format', 'attributes' and 'intensity' were detailed. Figure 6.4 shows there were no changes made to the framework compared to the previous chapter. Table 6.12 details the changes made to the framework dimensions based on findings of the 24-hour Challenge and the key sub-dimensions identified for each dimension. The key sub-dimensions specifically identified in this study (not identified through Study I) are highlighted bold and in red.

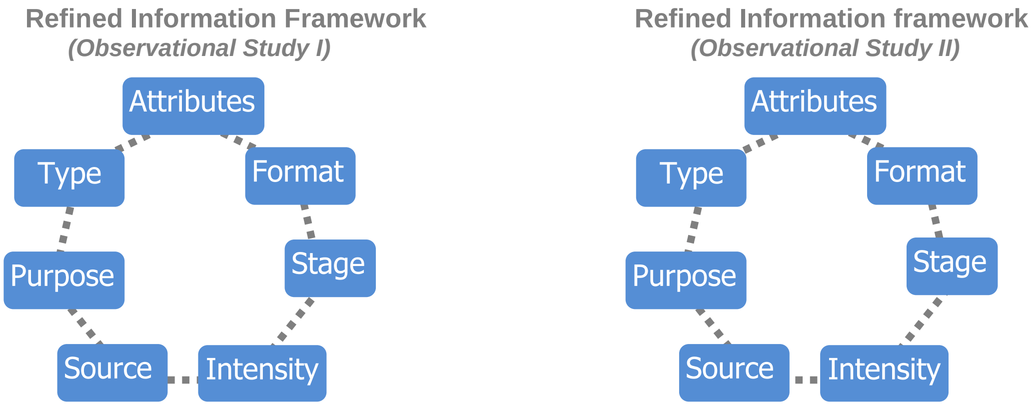


Figure 6.4 The refined framework based on the findings from the Observational Studies I and II

Table 6.12 Changes made to framework dimensions based on the 24-hour Challenge findings

Dimension	Changes	Result	
Purpose	Detailed	Stage:	Discover *Insight*, ***Empathy***, *Inspiration* Define ***Inspiration***, ***Insight***, *Communication*, *Information* Develop *Evaluation*, ***Confirmation***, *Information* Deliver *Confirmation*, *Communication*, ***Evaluation***
Source	Detailed	Stage:	Discover *User research*, ***Intuition***, *Internet*, ***Client*** Define *User research*, *Intuition*, *Previous stage* Develop ***User research***, *Previous stages*, ***Intuition*** Deliver *Previous stages*, ***User research***, *Intuition*, ***Client***
Type	Detailed	Stage:	Discover *Problems*, *Needs*, *Experience & context of use* Define ***Physical & sensory capabilities***, *Experience & context of use*, *Problems* Develop *Experience & context of use*, *Physical & sensory capabilities*, ***Emotions***, ***Needs*** Deliver ***Emotions***, *Behaviour*, *Needs*, *Problems*, ***Experience***
Format	Detailed	Stage:	Discover *Qualitative*, ***Raw***, ***Persona & scenario***, ***Photographic records, Audio-oral*** Define *Qualitative*, ***Quotes & anecdotes***, *Persona & scenario*, ***Photographic records***, ***Audio-oral*** Develop ***Qualitative***, ***Persona & scenario***, ***Photographic records***, ***Video*** Deliver ***Qualitative***, *Photographic records*, ***Video***, *Quotes & anecdotes*, ***Persona & scenario***
Attributes	Detailed	Stage:	Discover ***Relevance***, ***Validity***, ***Ease of use & search***, ***Clarity*** Define ***Relevance***, ***Clarity***, ***Simplicity***, *Importance* Develop *Relevance*, ***Importance***, *Accuracy* Deliver ***Relevance***, ***Simplicity***, *Clarity*

Intensity	Detailed	Stage:

Intensity	Detailed	Stage:	Discover *Range* 4.13 (on a scale of 1 to 7) *Depth* 5.41 (on a scale of 1 to 7) *Frequency* 5.75 (on a scale of 1 to 7) Define *Range* 3.15 (on a scale of 1 to 7) *Depth* 5.25 (on a scale of 1 to 7) *Frequency* 5.63 (on a scale of 1 to 7) Develop *Range* 4.11 (on a scale of 1 to 7) *Depth* 4.61 (on a scale of 1 to 7) *Frequency* 5.11 (on a scale of 1 to 7) Deliver *Range* 3.90 (on a scale of 1 to 7) *Depth* 3.61 (on a scale of 1 to 7) *Frequency* 4.10 (on a scale of 1 to 7)
Stage	Detailed	*Discover, Define, Develop, Deliver*	

6.7 Summary

6.7.1 Key insights

Both observed and reported information behaviour of designers identified interrelations between certain dimensions of information framework, in particular, connections between 'purpose' and 'source', and 'type' with 'format' and 'qualities'. These were in line with conclusions from the first observational study in Chapter Five. The time-pressured nature of the study did not allow for conflicts between certain information dimensions to be identified. However, overall, it could be observed that the first two stages of the design process i.e. Discover and Define were more people information-intensive.

6.7.2 Study implications

This study was the second of the two observational studies planned to refine, evaluate and detail the information framework. Both studies helped use and detail the information framework in a real-world design context and brought first-hand insights into various dimensions of the framework. Six dimensions of the framework were detailed based on the findings and no further refinement to existing dimensions or inclusion of a new one was suggested. The next chapter will describe the third method of data collection i.e. survey of designers and design researchers. The detailed framework based on the 24-hour Challenge in this chapter will be used in the next chapter for the final iterative cycle of refinement, evaluation and detailing.

Chapter Seven

Survey of designers and design researchers

"There will soon be more information for designers to use - understanding how designers use this information will help re-design how some information can be delivered ."

Information Behaviour in Design survey respondent - Design anthropologist, UK (2011)

Adopting a methodological triangulation approach (Seale, 1999), the initial information framework was refined, evaluated and detailed through interviews and observations of designers in three separate studies (Chapters Four, Five and Six) in an iterative cycle. As the last of the three triangulated research methods, a survey was conducted with designers and design researchers aiming at refinement, evaluation and detailing of the information framework. This chapter presents the process and the results of this online survey completed by 90 participants overall (67 participants detailing the framework and 90 participants evaluating and refining the framework). The structure of the chapter is illustrated in Figure 7.0.

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Figure 7.0 Chapter Seven structure

7.1 Introduction

The initial information framework was refined, evaluated and detailed through two 'qualitative' methods i.e. interviews and questionnaire administered to nine design companies, and observation of four design teams in two real-world design projects (24 designers observed overall). In order to add validity and robustness to the findings and enable cross examination (Cheng, 2005), a fourth complimentary study was carried out adopting a 'quantitative' research method. This would help further the understanding of designers' information behaviour through collection, analysis and comparison of both their 'observed' and 'reported' behaviour. This would also enable research triangulation (Jick, 1979; Creswell and Vicki, 2007). Surveys are one of the most common quantitative research methods providing a straightforward approach to the study of attitudes and motives (Robson, 2002). Thus, a survey method was adopted as the third research method in order to collect qualitative and self-reported data on designers' information behaviour.

This chapter reports on the survey carried out with designers and design researchers. First, aim, objectives and research questions in regard to the survey are summarised in Section 7.2. Then setting up of the survey is detailed in Section 7.3. This includes questionnaire design, identifying participants and methods of data collection and analysis. Section 7.4 presents results and findings in regard to survey aim and research questions. Section 7.5 discusses the key findings and study limitations. Sections 7.6 and 7.7 present the changes to the information framework as a result of the survey study, and outline conclusions and implications respectively.

7.2 Aim, Objectives and Research questions

The survey was set up mainly following its aim and objectives. The aim, objectives and research questions for the survey study were in line with that of previous studies (Chapters Four, Five and Six). However, the method used for addressing the objectives and questions varied. The aim of the survey was three-fold; to evaluate the framework, to refine the framework and to further detail the framework which was revised and detailed through the past three studies. In order to achieve this, two types of questions were devised; questions aimed at collecting feedback, comments and suggestions, and questions aimed at gathering specific information. Collecting feedback helped address the evaluation and refinement objectives of the survey and gathering specific information helped further detail the framework. Table 7.1 presents a breakdown of aim and objectives in the survey study.

Table 7.1 Aims and Objectives of the survey study

Aim	Objectives
1. Refining, Evaluating and Detailing the information framework	*1.1 To evaluate the framework* *1.2 To refine dimensions of the framework* *1.3 To detail dimensions of the framework*

❖ **Research questions**

Eight research questions were formulated in line with the survey study aim and objectives. The first two research questions aimed at overall and detailed 'evaluation' and 'refinement' of the framework and its dimensions. Research questions three to eight aimed at 'detailing' the framework dimensions through investigating designers' information behaviour throughout the design process based on six dimensions of the information framework i.e. 'purpose', 'source', 'type', 'format', 'attributes' and 'intensity'. Designers' information behaviour was studied specifically in regard to people information and the seventh framework dimension i.e. 'stage' was used as the context to the investigation, breaking down the design process into four stages i.e. Discover, Define, Develop and Deliver (Design Council, 2005). Table 7.2 presents research questions in relation to study objectives.

Table 7.2 Research questions of survey study in relation to study objectives

Research Questions **PART A - Evaluating and Refining the framework and its dimensions**	**Objectives**
1. Could the framework help address key aspects of designers' information behaviour?	1.1
2. What dimension/s should be included, deleted or refined?	1.2
Research Questions **PART B - Detailing the framework dimensions**	**Objectives**
3. Why do designers use people information?	1.3
4. How do designers source the people information?	1.3
5. What types of people information designers use?	1.3
6. What formats of people information designers use?	1.3
7. What are the attributes of the people information designers use?	1.3
8. What range and depth of people information is used and how frequently?	1.3

Following the breakdown of the research questions the survey was broken down into two main parts i.e. Parts A and B. Part A of the survey, collected participants' comments on overall evaluation of information framework and refinement of its dimensions (addressing Research Questions 1 and 2). Four questions were devised for this purpose in Part A. In order to evaluate the framework, three questions were formulated addressing validity, verification and the value of the framework. One question was formulated addressing the refinement of the framework asking the respondents regarding any refinements to the dimensions. Part B of the survey aimed at detailing the information framework dimensions through questions addressing each dimension throughout the four stages of the design process. The research objectives are detailed below.

❖ **Objective 1: Evaluating the framework**

As a work-in-progress, the initial framework was already evaluated through two research methods including interviews and observation. The evaluation process consisted of two elements of validation and verification of the framework. However, the collected information from the observation and interview studies could better serve the purpose of verifying the framework rather than validating it. This was due to the nature of those two studies and the methods they used. Through the survey however, it was possible to address both elements of validation and verification.

Three survey questions were devised at the beginning of the questionnaire (Q.1, Q.2 and Q.4 provided in Appendix D1) to address validation and verification aspects. Q.1 and Q.2 in the survey addressed validity and verification of the framework respectively. Q.4 addressed a combination of both through collecting response on the overall value and usefulness of the framework. All survey questions and their ordering is provided in Appendix D1.

❖ **Objective 2: Refining the framework dimensions**

Following validation and verification questions, one question (Q.3) was included in the survey in order to collect comments and suggestions to revise and refine the framework. Responses on revising the framework could have been more thoroughly gathered were the respondents able to sketch and annotate their suggested modifications to the overall framework and its dimensions. However, using an online survey format, this proved difficult to accommodate and if accommodated, it could complicate and lengthen the process of responding to the survey. Therefore, respondents were invited to leave their comments and suggestions in writing.

- **Objective 3: Detailing the framework dimensions**

The survey also aimed to collect specific information. This was in order to specify what sub-dimensions of dimensions were relevant in various stages of the design process. The four stages of the Double Diamond Design Process (Design Council, 2005) were used for this purpose. This was in line with the other two studies where through observation, relevant sub-dimensions for each dimension of the framework were identified. In the survey, sub-dimensions presented for each dimension were a collation of all sub-dimensions identified based on findings from literature review, interview and observation studies. Participants were asked to select all the sub-dimensions that applied to one dimension in each stage of the design process. Participants were also asked to add any sub-dimension that applied to one dimension but was not included in the list.

- **Expected outcome**

The survey was expected to provide the following information regarding information behaviour of practicing designers using people information:

- Feedback on validation of the framework
- Feedback on verification of the framework
- Suggestions on refining dimensions of the framework
- Arranging and prioritising sub-dimensions for each stage of the design process - this had to be comparable to results from previous studies
- Adding new sub-dimensions and refining them where needed

7.3 Setting-up of the survey

This section details how the survey was planned, designed and set up with designers and design researchers. First, the survey administration method, participant selection process and questionnaire design is explained. Then the survey procedure and methods of data analysis are presented.

Web-based survey was selected over the traditional mail or face to face survey methods as an effective way of collecting large amount of data, with very low cost, in a considerably short period of time (Robson, 2002) and with higher potential for a high response rate due to its relative ease of completion compared to mail or face to face surveys. The advantages of web-based surveys over face to face surveys were identified as being self-administered thus allowing for more honest responses (Bruce, 2004) and allowing respondents to take their own time to complete the survey, also allowing for larger amount of data collection considering the time, effort and resources needed. The advantages over mail surveys were being less expensive and faster in completion process and also being environmentally friendly (Yun and Trumbo, 2000). SurveyMonkey[9] was selected as the online survey design and distribution tool.

7.3.1 Identifying participants

Two key groups including designers and design researchers were targeted as the main participants of the survey. Design researchers were identified as the main audience for the uptake and use of the framework, thus they were best to respond to Part A of the survey, addressing objectives 1.1 and 1.2. These two objectives focused on refining and evaluating the framework and its dimensions. Designers were targeted to mainly respond to Part B of the survey, addressing objective 1.3. This objective focused on detailing each of the six dimensions of the information framework. For this purpose, designers were asked to answer six questions for each of the four stages of the design process, thus reporting on their information behaviour throughout the design process. In order for the results to be in line with other studies, practicing designers were specifically focused upon. Also, in order to enhance the findings and enable further analysis, both target groups were asked to complete both parts of the survey.

[9] SurveyMonkey is a private American company that enables users to create their own web-survey (SurveyMonkey website, 2011)

LinkedIn[10] was used as the main online platform to identify and target relevant designers and design researchers to participate in the survey. Two sampling methods were utilised i.e. purposive sampling (Robson, 2002) and self-selected method (Fricker, 2008). This was in order to ensure a good number of responses considering the scope of the study. The two methods fitted together in that they both used the same online platform for identification of participants but complemented each other in terms of different methods of reaching to their target participants. The process of utilising these two sampling methods is summarised below:

In line with focus of the research on design researchers and practicing designers in the field of product and industrial design, a number of relevant design groups were identified on LinkedIn through the Groups Directory search function available on LinkedIn website. Targeting design researchers, ten relevant LinkedIn groups were identified, i.e. 'Design Research', 'Design Research Society', 'DESRIST', 'DMI Design Management Institute', 'Design Thinking', 'Human Factors and Ergonomics Society', 'Design and Emotion Society', 'User Experience', 'Design for All' and 'Include Network'. The last two groups were specialising in inclusive design, also generally known as design for all. Aiming at designers, ten relevant LinkedIn groups were identified, i.e. 'Industrial Design', 'Product Design', 'IDSA', 'Design Council', 'Interaction Design Association', 'Packaging Design', 'User Experience', 'Design+', 'Design Keys' and 'PHILIPS'. The 'User Experience' group was identified as relevant to both groups. Altogether, 19 design-related groups were identified on LinkedIn network and the link to survey was posted on pages of these groups (unrestricted self-selected method). It was thought that this number of groups would be suitable for the scope of this study. Also, a number of individuals who were members of the above groups and were already in the researcher's network on LinkedIn, were identified and directly contacted in order to participate in the survey (purposive sampling).

[10] LinkedIn is a business-related social networking site mainly used for professional networking with over 100 Million members in more than 200 countries and territories. (LinkedIn Profile, Retrieved January 2, 2012)

7.3.2 Questionnaire design

Relevance and accuracy are two key factors encompassing a reliable survey design and thus a reliable result (Larossi, 2006). Accuracy could ensure that the questions were standardised and thus meant the same thing to different respondents (Robson, 2002). And relevance was a contributing factor to ensure a good response rate and validity of responses. Larossi (2006) suggests considering the wording style, type, questions sequence, and the (short) length of time needed to complete the survey, as some factors to enhance the accuracy of survey. It was also important that the collected data enabled comparison with findings from the observation and interview studies in previous chapters, therefore the survey largely followed the structure, wording and logic of self-reporting questionnaires administered to participating designers in the two observational studies. The survey was designed to be completed in no more than 20 minutes.

Survey piloting was carried out in two consecutive stages. Larossi (2006) summarises the goals of survey piloting as:

1. Evaluating the competency of the questionnaire

2. Estimating the length of the survey or time to take the survey

3. Determining the quality of the surveyor

All the above results were expected from the questionnaire piloting and the pilot was carried out in two main stages. First the questionnaire draft was reviewed by three experts, one specialising in design research, one specialising in design practice and one form the information systems field. It was hoped that through this expert review, both target audience groups of the survey i.e. design researchers and design practitioners were addressed and that the questionnaire was also checked from the Library and Information Sciences point of view. A number of recommendations were made based on the expert review and the questionnaire was revised accordingly. These recommendations included increasing the precision and clarity of the questionnaire, wording, change of question types, providing clear introductory definitions and reducing length of the survey. The revised questionnaire was then piloted with ten selected participants including four practicing designers, five design researchers and academics and one social sciences researcher with no background in design (in order to check the overall presentation, structure and clarity of the survey). The respondents were also asked to measure how long it took them to complete the survey. After completion, all respondents were asked to share their comments and thoughts on the design of the survey and issues relating accuracy, relevance and user-friendliness of the questionnaire. The survey was revised for a second time based on the received feedback and questionnaires responses. This resulted in further revision of wording, detailing of some questions, introduction and definitions provided and order of questions.

The final questionnaire was revised to be completed in approximately 20 minutes and was divided into four main sections outlined in Table 7.3. Various types of questions were asked depending on the type and format of data aimed to be collected and the section of the questionnaire. The first section included a small introduction to the research, purpose and structure of the questionnaire. This was in order to elicit appropriate responses and clarify the research aims (Gillham, 2000).

Section two aimed to collect assessment responses on the framework and its dimensions. Lofthouse (2006) argues that using a non-perfect prototype of an 'in-progress' nature, helps encourage discussion and that such mock-up nature is widely used in practice of design and is thus familiar to designers and design researchers. Therefore, aiming to provide a wide range of positive and negative responses, enriching the evaluation and refinement, the framework was presented as an 'in-progress' product encouraging comments for further developments. Following the aim of section two, the questions designed for this section combined both close-ended and open-ended style; providing multiple choice multi-chotomous (Brace, 2004) questions with an open-ended section for adding comments.

Table 7.3 Questionnaire structure

Section 1	Introduction to the survey, key definitions and survey incentives
Section 2	Evaluation of the framework and Refinement of framework dimensions
Section 3	Detailing the framework dimensions based on design process stages A – Discover stage B – Define stage C – Develop stage D – Deliver stage
Section 4	General participant information such as position, years of experience, willingness for receiving study results and contact details

The third section of the questionnaire was broken down into four stages, aiming to collect data regarding designers' information behaviour throughout the four stages of the Double Diamond design Process (Design Council, 2005). The questions addressed each dimension of the information framework and included two close-ended types depending on what dimension was being detailed. Close ended questions with multiple choices allowing multiple answers together with an "Other, please specify" option, were designed to detail the 'purpose', 'source', 'format', 'type' and 'attributes' dimensions. The "Other, please specify" option was provided in order to enable adding any sub-dimensions that the respondent believed was not listed but was applicable. Matrix and rating type questions are best suited when surveying the frequency of a behaviour or attitude (Brace, 2004). Thus this type was adopted for collecting data regarding the 'intensity' dimension of the framework and the semantic differential scale (Brace, 2004) was used to collect responses. Brace (2004) recommends using a seven-point scale for this type of question and keeping the statements on the opposite sides short and precise. Therefore, a 1-7 scale was adopted for differential scale question and extra care was given to the use of terminology to describe the opposite sides of the spectrum. A copy of the final survey questionnaire is provided in Appendix D1.

Finally, the fourth section wrapped up the questionnaire with some general background questions regarding the participant's background.

7.3.3 Survey procedure

Calculating an overall response rate for the survey was not applicable as two different sampling methods were used and the main method of administration was posting on public discussion page of various LinkedIn groups identified in section 7.2.2. In order to maximise the response rate and encourage participation, a number of strategies and steps were adopted:

1. Providing a relevant title and short paragraph accompanying the link to the questionnaire, clarifying the purpose, relevance and reason for participation in the survey. This paragraph was customised for each LinkedIn group, based on the group core activity and its relevance to the subject of the survey.
2. Offering a professional participation incentive to participants.
3. Offering to share the summary of the research findings to participants.
4. Reposting the survey on the intended LinkedIn groups after three weeks. This was done at least once for each selected LinkedIn group. Also, in purposive sampling, some email reminders were sent to participants after two weeks.

7.3.4 Methods of analysis

Responses to the questionnaire were analysed after the data collection stage was finished. A number of different analysis methods were used in order to best interpret the results for different sections of the survey. These included coding scheme, statistical analysis and multi-comparisons. Both descriptive and inferential methods were used for statistical analysis of results in Sections two and three. However, for section four, only descriptive analysis was used. The key analysis methods used are briefly described.

❖ **Statistical analysis**

Descriptive analysis was used for sections two, three and four of the survey (Table 7.3). Based on the overall number of participants and the response rate for each question, percentages were calculated. In analysis of the 'intensity' dimension question, means was also calculated. This will be discussed in the results and findings section.

Inferential analysis was used for sections two and three of the survey (Table 7.3). The descriptive results for various sub-dimensions within each stage in section three were tested for statistical significance. The same process was also applied to the descriptive results on evaluation and refinement of the frameworks and its dimensions in section two.

- **Coding scheme**

Open-ended comments allowing quantitative responses were incorporated in section two of the survey (Table 7.3) in order to enrich evaluation and refinement. Also, "other" category was enabled in section three. In order to analyse results for this type of data, separate coding schemes were generated for the responses received for above questions. These will be discussed in the findings section.

- **Multi-comparisons**

A number of comparisons were made between various groups and sets of data. These included comparison of evaluation results between the whole respondents group and design researchers and designers, and comparison of detailing results between each stage of the design process for all dimensions.

7.4 Results and Findings

Altogether, 91 responses were received for the web survey. Out of these, 90 responses (98.9 %) were complete for Part A (i.e. refinement and evaluation of the information framework). 67 responses (73.6 %) out of the 91 responses, were complete for Part B (i.e. detailing of the framework dimensions; reporting on designers' information behaviour throughout the four stages of the design process). Both complete response rates were evaluated as high for web surveys. Alongside posting the survey directly on LinkedIn groups, a number of members of these groups who were also on the researcher's LinkedIn network, were directly contacted via email to participate in the survey (purposive sampling). Altogether 44 LinkedIn members were contacted through this method, out of which 25 completed the survey (56.8 %). This was considered a good response rate for email survey administration[11] (purposive sampling).

[11] Relative response rates for survey administration methods (Creech and Steve, 2007):
- Mail: 50 % adequate, 60-70 % good to very good

7.4.1 Respondents' position

Out of the 90 responses received for Part A and 67 responses received for Part B, one response belonged to a design student. As the focus of the survey was on practicing designers and design researchers, this participant was deleted from the data set. Thus the final number of completed Part A was 89 and Part B was 66. Tables 7.4 and 7.5 show the breakdown of survey respondents in Part A and Part B of the questionnaire respectively, based on their position. The tables also show the final respondents breakdown for analysis of the data. As seen in Table 7.4, out of the 90 participants who completed Part A, 67 responded to the question regarding their position. Thus 23 out of the 90 complete responses for Part A were categorised as 'unidentified' position.

Table 7.4 Part A survey participant breakdown based on position

<table>
<tr><th>Survey participant Breakdown (position)</th><th>No.</th><th>Transitory participant Breakdown</th><th>No.</th><th>Final participant breakdown</th></tr>
<tr><td>Designer</td><td>15</td><td rowspan="2">25</td><td rowspan="3">32</td><td rowspan="3">Designer</td></tr>
<tr><td>Design Strategist</td><td>10</td></tr>
<tr><td>Design Researcher</td><td>16</td><td rowspan="4">29</td></tr>
<tr><td>Design Academic</td><td>6</td><td rowspan="3">33</td><td rowspan="3">Design Researcher</td></tr>
<tr><td>Ergonomist</td><td>7</td></tr>
<tr><td>Tool Developer</td><td>0</td></tr>
<tr><td rowspan="2">Other</td><td rowspan="2">12</td><td>8 (Designer)</td><td rowspan="4">23</td><td rowspan="4">Unidentified</td></tr>
<tr><td>4 (Design Researcher)</td></tr>
<tr><td>Design Student</td><td>1</td><td>0</td></tr>
<tr><td>No response</td><td>23</td><td>23</td></tr>
<tr><td>TOTAL</td><td>90</td><td>89</td><td>89</td><td>TOTAL</td></tr>
</table>

Table 7.5 Part B survey participant breakdown based on position

<table>
<tr><th>Survey participant Breakdown (position)</th><th>No.</th><th>Transitory participant Breakdown</th><th>No.</th><th>Final participant breakdown</th></tr>
<tr><td>Designer</td><td>15</td><td rowspan="2">25</td><td rowspan="3">33</td><td rowspan="3">Designer</td></tr>
<tr><td>Design Strategist</td><td>10</td></tr>
<tr><td>Design Researcher</td><td>16</td><td rowspan="4">29</td></tr>
<tr><td>Design Academic</td><td>6</td><td rowspan="3">33</td><td rowspan="3">Design Researcher</td></tr>
<tr><td>Ergonomist</td><td>7</td></tr>
<tr><td>Tool Developer</td><td>0</td></tr>
<tr><td rowspan="2">Other</td><td rowspan="2">12</td><td>8 (Designer)</td><td rowspan="3">0</td><td rowspan="3">-</td></tr>
<tr><td>4 (Design Researcher)</td></tr>
<tr><td>Design Student</td><td>1</td><td>0</td></tr>
<tr><td>TOTAL</td><td>67</td><td>66</td><td>66</td><td>TOTAL</td></tr>
</table>

- Phone: 80 % good
- Email: 40 % average, 50-60 % good to very good
- Online: 30 % average
- Classroom pager: 50+ % good
- Face to Face: 80-85 % good

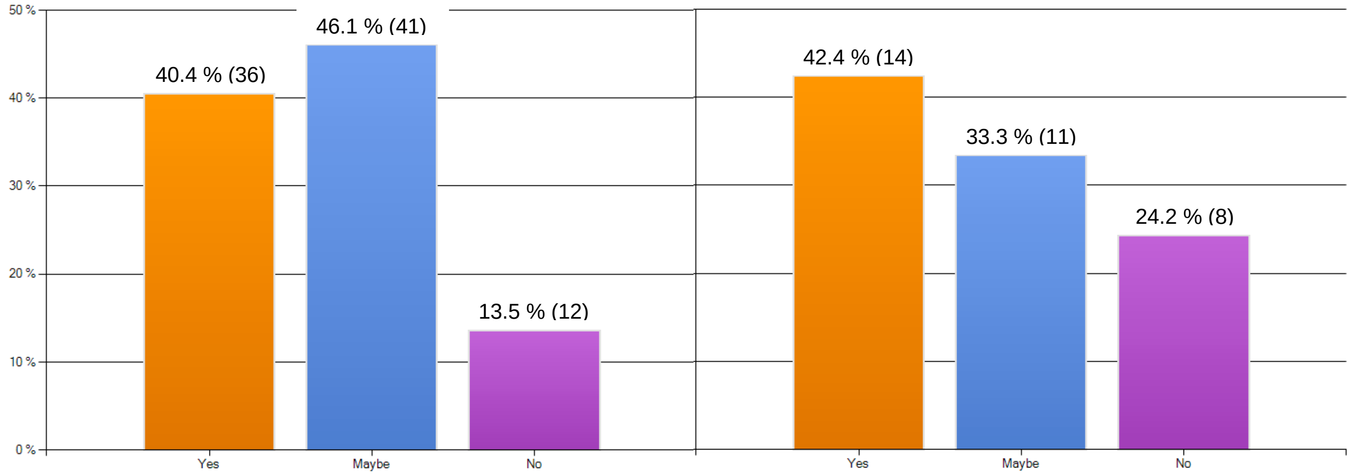
7.4.2 Evaluation of the Framework

Three questions in Part A of the survey, collected participants' responses and opinions in regard to 'evaluation' of the information framework. These questions addressed 'validity', 'verification' and overall 'value' of the framework respectively. Single choice multiple answer questions with open ended comments were used as method of data collection. Descriptive and inferential statistical analysis and 'template approach' (Robson, 2002) were used as methods of data analysis. Template approach is a coding and clustering (Dong, 2004) method and constitutes of two main stages of coding the data and then clustering the data of the same code into groups. This method was used for analysis of the quantitative data collected from open-ended comments section for each question. The multiple choice results and the coded and clustered comments are presented below for each evaluation question. As the design researchers were the key respondent group for this part of the survey, both overall responses and design researchers' responses are presented and compared here.

❖ **Validation of the Information Framework**

The first question in Part A asked the respondents if in their opinion the framework helped them understand designers' information behaviour. Figure 7.1 presents results for this question addressing validity of the framework. The results are presented for both design researchers and all respondents. Altogether 86.5 % of all respondents (77 people) and 75.7 % of design researchers (25 people) responded 'Yes' or 'Maybe' to this question. The percentage of 'No' responses was considerably higher (24.2 %) among design researchers compared to overall responses (13.5 %), while the percentage of 'Maybe' responses was lower among design researchers (33.3 %) compared to overall responses (46.1 %). This could be due to the fact that design researchers were the main audience of the framework and based on their research expertise they were in a better place to evaluate the framework and were more certain on their judgement.

Validation - Does this framework help you to understand designers' information behaviour?



A. Overall responses B. Design researchers' responses

Figure 7.1 Validation - All respondents' and design researchers' opinions on whether the framework helps them understand designers' information behaviour

Pearson's Chi-squared test was applied to both overall and design researchers' responses in order to assess the statistical significance of the results. Table 7.6 presents results for the Chi-squared test. Based on the table, the overall responses on validation of the information framework were statistically significant (p <0.05) but design researchers' responses on validation of the framework were not statistically significant (p >0.05). This meant that there was more than 5 % likelihood that any deviation from expected results for 'design researchers' 'was due to chance only. This is while there was less than 0.01 % likelihood that the 'overall' responses were due to chance only. The results from overall responses showed that over 80 % of respondents perceived that the information framework did or could possibly help them understand designers' information behaviour.

Table 7.6 Chi-squared Test for Information Framework 'validation' question

	Degrees of freedom ***(df)*** [12]	X^2 [13]	**Probability** ***(p)*** ***0.05***	**Probability** ***(p)*** ***0.001***	**Statistical significance**
Overall responses	2	16.20	5.99	13.82	p <0.001 YES
Design researchers' responses	2	1.63	5.99	13.82	p > 0.05 NO

[12] The Degrees of Freedom (*df*) for Chi-squared Test is calculated based on the number of categories minus 1. There were three option categories for this question (i.e. Yes, Maybe, No) thus *df* was 2 (3-1=2).

[13] X^2 for Chi-squared Test is calculated based on the formula $X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$ where ***O*** is the observed value and ***E*** is the expected value.

Table 7.7 presents the respondents' comments on whether the framework helped them understand designers' information behaviour. These open-ended comments were provided by respondents under "please state why" option. The open-ended comments were coded and clustered using the template approach (Robson, 2002). The comments mentioned more than twice have been highlighted.

The main reasons stated by respondents who found the framework helpful included providing a good breakdown of related aspects, comprehensiveness, and overall usefulness of the framework. One main issue stated by respondents uncertain about the framework, was lack of clarity and purpose why and how the framework could be used. This brought up the issue of 'relevance' as the framework was not primarily related to designers but aimed at researchers specifically involved with design information and designers. Being complicated and confusing was the main issue stated by respondents who perceived the framework as unhelpful (Table 7.7).

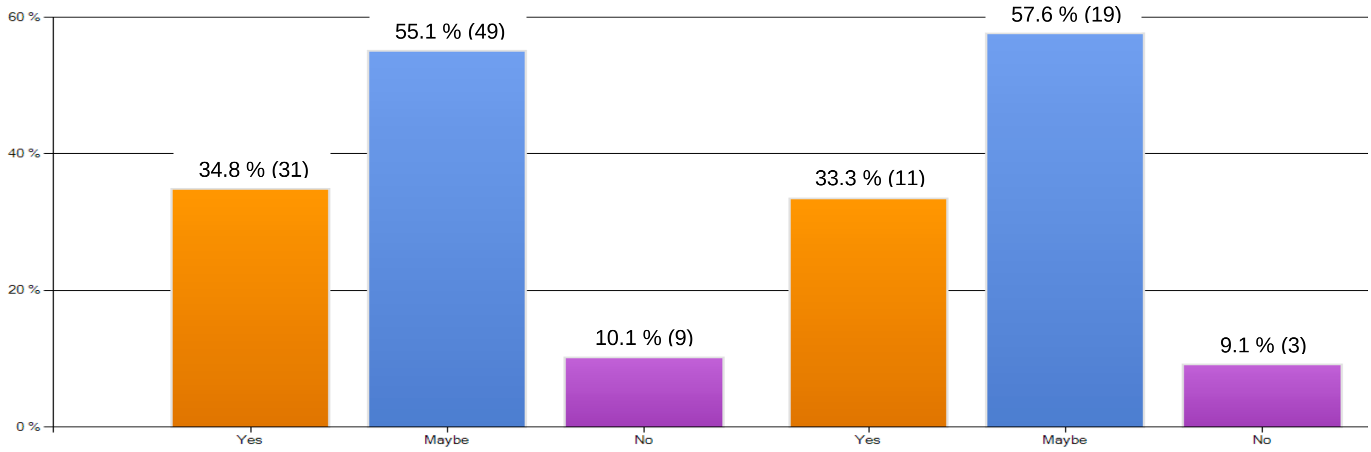
Table 7.7 Validation - Respondents' comments on whether the framework helps them understand designers' information behaviour

Does this framework help you to understand designers' information behaviour?	**Frequency**
Yes	
Good breakdown and categorisation of related aspects	5
Encompassing	4
Revolving around 'wh' question dimensions	4
Useful for the purpose	3
Clear and simple	3
Covering information needs and requirements - different language	2
Preparing graduates for the workplace	1
Identifying what would be missing from an information gathering task	1
Structuring and clustering the information used to create any new idea	1
Questioning the information designers have and use	1
Critically understanding the value designers add to the big picture	1
Assessing the information use	1
Ensuring the full spectrum is being considered	1
Exploring relevant areas questioned when using design information	1
Making the subconscious explicit	1
Maybe	
Purpose not clear: why should I use it	8
Narrative and context not clear	2
Audience not clear: aimed at designers or design researchers?	1
Lack of expertise to judge	1
Needs populating for additional understanding	1
Needs to be 'explanatory'	1
Needs working scenarios	1
No	
Complicated and confusing	4
Only focus on 'Use', not addressing 'Seeking'	1
Subtle	1
Not useful to designers	1
Needs some research platform behind	1
Only categorises information, doesn't help designer do anything with it	1

❖ Verification of the Information Framework

The second question in Part A aimed to verify the framework asking the respondents if in their opinion, the framework addressed key aspects of designers' information behaviour. Figure 7.2 presents results for this question for both design researchers and all respondents. Altogether 89.9 % of all respondents (80 people) and 90.9 % of design researchers (30 people) responded 'Yes' or 'Maybe' to this question. The answer distribution patterns (i.e. percentage of Yes, Maybe and No responses) were the same between the overall responses and the design researchers' responses and the percentages were very close. More than 50 % of respondents (both overall respondents and design researchers) chose the 'Maybe' option, while approximately 35 % responded 'yes' and 10 % responded 'No'. This could be due to the fact that respondents needed to engage more with the framework in order to be able to respond to this question more confidently.

Verification - Do the framework dimension address key aspects of designers' information behaviour?



A. Overall responses B. Design researchers' responses

Figure 7.2 Verification - All respondents' and design researchers' opinions on whether the framework dimensions address the key aspects of designers' information behaviour

Pearson's Chi-squared test was applied to both overall and design researchers' responses to assess the statistical significance of the results. Table 7.8 presents the results for the Chi-squared test. Based on the table, the overall responses and the design researchers' responses to the framework verification question were both statistically significant. Based on the '*P'* values, there was less than 1 % likelihood that any deviation from expected results from design researchers' responses was due to chance only, and there was less than 0.01 % likelihood that the overall responses were due to chance only. This confirmed that about 90 % of respondents perceived the framework did address or perhaps could address key aspects of designers' information behaviour.

Table 7.8 Chi-squared Test for Information Framework 'verification' question

	Degrees of freedom *(df)*	X^2	**Probability *(p)* *0.01***	**Probability *(p)* *0.001***	**Statistical significance**
Overall responses	2	27.06	9.21	13.82	$p < 0.001$ YES
Design researchers' responses	2	11.63	9.21	13.82	$p < 0.01$ YES

Table 7.9 presents the open-ended comments on whether the framework was believed to address the key aspects of information behaviour. Similar to validation question, the comments were coded and clustered. The comments mentioned more than twice have been highlighted. The key issue mentioned in 'Yes' answers was the perceived comprehensiveness of the framework.

A wide range of reasons were mentioned as to why respondents selected the 'Maybe' and 'No' answers. Overall, the framework was perceived to be general and whether it could be applied to various contexts was questioned, also the fact that designers do not look at information they use in such analytical way was also mentioned.

Table 7.9 Verification - Respondents' comments on whether the framework dimensions address the key aspects of designers' information behaviour

The framework currently has seven dimensions, do these dimensions address the key aspects of designers' information behaviour?	**Frequency**
Yes	
Addresses the key aspects of information	3
Very comprehensive list	3
Describes information behaviour well	1
Strong broad framework conceptually decomposing designer's IB[14]	1
Good jumping-off point	1
looks at information behaviour at 360 degrees	1
Useful set of dimensions capturing key aspects	1
Offers a good set of considerations	1
Maybe	
Dependent on type of project and industry the designer is in	1
Why designers are considered different from other types of people?	1
Difficult to verify	1
Not all dimensions may be used as a whole	1
Cultural relevance of information missing	1
Does it include what the information actually tells the designer?	1
Not fully clear diagram	1
Never analysed the information I used before!	1
Description too brief to actually decide whether it is useful	1
No	
Most designers do not actually think of information this way	2
Intuitive and subliminal influence are important in information gathering	1
'When' and 'Where' are missing	1
IB-related areas are not identified in a way distinct to designers	1
Some dimensions are more general than others	1
Range of information too diverse to put into a prescribed framework	1
'Attributes' is unclear	1
Without emotion and humanism the approach may seem mechanical	1
Too strict to address human behaviour	1
Focus to be on 'design effort' as a whole not on designer as solo actor	1
Not the key aspects	1

[14] Information Behaviour

❖ **Value of the Information Framework**

The third question in Part A aimed to address the value of the framework by asking the respondents if they were willing to use the framework. Figure 7.2 presents results for this question for both design researchers and all respondents. The distribution of Yes, Maybe and No answers were very close among the overall and design researchers' responses. Approximately 84 % of respondents (all respondents and design researchers both) stated that they 'will be willing' or 'may be willing' to use the framework and about 15 % of respondents stated they were not willing to use the framework.

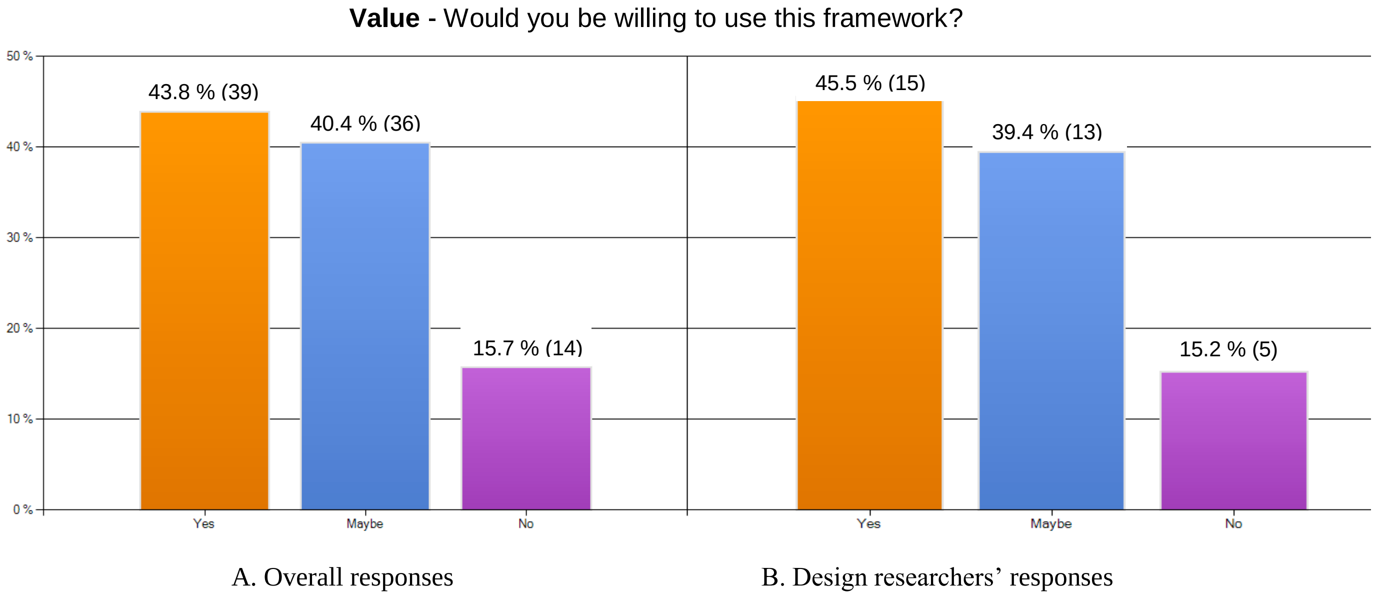


Figure 7.3 Value - All respondents' and design researchers' responses on whether they were willing to use the framework

Table 7.10 presents the results for the Chi-squared test applied to both overall and design researchers' responses to assess the statistical significance of the results. The overall responses to the value question were statistically significant (P <0.01) with less than 1 % likelihood that the results were due to chance only. The design researchers' responses were almost statistically significant ($P \cong 0.05$) with almost 5 % likelihood for the results to be due to chance only. However, as the response distribution patterns were the same between the overall responses and design researchers' responses, the results shown in Figure 7.3 could be confirmed.

Table 7.10 Chi-squared Test for Information Framework 'value' question

	Degrees of freedom *(df)*	X^2	Probability *(p)* *0.05*	Probability *(p)* *0.01*	Statistical significance
Overall responses	2	12.56	5.99	9.21	$p < 0.01$ YES
Design researchers' responses	2	5.09	5.99	9.21	$p \cong 0.05$ Border line

The open-ended comments on whether the respondents were willing to use the framework provided a well-detailed picture of perceptions and reflections on the framework. Some of the coded and clustered responses were provided in response to the validation and verification questions and were moved to Table 7.11 based on being primarily relevant to the perceived 'value' of the framework rather than its 'validation' or 'verification'. The overall perceived value of the framework was mainly based on its novelty and approach and also comprehensiveness. The functions of the framework perceived as valuable by respondents were clustered as 'guiding', 'understanding', 'encouraging', 'checking', 'introducing', 'structuring' and 'enabling' various acts in regard to designers and their information behaviour. These are detailed in Table 7.11. The main concerns resulting in uncertainty regarding value of the framework were lack of clarity in terms of the purpose and the need for framework and its content. These were in line with the issues highlighted in the comments for the validation and verification questions. The main issues concerning lack of value of the framework (no responses) were clustered under 'usefulness' and 'usability' issues. Key concerns regarding usefulness were 'lack of clarity of purpose', 'lack of relevance' (to designers) and 'inapplicability'. The key concern regarding usability was 'complexity' of the framework and it not being fully clear.

Table 7.11 Value - Respondents' comments on their willingness to use the framework

Would you be willing to use this framework?	**Frequency**
Yes	
General	
New and interesting	3
Comprehensive and clear	2
Implementable in the design process	1
A set of considerations	1
A reference	1
Seven key aspects make it a usable framework	1
Guide	
Supports research to support design process	2
Guides suppliers of information and goods	1
Points key questions to be asked during information use	1
for thinking about motivations and priorities	1
Understand	
Understand how designers use information to help re-design how some information can be delivered	2
Encourage	
Encourages designers to expand their information sourcing	1
Prompts discussion to look more into information use and behaviour	1
Check	
Provides insight on what is missing from information picture	1
Checks the information used spans the full spectrum needed to facilitate good design	1
Checks students' effectiveness in dealing and communicating information - part of design curriculum	1
Introduce	
Introduces people to how designers get information	1
Structure	
Clusters ideas	1
Structures the information used better and more	1
Categorises and targets the information when providing it to designers	1
Enable	
Increases ability to keep the information useful	1
Maybe	
Need or purpose unclear	5
Lack of clarity	3
Lack of relevance	2
Lack of novelty	1
Credibility unclear	1
Application unclear	1
Client-dependent	1
Not a natural way of thinking of information use	1
limited application - deeper client engagements	1
Needs to be tested through application	1
Needs getting used to - usability	1
Needs a scenario of application beforehand	1
Unsure if framework affects the way design is done	1
Expected effect unclear- on designers' behaviour in the process or to assist documentation after the act?	1
No	
Usefulness	
Need or purpose unclear	4
Not relevant (to designers)	3
Not applicable	3
Reveals nothing needed	1
A similar process already used	1

Usability	
Complex and unclear	3
Needs structure - loose activity	1
Needs development to address problem solving or the design process	1
Needs expansion to be complete	1
Too predetermined - constricts the thinking	1
Too abstract and theoretical	1
No practical application in current guise	1

7.4.3 Refinement of Framework

The last question in Part A of the survey collected participants' responses and opinions in regard to 'refinement' of the information framework. Single choice multiple answer question with open ended comments was used as method of data collection. Descriptive and inferential statistical analysis and coding and clustering were used as methods of data analysis. Figure 7.4 presents results on participants' responses.

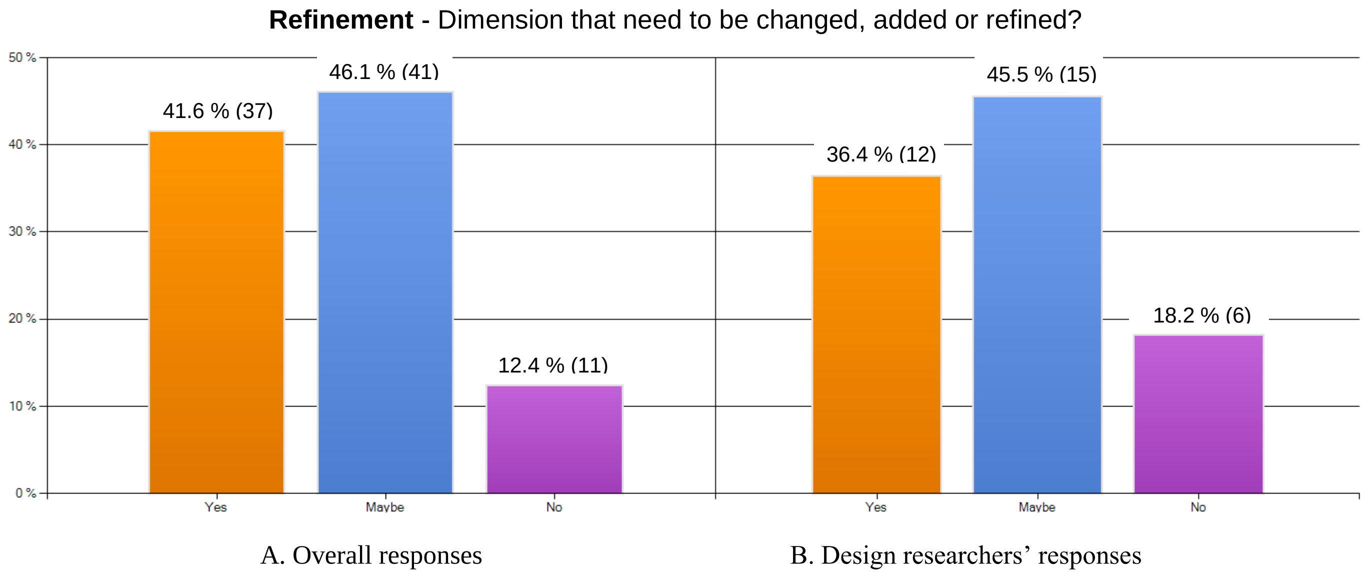


Figure 7.4 Refinement - All respondents' and design researchers' responses on whether there are dimensions that need to be changed, added or refined

Pearson's Chi-squared test was applied to both overall and design researchers' responses to assess the statistical significance of the results. Based on the Chi-squared test results presented in Table 7.12, the overall responses regarding refinement of the framework were statistically significant (*P* <0.01). This meant there was less than 0.01 % possibility of the results being due to chance. However, the design researchers' responses were not statistically significant (P>0.05), this meant there was more than 5 % chance of the results being due to chance only. Thus only overall responses were to be analysed. Approximately 10 % of respondents thought the framework dimensions did not need to be refined while approximately 90 % responded 'Yes' or 'Maybe' to the question whether the dimensions needed refinement.

Table 7.12 Chi-squared Test for Information Framework 'value' question

	Degrees of freedom *(df)*	X^2	Probability *(p)* *0.05*	Probability *(p)* *0.001*	Statistical significance
Overall responses	2	17.89	5.99	13.82	$p < 0.01$ YES
Design researchers' responses	2	3.81	5.99	13.82	$p \cong 0.05$ Border line

Table 7.13 presents results on dimensions suggested to be included and refined. This table is the result of two rounds of coding and clustering and refinements of the results in order to summarise the comments. The initial two tables that were summarised into Table 7.13 are provided in Appendix D2. The dimensions and aspects suggested for inclusion were coded and clustered into four key groups including 'behaviour-related', 'information-related', 'context-related' and 'individual-related'.

The key behaviour-related aspects suggested for inclusion were 'processing and filtering' and 'evaluation and appraisal' of information. However, the focus of the framework dimension was mainly on information rather than the behavioural aspects of engaging with information. The major information-related aspects suggested were related to 'attributes' dimension. These included relevance, quality, usability and credibility of information, all of which were already included as sub-dimensions of the attributes dimension.

Context-related aspects were also a major suggestion in terms of dimensions to be included. The key aspects included the 'context' and 'who' the information was aimed at and also 'who' collected and provided the information. Chapter Two identified 'Design Context' as a major background factor for the information framework and broke it down into a number of facets including the designer.

A number of dimensions were also suggested to be refined. Major recommendations included further clarifying the 'Attributes' dimension and changing the terminology. The 'Intensity' dimension was commented as too broad and suggested to be divided into two. The difference between the 'Type' and 'Format' was also mentioned as unclear. Some refinements were also suggested for the 'Source' and 'Purpose' dimension

Table 7.13 Refinement – Respondent comments on dimensions to be included or refined

Are there dimensions/aspects that are missing or that need to be refined or changed?	**Frequency**
To be included	
Behaviour – related	
Acts	
Processing and filtering	6
Evaluation and appraisal- further sourcing	3
Storage and retrieval - overall & from designers' own systems	2
Search	2
Interpretation and translation	2
Collaboration - arising amidst the interactive IB[15] of design team	2
Other	
Time – temporal	4
Urgency (of need)	2
Information – related	
Attributes	
Relevance	4
Quality	3
Usability and perceptibility	3
Credibility and justifiability	3
Validity	2
Integrity and authenticity	2
Temporality - how stable or dynamic is information over time?	2
Other	
Impact - what happens as a result of using information	3
Context – related	
Context	5
Who - aimed at/collected/provided/paid for the information	5
Target audience	5
Individual – related	
Iterative process of the designer	1
Personal lenses: culture/personal experience/intuition	1
Previous experience - shaping the behaviour	1
Subjective engagement	1
To be refined	
Attributes	
Needs to be more clearly defined	4
'Qualities' more obvious than 'Attributes'	1
Intensity	
Too broad - separate frequency from range and depth	1
Odd term - quality of information more fitting	1
Divide into two - information breadth + depth	1
Source	
Divide into: *1. Type of support (books, internet, etc.)* *2. Theoretical vs. empirical information (books vs. interview)*	1
Not only 'how' (method) but also 'where' (location) sourced	1
Type	
Difference between type and format not fully clear	1
Type considered an Attribute too?	1
Purpose	
Not why is it used - why is it needed? What is it used for?	1
Format	
Format less important than the communication aspect of it	1

[15] Information Behaviour

Respondents also provided some comments on overall refinement of the framework. These comments are presented in Table 7.14. One major comment was the relationship between the dimensions in terms of the way they were linked, their order and hierarchy. Visual representation of the framework and the logic behind the shape was also questioned. Another overall suggestion was regarding the terminology used in the information framework and its clarification and simplification. From the content point of view, a number of issues were raised including having too many dimensions, the need for the overall framework to be refined and clarifying the intent and the need for the framework. Table 7.14 details these suggestions.

Table 7.14 Refinement - Respondents' comments on refinement of the overall framework

Overall Framework	
Relationship between dimensions	
Linkage	4
Priority/importance/hierarchy	3
Iterative loops - interaction of dimensions	2
Different timing	1
Where to start	1
Visual representation	
Misleading - not linear	1
Graphical analysis	1
Difficult for visual dyslexic	1
Terminology	
Vague and inaccurate	1
Unfamiliar	1
Too academic - use of simple English	1
'Dimension' suggests bi-polar adjective pairs - replace with 'facet'	1
'Dimensions' not appropriate	1
Content	
Too many dimensions	2
Reduce: 'type', 'source', 'purpose' or 'need' and 'format'	1
Behaviour - what happens WITHIN the head of the designer	1
Needs to be redefined	1
Needs to be refined	1
The purpose and intent of the framework	1

7.4.4 Detailing the Framework dimensions

In Part B of the survey, respondents were asked to report on their information behaviour in regard to people information, throughout the four stages of the design process i.e. Discover, Define, Develop and Deliver. This was done through responding to six questions that each detailed one dimension of the information framework. Multiple-choice multiple-answer questions with open ended comments section and semantic differential scale with a seven-point scale were used as methods of data collection. Descriptive and inferential statistical analysis and coding and clustering were used as methods of data analysis.

Pearson's Chi-squared test was used for inferential statistical analysis of the results for the five multiple-choice multiple-answer questions. Results and findings are presented for each framework dimension. As the designers were the key respondent group for this part of the survey, both overall responses and designers' responses are presented and compared here.

Four tables present the results and findings for each dimension (results for the 'Intensity' dimension are presented in three tables). The first table provides both the percentage of mentioning each sub-dimension in each of the four stages and its ranking among other sub-dimensions in each stage. The rows presenting ranking are highlighted for ease of reading. The second table provides the results of the Chi-squared test analysing the statistical significance of the results for each dimension. The third table presents the key sub-dimensions identified for each dimension and the fourth table presents the open ended comments for each stage. The full statistical calculations for the Pearson's Chi-squared test for this section are provided in Appendix D3.

❖ **Purpose - Why do you use people information?**

Table 7.15 presents the percentage of mentioning each sub-dimension in all the four design process stages and its ranking (among seven sub-dimensions) in each stage. The rows presenting the ranking are highlighted for ease of reading. Table 7.16 provides the results of the Chi-squared test analysing the statistical significance of the results among all responses and designers' responses.

Table 7.15 Purpose - All respondents and designers reporting on why they use people information in the four stages of the design process

Purpose - Why do you use people information?								
	All respondents				***Designers***			
	Stage 1 Discover	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**	**Stage 1 Discover**	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
Inspiration & Ideation	76.7	53.7	53.5	14.5	81.8	46.9	48.3	13.8
	2	5	5	7	2	6	6	7
Empathy	72.6	41.8	39.0	23.6	72.7	34.4	51.7	27.6
	3	7	7	6	3	7	5	5
Insight & Understanding	95.9	76.1	50.8	27.3	97.0	68.8	44.8	20.7
	1	2	6	5	1	3	7	6
Information & Specification	63.0	77.6	57.6	29.1	57.6	75.0	55.2	31.0
	4	1	4	4	4	2	4	4
Evaluation & Refinement	30.1	50.7	74.6	74.5	33.3	50.0	72.4	65.5
	7	6	2	2	7	5	2	2
Confirmation & Support	41.1	67.2	76.3	76.4	42.4	62.5	82.8	72.4
	6	4	1	1	6	4	1	1
Communication & Discussion	41.7	71.6	59.3	65.5	48.5	78.1	58.6	58.6
	5	3	3	3	5	1	3	3

Table 7.16 Chi-squared Test for ‘Purpose’ dimension

	Stage	**Degrees of freedom *(df)***	X^2	**Probability *(p)* *0.05***	**Probability *(p)* *0.001***	**Statistical significance**
Overall responses	1	6	53.65	12.6	22.5	*P* <0.001 YES
	2	6	26.77	12.6	22.5	*P* <0.001 YES
	3	6	17.67	12.6	22.5	*P* <0.005 YES
	4	6	46.33	12.6	22.5	*P* <0.001 YES
Designers' responses	1	6	27.25	12.6	22.5	*P* <0.05 YES
	2	6	13.93	12.6	22.5	*P* <0.05 YES
	3	6	9.91	12.6	22.5	*P* >0.05 NO
	4	6	22.32	12.6	22.5	*P* <0.05 YES

The overall responses to the ‘purpose’ question were statistically significant (P<0.001 and P<0.005) among all four stages (i.e. Discover, Define, Develop, Deliver). However the design researchers’ responses were not statistically significant among all stages and there was more than 5 % likelihood of the results being due to only chance in the Develop stage.

Based on the results from Tables 7.15 and 7.16, the top three reasons for use of people information in the four stages of design process were identified in Table 7.17. In the Discover stage, the key use purposes were getting insights, inspiration and empathy, while moving into Define stage the information use purposes became more specific in terms of facilitating communication and discussion, and providing information, specification and insights. While in the first two stages purposes for use of people information were different, in the Develop and Deliver stages the reasons were the same; confirmation, evaluation and communication were the key use purposes. This highlighted a difference between the purpose of information use in the first and second half of the design process.

Table 7.17 Purpose - key sub-dimensions identified for 'purpose' dimension in the four stages of the design process

Purpose – Why do you use people information? (All respondents)				
	Stage 1 Discover	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
1	Insight & understanding	Communication & Discussion	Confirmation & Support	Confirmation & Support
2	Inspiration & Ideation	Information & Specification	Evaluation & Refinement	Evaluation & Refinement
3	Empathy	Insight & Understanding	Communication & Discussion	Communication & Discussion

The open-ended comments regarding the purpose of people information use are presented in Table 7.18. Comments represented a wide range of reasons mentioned by respondents, these were overall in line with the seven sub-dimensions identified for the purpose dimension.

Table 7.18 Purpose - open-ended comments as stated under the 'Other - please specify' option

Purpose - Why do you use people information?	
Stage 1 Discover	- *Challenging existing assumptions/beliefs* - *Collecting data and previous research and evidence* - *Psychological theory, motivation, decision-making and significance* - *Safety; strong 'Base' for start* - *Observation* - *Socialisation of the project. Recommendations more likely to be positively reviewed if the audience has been part of the process* - *Justification* - *Contextualisation*
Stage 2 Define	- *Educating the user - a two way street at this stage, more than discussion* - *Specification of design criteria, e.g. based on body size, strength, etc.* - *Building the argument - to validate an assumption or to clarify fuzzy zones* - *Getting an impression of the size of the target group*
Stage 3 Develop	- *Predicting possible problems in final product and correct possible mistakes*
Stage 4 Deliver	- *Selling the resulting product* - *Building the case and showing Usability*

❖ **Source - Where do you obtain your people information from?**

Table 7.19 presents the percentage of mentioning and ranking of 'Source' sub-dimensions (among 12 sub-dimensions) in each of the four stages of the design process. Table 7.20 shows the Chi-squared test for statistical significance of the results.

Table 7.19 Source - All respondents and designers reporting on where they obtain the people information from in the four stages of the design process

Source - Where do you obtain your people information from?								
	All respondents				***Designers***			
	Stage 1 Discover	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**	**Stage 1 Discover**	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
Intuition, experience[16]	71.2	61.2	55.2	26.4	78.8	56.3	62.1	21.4
	2	3	4	7	2	5	3	7
Client	61.6	58.2	56.9	54.7	60.6	68.8	58.6	50.0
	5	4	3	2	4	3	4	3
Previous stage/s[17]	0	77.6	82.8	50.9	0	71.9	79.3	53.6
	-	1	1	3	-	2	1	2
Specialists, experts[18]	63.0	56.7	51.7	49.1	60.6	59.4	58.6	46.4
	4	5	5	4	4	4	4	4
Colleagues, friends, etc.	57.5	52.2	43.1	30.2	57.6	50.0	31.0	14.3
	6	7	7	5	7	6	10	9
User research[19]	82.2	77.6	70.7	66.0	84.8	75.0	72.4	67.9
	1	1	2	1	1	1	2	1
Books, handbooks[20]	37.0	31.3	36.2	13.2	33.3	25.0	37.9	7.1
	10	11	10	11	10	11	7	11
Internet	56.2	44.8	27.6	17.0	60.6	40.6	20.7	14.3
	7	10	11	10	4	10	11	9
Guidelines, standards[21]	47.9	50.7	50.0	28.3	42.4	50.0	51.7	25.0
	8	8	6	6	8	6	6	6
Other projects[22]	69.9	55.2	43.1	22.6	78.8	46.9	34.5	21.4
	3	6	7	9	2	9	9	7
Journals	32.9	25.4	20.7	11.3	30.3	18.8	20.7	7.1
	11	12	12	12	11	12	11	11
User data tools[23]	43.8	46.3	39.7	26.4	42.4	50.0	37.9	28.6
	9	9	9	7	8	6	7	5

[16] Full title as stated in the survey: Own intuition, experience, common sense
[17] Full title as stated in the survey: Previous stage/s - information gathered from previous stages of the design process
[18] Full title as stated in the survey: Specialists and experts in the field
[19] Full title as stated in the survey: User research (observation, testing, focus group)
[20] Full title as stated in the survey: Books, manuals, handbooks
[21] Full title as stated in the survey: Guidelines, standards, regulations
[22] Full title as stated in the survey: Other projects - information gathered from other projects
[23] Full title as stated in the survey: Specific user data tools

The Chi-squared test results in Table 7.20 showed both the overall and the designers' responses regarding 'source' of people information were statistically significant for all stages ($P < 0.05$).

Table 7.20 Chi-squared Test for 'Source' dimension

	Stage	Degrees of freedom *(df)*	X^2	Probability *(p)* *0.05*	Probability *(p)* *0.001*	Statistical significance
Overall responses	1	11	40.18	19.7	31.3	*P* <0.001 YES
	2	11	33.58	19.7	31.3	*P* <0.001 YES
	3	11	37.17	19.7	31.3	*P* <0.001 YES
	4	11	71.96	19.7	31.3	*P* <0.001 YES
Designers' responses	1	11	26.71	19.7	31.3	*P* <0.05 YES
	2	11	21.00	19.7	31.3	*P* <0.05 YES
	3	11	24.75	19.7	31.3	*P* <0.05 YES
	4	11	52.00	19.7	31.3	*P* <0.05 YES

Based on the results from Tables 7.19 and 7.20, the top three sources of people information in the four stages of design process were identified in Table 7.21. This was based on results from overall responses in order to be in line with the findings for 'Purpose' dimension (also based on overall responses). No major pattern was observed in terms of the difference between top three sources mentioned for each stage and there were many commonalities between the top sources mentioned among all four stages. These common sources included *user research*, *previous stages*, *intuition, experience and common sense* and the *client*. Among all, user research, previous stages and intuition and experience were mentioned at least twice as the top two sources.

Table 7.21 Source - key sub-dimensions identified for 'source' dimension in the four stages of the design process

Source - Where do you obtain people information from? (All respondents)				
	Stage 1 Discover	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
1	User research	User research + Previous stage	Previous stages	User research
2	Intuition, experience, common sense	Intuition, experience, common sense	User research	Client
3	Other projects	Client	Client + Intuition, experience, common sense	Previous stages + Specialists and experts

The open-ended comments regarding the source of people information are presented in Table 7.22. Most comments could be classified under one or two sub-dimensions. Comments represented a wide range of reasons mentioned by respondents. In some cases, the sub-dimensions suggested were categorised as sub-dimensions for other dimensions. For instance 'personas' was a sub-dimension of the 'format' dimension.

Table 7.22 Source - Open-ended comments as stated under the 'Other-please specify' option

Source - Where do you obtain your people information from?	
Stage 1 Discover	- *Discussion groups* - *Other situations/scenarios for comparison* - *Libraries* - *Wikipedia* - *Research agencies - providing solid user data* - *Product support information* - *Internet communities; blogs, etc.* - *Unstructured user research - observation of potential users, undergoing activities of the potential user, talking to people involved* - *Informal places such as cafes, exhibitions, museums, events* - *Informal conversations or social interactions, knowledge sharing events and co-creation workshops* - *Imagination journeys*
Stage 2 Define	- *Other disciplines within the same project*
Stage 3 Develop	- *Personas*
Stage 4 Deliver	- *Everyday media* - *Feedback from audience-consumers* - *Personas* - *Feedback mechanisms put in place across many touch-points, including users*

❖ **Type - What kind of people information do you use?**

Table 7.23 presents the percentage and ranking of each sub-dimension in the four stages of design process. The highlighted rows present the ranking (among 13 sub-dimensions). Based on the Chi-squared test in Table 7.24, the 'Define' and 'Develop' stages did not have statistically significant results (*P* >0.05) for designers. However, the results from all respondents were statistically significant across all four stages.

Table 7.23 Type - All respondents and designers reporting on what kind of people information they use in the four stages of the design process

Type – What kind of people information do you use?								
	All respondents				***Designers***			
	Stage 1 Discover	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**	**Stage 1 Discover**	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
General, statistical[24]	52.1	46.9	35.7	22.6	42.4	43.3	33.3	21.4
	11	13	11	12	12	10	12	12
Personal, individual[25]	49.3	48.4	46.4	28.3	45.5	46.7	51.9	28.6
	12	12	10	10	11	8	8	8
Experience, context of use	87.7	78.1	62.5	73.6	87.9	80.0	63.0	71.4
	1	2	4	1	1	2	4	1
People diversity	56.2	50.0	33.9	30.2	48.5	36.7	37.0	21.4
	9	10	12	9	9	13	11	10
People dimensions[26]	49.3	53.1	57.1	22.6	39.4	43.3	55.6	17.9
	12	8	6	12	13	10	6	13
People needs	86.3	87.5	75.0	45.3	81.8	93.3	81.5	42.9
	2	1	1	3	4	1	1	5
People problems[27]	86.3	64.1	53.6	37.7	87.9	56.7	59.3	39.3
	2	5	7	6	1	4	5	7
Physical capability	56.2	57.8	60.7	28.3	48.5	46.7	51.9	21.4
	9	7	5	10	9	8	8	10
Cognitive capability	57.5	67.8	64.3	37.7	57.6	50.0	66.7	46.4
	7	4	3	6	8	7	3	4
Sensory capability	57.5	50.0	50.0	43.4	51.5	43.3	55.6	42.9
	7	10	9	5	7	10	6	5
People behaviour	86.3	73.4	73.2	71.7	84.8	63.3	77.8	64.3
	2	3	2	2	3	3	2	2
Socioeconomic, trends,lifestyle[28]	68.5	51.6	30.4	32.1	78.8	56.7	33.3	28.6
	6	9	13	8	5	4	12	8
Emotions, personality[29]	72.6	60.9	51.8	45.3	75.8	53.3	51.9	50.0
	5	6	8	3	6	6	8	3

[24] Full title as stated in the survey: General - statistical general information on people
[25] Full title as stated in the survey: Personal, Specific information on individuals
[26] Full title as stated in the survey: People dimension (physical)
[27] Full title as stated in the survey: People problems (problems facing the potential user)
[28] Full title as stated in the survey: People socio-economic status, lifestyle and trends
[29] Full title as stated in the survey: People emotions, aspirations and personality

Table 7.24 Chi-squared Test for 'Type' dimension

	Stage	Degrees of freedom *(df)*	X^2	Probability *(p)* *0.05*	Probability *(p)* *0.001*	Statistical significance
Overall responses	1	12	80.65	21.0	32.9	*P* <0.001 YES
	2	12	34.27	21.0	32.9	*P* <0.001 YES
	3	12	30.59	21.0	32.9	*P* <0.005 YES
	4	12	45.76	21.0	32.9	*P* <0.001 YES
Designers' responses	1	12	45.16	21.0	32.9	*P* <0.001 YES
	2	12	20.33	21.0	32.9	*P* >0.05 NO
	3	12	16.68	21.0	32.9	*P* >0.05 NO
	4	12	29.64	21.0	32.9	*P* <0.005 YES

Table 7.25 presents the top three types of people information stated by all respondents as used in the four stages of design process. People 'needs' and people 'behaviour' were among the top three sub-dimensions mentioned in all four stages. Also, people 'experience and context of use' and people 'emotions, aspirations and personality' were highly mentioned in the Discover and Deliver (first and last) stages of the design process. People 'problems' was mentioned as a key type of information only in the Discover stage.

Table 7.25 Type - key sub-dimensions identified for 'type' dimension in the four stages of the design process

Type - What kind of people information do you use? (All respondents)	**Stage 1 Discover**	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
1	Experience, context of use	Needs	Needs	Experience, context of use
2	Needs + Problems + Behaviour	Experience, context of use	Behaviour	Behaviour
3	Emotions, aspirations & personality	Behaviour	Cognitive capability	Needs + Emotions, aspirations & personality

The open-ended comments on type of people information used are presented in Table 7.26. Comments for the Discover and Define stages were in line with the identified sub-dimensions. However, people's 'opinion and response' to the ideas and the developed product was one type of people information that could be specifically included as an option in the Develop and Deliver stages.

Table 7.26 Type - Open-ended comments as stated under the 'Other-please specify' option

Type - What kind of people information do you use?	
Stage 1 Discover	- *Values, personal economics (how people assess choice and make relevant choices)* - *Context: technology / device / situation* - *Personal experience* - *Physical execution investigations - not anthropometric e.g. different way people hold things, etc.* - *Preferences* - *Motivations and task context* - *Stories and metaphors*
Stage 2 Define	- *Values, personal economics* - *Preferences*
Stage 3 Develop	- *People's opinions on the ideas being developed*
Stage 4 Deliver	- *People's opinions of and responds to the product that has been developed; are there less helpdesk requests? Do they like it? Do they use it? (2)*[30] - *If it's a pilot study then I'll try to obtain all people information to prove efficacy* - *General public perception of completed project*

❖ Format - What format of people information do you use?

The various formats of people information reported as being used in the design process are presented in Table 7.27 together with the ranking of each (among 15 sub-dimensions). The Chi-squared test results in Table 7.28 showed all responses were statistically significant for both overall respondents and the designers, apart from designers' responses in the Deliver stage ($P > 0.05$).

[30] Mentioned twice

Table 7.27 Format - All respondents and designers reporting on what format of people information they use in the four stages of the design process

Format - What format of people information do you use?	All respondents				Designers			
	Stage 1 Discover	Stage 2 Define	Stage3 Develop	Stage 4 Deliver	Stage 1 Discover	Stage 2 Define	Stage3 Develop	Stage 4 Deliver
Raw, unstructured[31]	43.7	33.3	19.3	18.0	45.5	32.3	28.6	22.2
	13	14	14	15	13	12	12	13
Processed, structured[32]	57.7	62.1	52.6	56.0	57.6	64.5	57.1	55.6
	9	3	4	2	7	3	3	2
Qualitative	83.1	75.8	70.2	66.0	78.8	74.2	75.0	63.0
	1	1	1	1	2	1	1	1
Quantitative	66.2	62.1	54.4	46.0	63.5	58.1	50.0	44.4
	4	3	2	3	4	4	4	6
Transcripts	46.5	34.8	14.0	28.0	51.5	22.6	14.3	25.9
	12	12	15	12	10	14	15	12
Quotes & anecdotes	63.4	47.0	35.1	44.0	60.6	38.7	42.9	51.9
	5	10	10	6	6	10	6	4
Photographic records	62.0	51.5	45.6	42.0	57.6	41.9	42.9	40.7
	6	7	5	8	7	9	6	7
Video	59.2	40.9	33.3	36.0	57.6	35.5	32.1	33.3
	8	11	11	11	7	11	11	10
Audio, oral or recorded	43.7	28.8	24.6	22.0	33.3	12.9	21.4	18.5
	13	15	13	14	14	15	14	15
Written report	53.5	51.5	42.1	46.0	51.5	58.1	46.4	55.6
	11	7	6	3	10	4	5	2
Info-graphics[33]	62.0	53.0	38.6	38.0	63.5	51.6	35.7	33.3
	6	6	8	9	4	7	9	10
Database, data tables	39.4	34.8	33.3	24.0	30.3	25.8	28.6	22.2
	15	12	11	13	15	13	12	13
Numerical, statistical	56.3	54.5	40.4	46.0	48.5	54.8	42.9	51.9
	10	5	7	3	12	6	6	4
Persona , scenario	80.3	72.7	54.4	44.0	87.9	74.2	67.9	37.0
	2	2	2	6	1	1	2	8
Case studies	69.0	48.5	38.6	38.0	69.7	45.2	35.7	37.0
	3	9	8	9	3	8	9	8

[31] Full title as stated in the survey: Raw (not edited, structured or analysed)
[32] Full title as stated in the survey: Processed (edited, structured or analysed)
[33] Full title as stated in the survey: Info-graphics; graphs, maps, diagrams

Table 7.28 Chi-squared Test for 'Format' dimension

	Stage	Degrees of freedom *(df)*	X^2	Probability *(p)* *0.05*	Probability *(p)* *0.001*	Statistical significance
Overall responses	1	14	42.59	23.70	36.1	*P* <0.001 YES
	2	14	35.00	23.70	36.1	*P* <0.005 YES
	3	14	72.02	23.70	36.1	*P* <0.001 YES
	4	14	36.72	23.70	36.1	*P* <0.001 YES
Designers' responses	1	14	26.40	23.70	36.1	*P* <0.05 YES
	2	14	30.95	23.70	36.1	*P* <0.05 YES
	3	14	27.42	23.70	36.1	*P* <0.05 YES
	4	14	23.53	23.70	36.1	*P* >0.05 NO

The top three formats of people information used were overall consistent across the four stages of the design process. These are presented in Table 7.29. 'Qualitative' was the most mentioned format of people information across all four stages. 'Persona and scenario' was one of the top formats of people information mentioned in the first three stages of the design process while 'processed and structured' and 'quantitative' were mentioned as key types in the last three stages. Among the other highly mentioned types of information were 'case studies' and 'numerical, statistical' and 'written reports', the first was mentioned in the Discover (first) stage. The latter two were mentioned in the Deliver (last) stage.

Table 7.29 Format - key sub-dimensions identified for 'Format' dimension in the four stages of the design process

Format - What format of people information do you use? (All respondents)				
	Stage 1 Discover	**Stage 2 Define**	**Stage 3 Develop**	**Stage 4 Deliver**
1	Qualitative	Qualitative	Qualitative	Qualitative
2	Persona, scenario	Persona, scenario	Persona, scenario + Quantitative	Processed, structured
3	Case studies	Quantitative + Processed, structured	Processed, structured	Quantitative + Numerical, statistical + Written report

The open-ended comments on format of people information are presented in Table 7.30. Comments were generally in line with already identified sub-dimensions. However, 'cultural probes' and 'diaries' mentioned in the open-ended comments as two specific methods of collecting and documenting people information used by designers, could be considered for inclusion as potential formats of people information. Some items mentioned as formats of people information better suited other dimensions, e.g. 'returns, problems and complaints' could be considered a 'Type' of people information. Also, items such as 'interactions, workshops and environments for collaboration' could be classified under a number of dimensions.

Table 7.30 Format - Open-ended comments as stated under the 'Other-please specify' option

Format - What format of people information do you use?	
Stage 1 Discover	- *Edited and structured, but still containing raw detail* - *Even better is being able to observe or discuss directly* - *live media; internet, TV, press* - *Diaries, cultural probes* - *Sketches, scribbled on a paper napkin or restaurant table*
Stage 2 Define	*None*
Stage 3 Develop	- *Other media* - *Everyday media; internet, TV, press* - *Interaction, discussion, drawing others out* - *Facilitating conversation and building consensus*
Stage 4 Deliver	- *Interactions, workshops, environments for collaboration* - *Returns, problems, complaints* - *A usability testing*

- **Attributes - What attributes do you consider as important for the people information you use?**

Table 7.31 presents all participants' and designers' responses to the attributes they consider important for people information they use. Both percentage of mentioning and ranking of each attribute (among 19 attributes) are shown in the table. Results of the chi-squared test for 'attributes' dimension in Table 7.32 showed responses for all four stages were statistically significant ($P < 0.05$) with the exception of the designers' responses for Discover stage ($P > 0.05$).

Table 7.31 Attributes - All respondents and designers reporting on what attributes they consider for people information they use in each of the four stages of the design process

Attributes - What attributes you consider as important for the people information you use?								
	All respondents				***Designers***			
	Stage 1 Discover	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**	**Stage 1 Discover**	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
Accessibility	48.6	50.8	39.3	34.6	46.9	43.3	33.3	33.3
	8	7	9	11	11	13	14	11
Accuracy	48.6	53.8	58.9	44.2	43.8	60.0	66.7	51.9
	8	5	3	5	14	4	2	6
Completeness	31.4	44.6	42.9	40.4	21.9	46.7	48.1	51.9
	18	12	8	9	19	10	7	6
Relevance	82.9	80.0	64.3	63.5	84.4	86.7	70.4	63.0
	1	1	2	1	1	1	1	1
Importance	44.3	53.8	50.0	44.2	50.0	60.0	48.1	55.6
	11	5	6	5	8	4	7	3
Clarity	67.1	56.9	57.1	42.3	65.6	63.3	63.0	55.6
	3	4	4	7	3	3	3	3
Cost	44.3	41.5	32.1	26.9	46.9	40.0	40.7	22.2
	11	13	14	13	11	15	9	17
Validity & Reliability	70.0	67.7	66.1	53.8	62.5	60.0	63.0	51.9
	2	2	1	2	4	4	3	6
Up-to-datedness	52.9	49.2	35.7	42.3	53.1	50.0	40.7	40.7
	5	8	12	7	7	7	9	9
Ease & speed of use	50.0	46.2	44.6	26.9	62.5	50.0	63.0	25.9
	7	10	7	13	4	7	3	14
Ease & speed of access[34]	45.7	38.5	32.1	26.9	46.9	26.7	40.7	29.6
	10	15	14	13	1	17	9	13
Visual representation	52.9	46.2	35.7	50.0	59.4	46.7	29.6	55.6
	5	10	12	4	6	10	15	3
Right level of detail	60.0	66.2	51.8	51.9	71.9	66.7	59.3	63.0
	4	3	5	3	2	2	6	1
Simplified into nuggets[35]	38.6	41.5	25.0	28.8	50.0	46.7	25.9	25.9
	15	13	16	12	8	10	16	14
Non-scientific[36]	31.4	27.7	16.1	26.9	34.4	20.0	18.5	33.3
	18	18	18	13	17	18	18	11
Open-endedness[37]	37.1	23.1	16.1	19.2	40.6	16.7	18.5	18.5
	16	19	18	18	16	19	18	18
Intuitiveness	44.3	36.9	37.5	25.0	50.0	43.3	40.7	25.9
	11	16	11	17	8	13	9	14
Simplicity	41.4	47.7	39.3	36.5	43.8	50.0	40.7	37.0
	14	9	9	10	14	7	9	10
Openness[38]	34.3	30.8	19.6	19.2	34.4	33.3	22.2	14.8
	17	17	17	18	17	16	17	19

[34] Full title as stated in the survey: Ease and speed of search and access
[35] Full title as stated in the survey: Simplified into nuggets of information
[36] Full title as stated in the survey: Non-scientific and non-technical language
[37] Full title as stated in the survey: Open-endedness (freedom of interpretation)
[38] Full title as stated in the survey: Openness (showing the raw data)

Table 7.32 Chi-squared Test for 'Attributes' dimension

	Stage	Degrees of freedom *(df)*	X^2	Probability *(p)* *0.05*	Probability *(p)* *0.001*	Statistical significance
Overall responses	1	18	37.93	28.9	42.3	*P* <0.005 YES
	2	18	47.00	28.9	42.3	*P* <0.001 YES
	3	18	64.70	28.9	42.3	*P* <0.001 YES
	4	18	60.34	28.9	42.3	*P* <0.001 YES
Designers' responses	1	18	24.25	28.9	42.3	*P* >0.05 NO
	2	18	30.93	28.9	42.3	*P* <0.05 YES
	3	18	30.12	28.9	42.3	*P* <0.05 YES
	4	18	34.57	28.9	42.3	*P* <0.05 YES

The top three attributes of people information in the four stages of the design process are presented in Table 7.33. These key attributes were overall consistent across all stages; 'relevance' and 'validity and reliability' were the top two attributes across all four stages. 'Right level of detail' was considered of high important specifically in the Define and Deliver stages, while 'clarity' of information and its 'accuracy' were specifically important in the Discover and Develop stages respectively.

Table 7.33 Attributes - key sub-dimensions identified for 'attributes' dimension in the four stages of the design process

Attributes - What attributes you consider as important for the people information you use? (All respondents)				
	Stage 1 Discover	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
1	Relevance	Relevance	Validity & reliability	Relevance
2	Validity & reliability	Validity & reliability	Relevance	Validity & reliability
3	Clarity	Right level of detail	Accuracy	Right level of detail

Table 7.34 presents the open-ended comments on attributes of people information the respondents considered important. These comments were in line with existing identified attributes of the information, however, 'ethical' information was a suggested sub-dimension that could be considered for inclusion among the people information attributes.

Table 7.34 Attributes - Open-ended comments as stated under the 'Other-please specify' option

Attributes - What attributes you consider as important for the people information you use?	
Stage 1 Discover	- *Ethical information* - *Objectivity* - *Raw; it says what it says* - *Source, context and person* - *Who created the data* - *Context*
Stage 2 Define	- *Ethical*
Stage 3 Develop	*None*
Stage 4 Deliver	*None*

❖ **Intensity - How in-depth and diverse is the people information you use and how frequently do you use it?**

The semantic differential scale was used for assessing and rating the 'Intensity' dimension and its three categories i.e. 'range', 'depth' and 'frequency'. Table 7.35 shows the semantic differential scale used for assessing and rating the three categories of Intensity in the survey study.

Table 7.35 The semantic differential scale for the three categories of 'Intensity' dimension

INTENSITY of information	*Rating*						
Range of information	1 least diverse	2	3	4	5	6	7 most diverse
Depth of information	1 least in-depth	2	3	4	5	6	7 most in-depth
Frequency of information use	1 least frequent	2	3	4	5	6	7 most frequent

Using the semantic differential scale, survey respondents rated the 'range', 'depth' and 'frequency' of people information use. Table 7.36 presents all participants' and design researchers' rating of these three categories. Both percentage and ranking of each scale are shown in the table. The average rating is provided for each category in each stage, these were largely in line for both designers and all respondents.

Table 7.36 Intensity - All respondents and designers reporting on how in-depth, diverse and frequent they use people information in the four stages of the design process

Intensity	***All respondents***				***Designers***			
	Stage 1 Discover	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**	**Stage 1 Discover**	**Stage 2 Define**	**Stage3 Develop**	**Stage 4 Deliver**
Depth - How in-depth is the people information you use?								
1 (least)	2.8	1.5	1.7	1.8	3.0	0.0	0.0	0.0
	7	7	7	7	7	7	7	7
2	4.2	3.0	3.4	3.6	6.1	3.1	3.4	6.9
	6	6	6	6	6	6	6	6
3	16.7	7.5	11.9	16.4	9.1	12.5	13.8	20.7
	4	5	5	3	5	5	4	2
4	23.6	16.4	13.6	27.3	24.2	15.6	6.9	17.2
	1	4	3	1	1	3	5	3
5	20.8	28.4	25.4	14.5	24.2	34.4	27.6	17.2
	2	1	2	4	1	1	2	3
6	12.5	22.4	13.6	14.5	12.1	12.5	17.2	10.3
	5	2	3	4	4	4	3	5
7 (most)	19.4	20.9	30.5	21.8	21.2	21.9	31.0	27.6
	3	3	1	2	3	2	1	1
AVERAGE	**4.50**	**5.18**	**5.20**	**4.80**	**4.58**	**5.06**	**5.34**	**4.86**
MEDIAN	**5**	**5**	**5**	**4**	**5**	**5**	**5**	**4**
Diversity - How diverse is the people information you use?								
1 (least)	0.0	1.5	1.7	9.1	0.0	3.2	3.4	6.9
	7	7	7	7	7	6	7	7
2	2.8	4.5	13.8	14.5	3.1	3.2	10.3	13.8
	6	6	5	2	6	6	5	3
3	11.3	22.7	17.2	14.5	6.3	25.8	17.2	13.8
	5	1	3	2	5	1	3	3
4	19.7	21.2	22.4	21.8	18.8	12.9	20.7	24.1
	4	2	1	1	3	4	1	1
5	21.1	15.2	19.0	10.9	28.1	19.4	20.7	10.3
	2	5	2	6	1	3	1	6
6	21.1	16.7	8.6	14.5	15.6	12.9	10.3	13.8
	2	4	6	2	4	4	5	3
7 (most)	23.9	18.2	17.2	14.5	28.1	22.6	17.2	17.2
	1	3	3	2	1	2	3	2
AVERAGE	**4.97**	**4.67**	**4.38**	**4.13**	**5.03**	**4.71**	**4.45**	**4.28**
MEDIAN	**5**	**4.5**	**4**	**4**	**5**	**4**	**4.5**	**4**
Frequency - How frequently do you use the people information?								
1 (least)	1.4	1.5	0.0	3.6	3.1	3.2	0.0	3.4
	6	6	7	7	5	6	7	7
2	1.4	1.5	6.8	9.1	0.0	3.2	6.9	13.8
	6	6	6	6	6	6	6	4
3	7.0	9.1	15.3	16.4	0.0	6.5	13.8	10.3
	5	5	4	3	6	5	4	6
4	21.1	16.7	22.0	16.4	18.8	22.6	24.1	17.2
	2	4	2	3	3	2	1	2
5	19.7	24.2	25.4	20.0	18.8	22.6	17.2	17.2
	3	1	1	1	3	2	3	2
6	19.7	24.2	11.9	18.2	25.0	16.1	13.8	13.8
	3	1	5	2	2	4	4	4
7 (most)	29.6	22.7	18.6	16.4	34.4	25.8	24.1	24.1
	1	3	3	3	1	1	1	1
AVERAGE	**5.14**	**5.24**	**4.76**	**4.60**	**5.44**	**5.10**	**4.90**	**4.69**
MEDIAN	**6**	**5**	**5**	**5**	**6**	**5**	**4.5**	**5**

In order to assess statistical significance of the ratings for intensity dimension, Chi-squared test was applied to the results. Results of the chi-squared test for 'intensity' dimension are presented in Table 7.37 and Table 7.38 for overall respondents and designers respectively.

Table 7.37 Chi-squared Test for 'Intensity' dimension - overall respondents

	Stage	Degrees of freedom *(df)*	X^2	Probability *(p)* *0.05*	Probability *(p)* *0.001*	Statistical significance
Depth	1	6	17.38	12.6	22.5	*P* <0.05 YES
	2	6	28	12.6	22.5	*P* <0.001 YES
	3	6	26.88	12.6	22.5	*P* <0.001 YES
	4	6	19.64	12.6	22.5	*P* <0.05 YES
Range	1	6	24.22	12.6	22.5	*P* <0.001 YES
	2	6	17.27	12.6	22.5	*P* <0.05 YES
	3	6	11	12.6	22.5	*P* >0.05 NO
	4	6	3.81	12.6	22.5	*P* >0.05 NO
Frequency	1	6	37.33	12.6	22.5	*P* <0.001 YES
	2	6	28.89	12.6	22.5	*P* <0.001 YES
	3	6	19.02	12.6	22.5	*P* <0.05 YES
	4	6	7.18	12.6	22.5	*P* >0.05 NO

The ratings by overall respondents and designers were not statistically significant ($P > 0.05$) across all stages and for all three categories. Generally, in both overall and designers' results, it was observed that statistical significance of ratings was lower towards the last two stages i.e. Develop and Deliver. This could be due to the length of the survey and possible loss of interest or focus of respondents towards the end of the survey which would directly influence the results for the Develop and Deliver stages. Also, designers' ratings of intensity dimension were less statistically significant compared to overall ratings. This is due to higher number of overall respondents (almost double the number of designers).

Table 7.38 Chi-squared Test for 'Intensity' dimension - designers

	Stage	Degrees of freedom *(df)*	X^2	Probability *(p)* *0.05*	Probability *(p)* *0.001*	Statistical significance
Depth	1	6	11.28	12.6	22.5	*P* >0.05 NO
	2	6	17.88	12.6	22.5	*P* <0.05 YES
	3	6	17.11	12.6	22.5	*P* <0.05 YES
	4	6	10.35	12.6	22.5	*P* >0.05 NO
Range	1	6	17.88	12.6	22.5	*P* <0.05 YES
	2	6	10.34	12.6	22.5	*P* >0.05 NO
	3	6	5.03	12.6	22.5	*P* >0.05 NO
	4	6	3.58	12.6	22.5	*P* >0.05 NO
Frequency	1	6	24.44	12.6	22.5	*P* <0.001 YES
	2	6	12.60	12.6	22.5	*P* <0.05 YES
	3	6	9.38	12.6	22.5	*P* >0.05 NO
	4	6	5.03	12.6	22.5	*P* >0.05 NO

Among the three categories of intensity dimension, only the ratings for 'depth' category were statistically significant across all four stages of the design process (overall responses). However, 'frequency' category had statistically significant ratings for the first three stages of the design process, while the 'range' category only had statistically significant results for the first two stages. This limited the overall usefulness of the survey results for intensity dimension.

Both 'frequency' and 'diversity' of people information showed a minor yet continual decline throughout the stages of the design process (looking at stages with statistically significant ratings), while 'depth' of people information used showed an increase moving from the Discover stage to Define and Develop stage and declined at the Deliver stage.

7.5 Discussion

In this section the three objectives of the survey i.e. evaluation, refinement, and detailing of the information framework are reviewed and the research approach is discussed.

7.5.1 Reflection on objectives

The survey with designers and design researchers had three objectives (outlined in Section 7.2.1) which are discussed below.

- ❖ **Objective 1: Evaluating the framework**

The framework was evaluated through three questions addressing 'validation', 'verification' and overall 'value' of the framework. Overall, the framework was evaluated positively based on its novelty, comprehensiveness, good categorisation of related aspects and its usefulness. Most negative comments were based on the relevance of framework to its target audience; lack of clarity and purpose why it should be used and also the complexity of the framework.

Validation - More than 85 % of all respondents (66 designers and design researchers) believed the framework did or might help them understand designers' information behaviour.

Verification - More than 50 % of respondents (both overall respondents and design researchers) stated the framework 'might' address key aspects of designers' information behaviour, while approximately 35 % believed it did and 10 % stated it did not. This could be due to the fact that respondents needed to engage with the framework further in order to be able to respond to this question more confidently.

Value - Approximately 84 % of all respondents stated that they 'will' or 'may' be willing to use the framework and about 15 % of respondents stated they were not willing to use the framework.

- ❖ **Objective 2: Refining the framework dimensions**

Approximately 12 % of respondents thought the framework dimensions did not need to be refined while approximately 88 % responded 'Yes' or 'Maybe' to the question whether the dimensions needed refinement.

Overall, visual representation of the framework and the relationship between its dimensions (linkage and hierarchy) were suggested for consideration. Also, the terminology used to communicate the framework and its dimensions was suggested for refinement. The dimensions mentioned as not clear in their terminology included 'Attributes', 'Intensity', 'Purpose', and 'Type' versus 'Format'.

❖ **Objective 3: Detailing the framework dimensions**

Six dimensions of the framework were detailed in the survey. 'Stage' dimension was detailed based on the Double Diamond model of the design process (Design Council, 2005). The key findings are reviewed below.

Purpose - reasons for use of people information changed from 'insight', 'information', 'communication' and 'empathy' in the first two stages of the design process (i.e. Discover and Define), to 'confirmation', 'evaluation' and 'communication' in the last two stages (i.e. Develop and Deliver).

Source - 'user research', 'intuition and experience', and 'client' were the top three sources of people information across all stages of the design process.

Type - 'needs' and 'behaviour' were key types of people information used throughout the design process. 'Experience and context of use' and 'emotions' were key in the first and last stage of the design process.

Format - 'qualitative' information was commonly used across all stages of the design process. 'Persona, scenario', 'processed, structured' and 'quantitative' were other formats of information highly mentioned.

Attributes - key qualities of people information across all stages were 'relevance' and 'validity and reliability'. 'Right level of detail', 'clarity' and 'accuracy' were also desired attributes.

Intensity - Depth of people information used increased in the first three stages and declined in the last stage. Diversity of people information used decreased in the first two stages and frequency of people information use showed a continual decline in the first three stages.

7.5.2 Critique of the research methods

A web-based survey was adopted as the appropriate data collection method for this study. The web-based survey proved an effective method for collecting the required data. Altogether, the survey received 91 responses. Complete response rate for both Part A and B of the survey was evaluated as high for web surveys (98.9 % complete for Part A and 73.6 % complete for Part B). Also, the survey had a very good response rate for email survey administration (56.8 % of people contacted directly via email participated in the survey).

Lack of 'time' and 'relevance' has been reported as some of the reasons for non-participation of design professionals in a survey (Sims, 2003). The good response rate for the survey could be due to relative ease of answering (online format and simple and attractive format of the survey) and relevance of the subject of the survey to its participants; the survey was posted on several LinkedIn groups for design professionals where the subject could be of potential interest and relevance to group members. For each group, the relevance of the survey was specifically highlighted to group members. Also, a number of strategies were adopted in order to maximise the response rate and encourage participation (detailed in Section 7.2.4).

Although an effective and increasingly accepted method of data collection, web-based surveys have some limitations as well. Adopting the web-based survey meant potential participants who did not use computer and the world-wide web would be excluded in the first place, however, this was not considered a major disadvantage as a wide majority of the intended audience of the survey (designers and design researchers) were assumed to have access to computer and world-wide web. Also, anonymity of the survey could introduce lack of control over participants and their eligibility to participate. However, this was controlled to a certain extent through posting the survey only on specific LinkedIn group pages, rather than public web pages. This meant only specific LinkedIn group members were able to see the link to survey.

Self-administered surveys have some general disadvantages that would also apply to web-based surveys. These include potential ambiguities and misunderstanding of survey questions, and difficulties in detecting if respondents treated the survey seriously (Robson, 2002). In order to minimise these disadvantages and maximise the advantages of web-based survey, a number of strategies were adopted in addition to what was detailed above and in Section 7.2.4. These included:

- Including an open-ended comment section for every question in the survey (apart from differential-scale questions for the 'Intensity' dimension).
- Conducting two rounds of survey piloting in order to evaluate accuracy and competency of the questionnaire; improving the wording style, type, questions sequence, and the (short) length of time needed to complete the survey.

Although the survey was revised and edited several times in order to reduce its length, it was still considered lengthy for an online survey (approximately 20 minutes). This could be one reason why the questions towards the end of the survey (Develop and Deliver stages) received less overall responses and multiple choices. The repetitive format of the survey (asking the same set of questions across the four stages of the design process) could be one contributing factor as well. In order to reduce the repetition effect and the risk of selecting the same choice due to repetition, the multiple choices (sub-dimensions) for the same question were presented in a different random order in each stage.

One advantage of the survey was that it was designed to collect different sets of data from various intended participants i.e. designers and design researchers. This also introduced some complications as certain parts of the survey were primarily aimed at one group of participants (e.g. the evaluation and refinement of the framework was mainly aimed at design researchers), thus it seemed to lack 'relevance' to the other group of participants. Some open-ended comments in Part A reporting on lack of clarity and purpose of framework (mainly made by designers) well demonstrated this issue. However, considering the advantages of combining both parts in one survey this issue was inevitable.

Part A of the survey aimed to evaluate and refine the information framework. However, there were inherent limitations regarding evaluation of the framework through a questionnaire rather than in actual use. It could be argued that the responses regarding validation, verification and value of the framework, and refinement of its dimensions, were all based on respondents' perceptions rather than actual use. A high percentage of 'Maybe' responses to the evaluation questions further confirmed this issue.

7.6 Refining, Evaluating and Detailing the framework

The web-based survey evaluated, refined and detailed the information framework. The framework was evaluated as comprehensive and useful yet complex and needing further clarity on its purpose. This was expected as the framework was intended to be primarily evaluated by design researchers rather than designers (though designers were one main group of respondents).

The results regarding refinement of the framework suggested further consideration for visual representation of the framework, the relationship between its dimensions, and the terminology used to communicate the framework. The dimensions with an unclear terminology included 'Attributes', 'Intensity', 'Purpose', and 'Type' versus 'Format'.

The 'Intensity' dimension replaced the 'use' dimension in the initial framework. Three categories were indicated as constituents of intensity, i.e. 'depth' 'range' and 'frequency'. It was expected that apart from assessing each category separately, an overall assessment of intensity based on certain combination of its constituents could be suggested. Semantic differential scale was adopted as the method for measuring and assessing intensity dimension. However, the numeric scale proved not fully suited for the purpose of observing and self-reporting the depth, range and frequency of information use. This resulted in highest level of diversity in results and raised issues of validity and reliability of findings in regards to this dimension. Also, no specific combination of three categories could be suggested for an overall assessment of intensity dimension. This implies further research needs to be carried out in order to suggest scaling methods for each category and proposing an overall assessment of intensity.

Six dimensions of the framework were detailed and further populated in the survey. Figure 7.5 presents an overview of the suggested refinements to the framework dimensions and Table 7.36 presents the populated framework dimensions based on the key sub-dimensions identified. The key sub-dimensions specifically identified in this study (not identified through observational studies) are highlighted in bold and red.

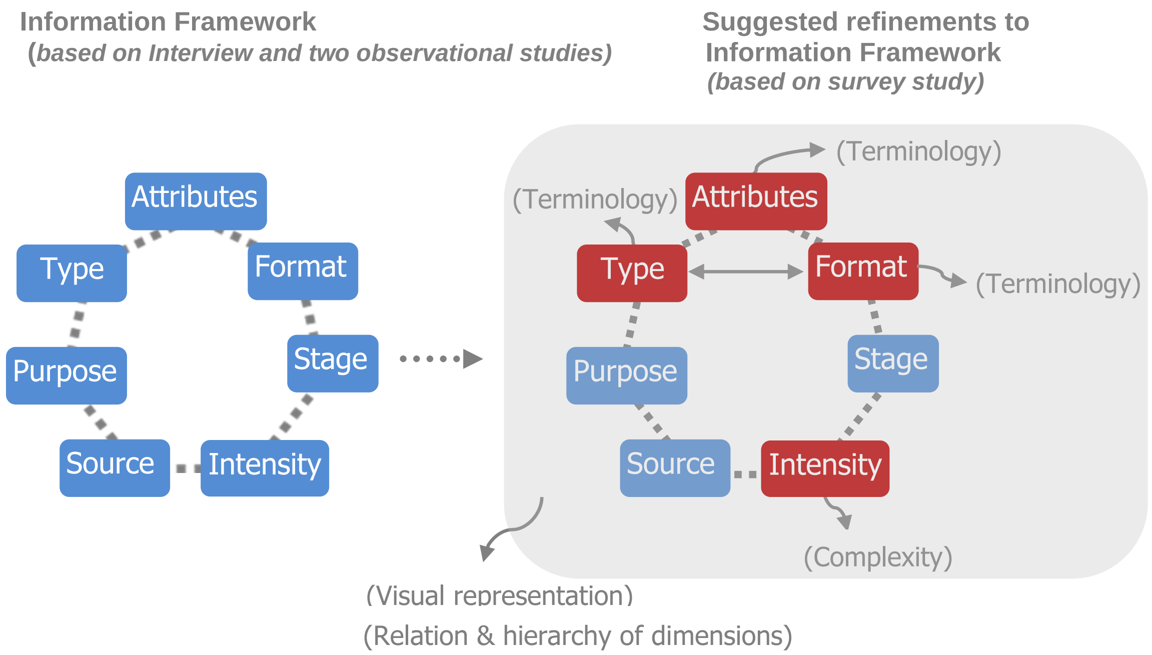


Figure 7.5 The Information Framework based on interview and observational studies and the suggested refinements to the framework based on survey study

Table 7.39 Detailing the framework based on findings from the survey study

Dimension	Changes	Result	
Purpose	Detailed	Stage:	Discover *Insight & understanding, Inspiration & ideation, Empathy* Define *Communication & Discussion, Information & specification, Insight & understanding* Develop *Confirmation & support, Evaluation & refinement,* ***Communication & discussion*** Deliver *Communication & discussion, Confirmation & support*
Source	Detailed	Stage:	Discover *User research, Intuition & experience,* ***Other projects*** Define *User research + Previous stage, Intuition,* ***Client*** Develop *Previous stages, User research,* ***Client*** *+ Intuition* Deliver *User research, Client, Previous stages +* ***Specialists***
Type	Detailed	Stage:	Discover *Experience & context of use, Needs + Problems +* ***Behaviour****,* ***Emotions & aspirations*** Define *Needs, Experience & context of use,* ***Behaviour*** Develop *Needs,* ***Behaviour****,* ***Cognitive capability*** Deliver *Experience & context of use, Behaviour, Needs + Emotions, aspirations & personality*
Format	Detailed	Stage:	Discover *Qualitative, Persona & scenario,* ***Case studies*** Define *Qualitative, Persona & scenario,* ***Quantitative*** *+* ***Processed*** Develop *Qualitative, Persona & scenario +* ***Quantitative****,* ***Processed****,* ***Structured*** Deliver *Qualitative,* ***Processed****,* ***Structured****,* ***Quantitative*** *+* ***Numerical*** *+* ***Written report***
Attributes	Detailed	Stage:	Discover *Relevance, Validity & reliability, Clarity* Define *Relevance, Validity & reliability,* ***Right level of detail*** Develop *Validity & reliability, Relevance, Accuracy* Deliver *Relevance, Validity & reliability,* ***Right level of detail***

Intensity	Detailed	Stage:	Discover *Range* 4.97 (on a scale of 1 to 7) *Depth* 4.50 (on a scale of 1 to 7) *Frequency* 5.14 (on a scale of 1 to 7) Define *Range* 4.67 (on a scale of 1 to 7) *Depth* 5.18 (on a scale of 1 to 7) *Frequency* 5.24 (on a scale of 1 to 7) Develop *Range* -[39] *Depth* 5.20 (on a scale of 1 to 7) *Frequency* 4.76 (on a scale of 1 to 7) Deliver *Range* -[40] *Depth* 4.80 (on a scale of 1 to 7) *Frequency* -[41]
Stage	Detailed[42]	*Discover, Define, Develop, Deliver*	

7.7 Summary

7.7.1 Key insights

The survey study proved successful in providing quantitative data to evaluate, refine and detail the framework. The quantitative data collected complemented the qualitative data gathered in the Interview, Design Bugs Out and 24-hour Challenge studies. Use of online platforms for participant identification and administration of the survey proved effective. The survey had a high complete response rate, however it was considered lengthy for a web-based survey. Separating survey respondents into two groups i.e. designers and design researchers helped with categorising and sorting of the data in terms of framework evaluation, refinement and detailing. Merging Part A and B of the survey into one whole survey aimed at both designers and design researchers was evaluated as successful. However, this caused confusions for designers in terms of relevance of Part A of survey, and therefore relevance of the information framework to them.

[39] The results for 'Range' were statistically insignificant in the Develop stage.
[40] The results for 'Range' were statistically insignificant in the Deliver stage.
[41] The results for 'Frequency' were statistically insignificant in the Deliver stage.
[42] (Design Council, 2005)

7.7.2 Study implications

Subsequent to being evaluated, refined and detailed through interview and observation, the information framework was evaluated, refined and detailed in the third round through a survey with designers and design researchers. This method was the last of the three methods aimed at research triangulation. Having collected data through the three triadic methods i.e. interview, observation, and survey, next chapter will collate, review and discuss the findings from each of these studies aiming for a conclusion. The suggestions made regarding refining the framework and its dimensions are discussed here:

❖ **Further refinement of the Information Framework**

The key findings from survey study suggested a number of major refinements to the information framework. These included three main areas i.e. terminology, visual presentation, and linkage and hierarchy and are considered to be revisited in further research. These aspects are briefly reviewed here.

- **Terminology:** a number of dimensions were suggested as unclear in their terminology. These included 'Attributes', 'Intensity', 'Purpose', and 'Type' versus 'Format'. Also, 'Intensity' dimension was suggested as being complex. Initially, one main criterion in selecting the terminology for each information dimension was the common use of it in the design field. A comprehensive review of terminology could be carried out in terms of revisiting the exiting terminology. One recommendation to be reviewed is to replace 'Type' with 'Content' and 'Format' with 'Presentation' respectively. Also, 'Attributes' could be replaced with 'Quality'. Figure 7.6 presents some of these changes to be further considered.

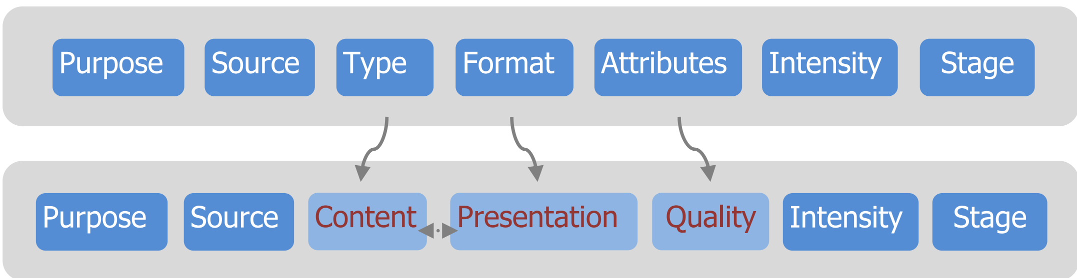


Figure 7.6 Terminology changes suggested for further consideration

- **Visual presentation:** initially, the information framework was visually presented in the shape of a heptagon. However, this suggested certain specifications such as direct connection, order and start and end points which were not supported through research. It also suggested an iterative cycle with linear connections between dimensions, which needed to be supported through further research on dimensions interrelation. Further research needs to be carried out in order to identify a visual depiction for the framework which best represents its features. Figure 7.7 shows the visual presentation of the information framework in the shape of a heptagon.

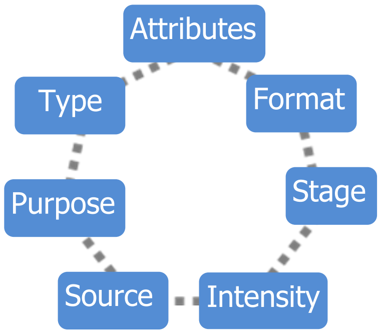


Figure 7.7 The information framework in its heptagonal shape

- **Linkage and hierarchy:** both observed and reported information behaviour of designers through the four studies identified conflicts and interrelations between certain dimensions of information framework. In particular, connections between 'purpose' and 'source', and 'type' with 'format' and 'qualities' were indicated. These conflicts and interrelations together with potential hierarchy and order between the framework dimensions need to be further studied. This would also impact the visual representation of the overall framework. Overall, it could be observed that the first two stages of the design process i.e. Discover and Define were more people information-intensive.

❖ Further refinement of the 'Intensity' dimension

There was potential for adopting a method better suited for the purpose of observing and self-reporting the depth, range and frequency of information use, as the numeric scale proved not fully suited. No specific combination of three categories could be suggested for an overall assessment of intensity dimension. Further research could be carried out in order to identify alternative scaling methods for each category and suggest an overall assessment of intensity.

Chapter Eight

Conclusion and Further work

"If we knew exactly what it was we were doing, it would not be called research, would it?"

Albert Einstein (1879-1955)

Analysis and synthesis of relevant literature resulted in outlining an initial information framework (Chapter Two). Through adopting a research triangulation approach and three complementary methods (i.e., interview, observation and survey (Chapter Three)), the initial information framework was refined, evaluated and detailed in four studies (Chapters Four, Five, Six and Seven). This chapter draws the overall conclusions for this PhD research based on the studies carried out, discusses and summarises contributions of this research to the field, and outlines limitations and further work. The structure of the chapter is illustrated in Figure 8.0.

Figure 8.0 Chapter Eight structure

8.1 Key conclusions

This section summarises the overall conclusions in regard to the outlining, refinement and evaluation, and detailing of the information framework based on the literature analysis and synthesis and the four studies carried out. For this purpose, the research aim and objectives (outlined in Section 1.3) are reiterated here and the extent to which, and how, each objective has been met is addressed through key conclusions.

❖ **Research aim and objectives**

This PhD research aimed to both provide a structure for investigation and analysis of information behaviour in design and to detail identified aspects of designers' information behaviour throughout a design process. For this purpose, three research objectives were outlined.

1. To develop a structure for better understanding of designers' information behaviour.
2. To evaluate and refine the developed structure through research.
3. To detail the information behaviour in design throughout a design process using the developed structure.

Below, the key conclusions of this PhD research are summarised in accordance with the three research objectives and the outcomes for each.

8.1.1 Research objective 1:

'Information Framework' in design and 'Design Context'

The first research objective was to develop a structure for better understanding of information behaviour in design. This objective was achieved through formation and outlining of the 'Information Framework' and 'Design Context' as two complementary structures to facilitate the understanding and analysis of designers' information behaviour. The two structures were identified through analysis and synthesis of relevant literature in Chapter Two.

The literature analysis carried out in Chapter Two suggested that there is a lack of a holistic understanding of information behaviour in design and that there is a need to study designers' information behaviour systematically and to approach it in a comprehensive way.

Analysis of literature identified an inherently distinctive approach and language in addressing information behaviour by the two fields (i.e. design, and library and information sciences); while the former focused on behavioural aspects, the latter was predominantly concerned with the information itself. Subsequently, an 'information-oriented', rather than 'behaviour-oriented' focus was adopted in the study of information behaviour in design in this thesis.

Synthesis of literature in Chapter Two resulted in the outlining of an 'Information Framework' and its information dimensions together with defining the 'Design Context' for information behaviour in design and its constituents. The 'Information Framework' consists of seven key dimensions of information summarised in Section 8.1.2. The 'Design Context' consists of four key elements i.e. Designer, Team, Client and Brief. Figure 8.1 presents the four constituents of design context based on analysis and synthesis of literature.

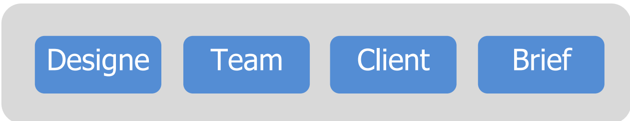


Figure 8.1 Design Context for information behaviour in design

This research suggests that the study of information dimensions alongside the design context could provide a holistic understanding of information behaviour in design.

8.1.2 Research objective 2:

Refinement and evaluation of the 'Information Framework'

The second research objective was to evaluate and refine the developed structure through research. This was planned for and achieved through four complementary studies presented in Chapters Four, Five, Six and Seven. The initial information framework was refined and evaluated using three complementary methods: interview with designers; observation of designers (two studies); and survey of designers and design researchers.

The interview study (Chapter Four) resulted in inclusion of one new dimension, 'Purpose', and the suggested refinement of the 'Use' dimension. The Design Bugs Out observational study (Chapter Five) led to the inclusion of one new dimension, 'Stage', and the refinement of the 'Use' dimension into 'Intensity'. The survey study (Chapter Seven) suggested the refinement of terminology for the 'Attributes', 'Type' and 'Format' dimensions. The visual representation of the information framework and the hierarchy and relation of framework dimensions were also suggested for further refinement and consideration.

The information framework was evaluated based on its capability to assist in the understanding of key aspects of designers' information behaviour through the interview study and two observational studies. The framework was also evaluated by designers and design researchers focusing on its overall value. Key findings suggested the information framework was helpful in investigation, analysis and reflection on designers' information behaviour.

The outcomes of the four studies led to a refined and verified version of the information framework that includes seven key dimensions (i.e., 'purpose', 'source', 'format', 'type', 'attributes', 'stage' and 'intensity') of people information that designers use in a design process. Figure 8.2 shows the refined information framework and its dimensions.

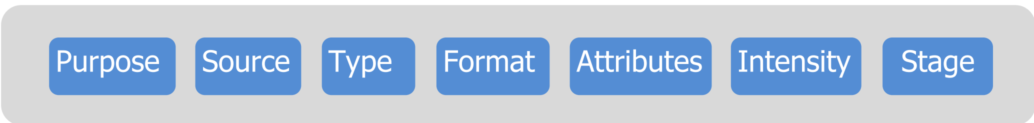


Figure 8.2 Dimensions of the refined Information Framework in design

These seven dimensions are summarised below:

Purpose – Why information is used.

Source – How information is sourced.

Type – What type of information is used.

Format – What representation of information is used.

Attributes – What the qualities of information are.

Stage – When information is used.

Intensity – What range and depth of information is used and how frequently.

8.1.3 Research objective 3:

Detailing the 'Information Framework'

The third research objective was to detail the developed structure in order to provide insights into information behaviour in design as part of a design process. This was achieved through detailing the 'Information Framework' in the four studies. Research triangulation was adopted in carrying out the studies and three distinctive data collection methods (i.e., interview, observation and survey). The framework was detailed based on the stages of the design process. For this purpose, the four stages identified in the Double Diamond model of design process (Design Council, 2005) were adopted. In order to summarise the key sub-dimensions for each information dimension, the key findings from each study (i.e., interview, the Design Bugs Out, the 24-hour Challenge and survey study) in regards to detailing the information framework were collated and reviewed in one table. The table is provided in Appendix E. The key sub-dimensions identified based on this table are presented in Table 8.1.

Key findings regarding the detailing of each information dimension were generally in line across the studies. However, key findings also indicated a degree of variation between observed and reported sub-dimensions and also between the findings from the two observational studies (i.e., the Design Bugs Out and the 24-hour Challenge). This could be due to different capabilities and limitations of data collection and analysis methods adopted for each study, inherent differences in self-reported and observed behaviour, and the different nature of each study resulting in manifestation and thus documentation of different aspects of designers' information behaviour. However, it is argued that this degree of variation in key sub-dimensions, resulting from the four different studies, could help detail the information dimensions in a more inclusive and descriptive manner and would help present a realistic picture of the complexity of information behaviour in design. Table 8.1 presents the key sub-dimensions identified based on the analysis of collated findings from the four studies carried out in this research. In analysing the findings, no weighting was considered for the studies and the most common key sub-dimensions were identified.

Table 8.1 Detailing the information framework - key findings from the four research studies

Dimension	Result	
Purpose	Discover	*Insight, Inspiration, Empathy, Information*
	Define	*Information, Communication, Insight, Inspiration*
	Develop	*Evaluation, Confirmation, Information, Communication*
	Deliver	*Communication, Confirmation, Evaluation*
Source	Discover	*User research, Intuition, Previous experience, Internet*
	Define	*User research, Intuition, Previous stage, Client*
	Develop	*Previous stages, User research, Other projects, Specialists*
	Deliver	*Previous stages, User research, Intuition, Client, Specialist*
Type	Discover	*Experience & context of use, Needs, Problems, Behaviour*
	Define	*Needs, Experience & context of use, Problems, Capabilities*
	Develop	*Capability (physical, sensory, cognitive), Experience & context of use, Needs, Behaviour*
	Deliver	*Needs, Problems, Behaviour, Experience, Emotions*
Format	Discover	*Qualitative, Persona & scenario, Quotes & anecdote, Visual & audio*[43]*, Case studies*
	Define	*Qualitative, Persona & scenario, Quantitative, Visual & audio*
	Develop	*Qualitative, Persona & scenario, Visual & audio, Processed, structured Photographic records*
	Deliver	*Qualitative, Photographic records, Processed, Quantitative, Quotes & anecdotes, Written report*
Attributes	Discover	*Relevance, Validity & reliability, Clarity, Accessibility*
	Define	*Relevance, Validity & reliability, Right level of detail, Importance*
	Develop	*Relevance, Accuracy, Validity & reliability, Accessibility, Importance*
	Deliver	*Relevance, Validity & reliability, Clarity, Right level of detail, Simplicity*
Intensity	Discover	*Depth 4.18* *Range 4.25* *Frequency 5.18* (on a scale of 1 to 7)
	Define	*Depth 5.12* *Range 4.10* *Frequency 5.09* (on a scale of 1 to 7)
	Develop	*Depth 4.97* *Range 3.70* *Frequency 4.65* (on a scale of 1 to 7)
	Deliver	*Depth 3.60* *Range 3.75* *Frequency 4.00* (on a scale of 1 to 7)
Stage	*Discover, Define, Develop, Deliver*	

The key findings regarding 'Intensity' dimension based on the research studies indicated the highest level of diversity. This could primarily be due to the quantitative and numeric nature of the detailing method selected (semantic differential scale) and its level of validity and reliability. This introduced questions in terms of how to calculate the final overall scale for the categories of Intensity dimension. This will be further addressed in Section 8.4.

[43] 'Visual & audio' includes: Info-graphics, Photographic records, Video, Audio-oral

Figure 8.3 presents the line chart based on numeric values for the three categories of Intensity (on a scale of 1 to 7, presented in Table 8.1) and how they fluctuated over the four stages of the design process. Overall, both ‘Frequency’ and ‘Range’ of information gradually decreased throughout the stages of the design process. At the same time, while ‘Depth’ of information increased and remained relatively high in the Define and Develop stages respectively, it declined in the final stage (i.e., Deliver).

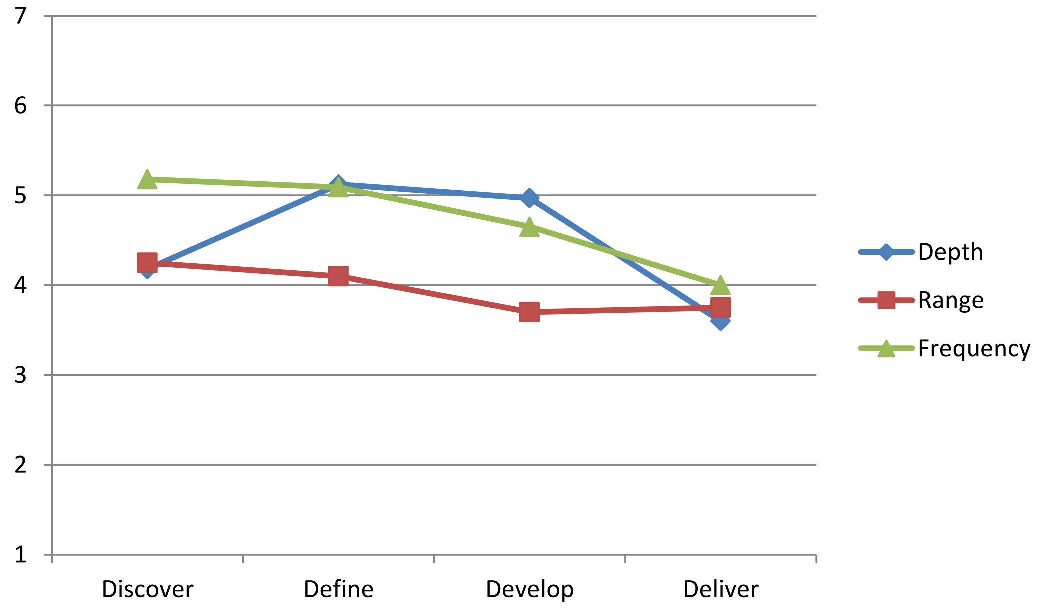


Figure 8.3 Line chart showing fluctuation of the three categories of ‘Intensity’ dimension (i.e., ‘Depth’, ‘Range’ and ‘Frequency’) throughout the design process

8.2 Contributions to knowledge

The research reported in this thesis has made three distinctive contributions to knowledge:

1. The research enhances the knowledge of information behaviour in design through creating a novel information framework which is comprehensive, integrated and systematic.
2. The research enhances understanding of designers' use of people information throughout the design process by detailing the seven dimensions of the proposed information framework.
3. The research facilitates investigation and communication of design information used by or aimed at designers, thus facilitating information design and development of information systems.

The contributions of the research are further summarised in the following subsections.

8.2.1 Creation of a novel information framework for design

Although there had been several narrow and scattered attempts reported in the literature to address design information and its communication and use, there was a lack of a comprehensive, integrated and systematic approach to study of information behaviour in design. This research, for the first time, outlined a comprehensive information framework based on both the integrated knowledge of information behaviour and a series of field studies. No such framework existed prior to this research. Little research was identified that integrated the knowledge of information behaviour in the field of library and information sciences (as the 'nesting' field) in order to create a structure for understanding and investigation of information behaviour in design. Also, no prior research was identified that analysed and synthesised knowledge of information behaviour in two diverse fields together with primary design research studies. The new information framework resulting from this PhD study is original in three aspects:

First, the framework is comprehensive in that it covers all key dimensions of information behaviour rather than focusing on one, or certain, dimensions. The framework brings together the fundamental aspects some of which were previously disjointedly addressed and makes sense of them as a whole.

Secondly, the framework is integrated; the framework is built on the knowledge of information behaviour in the field of library and information sciences. It encompasses both behaviour-oriented and information-oriented aspects while translating both into the language of the latter.

Thirdly, the framework is systematic; it is originated based on analysis and synthesis of knowledge of information behaviour in two diverse fields together with data from empirical studies of various breadth, depth, level of control, scope and generalisability (Chapters Four, Five, Six and Seven).

The manner in which this PhD research has been methodologically conducted could be considered a systematically novel approach adopting and adapting a design problem solving analogy to the design and development of the information framework. In this analogy, thoroughly planned and implemented throughout all stages of the PhD research, the information framework was considered as an end product which needed to go through a design process and an iterative cycle of refinement, detailing and development. This methodological approach proved helpful and effective and could be adopted in conducting future PhD research of similar type.

8.2.2 Detailing practicing designers' people information behaviour

Although the need for, and importance of, people information and its implementation in the design process is increasing, very limited understanding of designers' ways of working with such information is currently available. Furthermore, the knowledge available is not holistic and comprehensive and tends to only focus upon certain aspects of designers' ways of working with people information. This is while people information, as one key type of design information, is constantly growing in volume and diversity. Such limited and partial understanding of people information use, not only creates an unrealistic picture of designers' practice, but also endangers further design and development of people information tools and systems aimed at designers. Therefore enhancing such understanding is of great importance.

This research sheds light on information behaviour of practicing designers throughout four stages of design process in regard to people information. In doing so, the research details the seven dimensions of the original information framework through four complementary empirical studies of various breadth, depth and scope.

The resulting information is novel in that:

A. It addresses all stages of the design process as a whole.

B. It addresses all key aspects of information behaviour rather than focusing upon certain aspects.

C. It is originated from four complementary empirical studies.

8.2.3 Facilitating investigation and communication of design information

This research makes an important contribution to both fields of design research and design practice through leading to a common way to discuss information behaviour in design; the new information framework together with the identified design context could be used by three groups:

A. By researchers, as a research tool to investigate, document and analyse information behaviour in various design applications and contexts.

B. By tool developers and those providing designers with information. Using the information framework, they could make informed decisions on what, how and when to communicate information to designers, ensuring information is delivered in a way which has maximum impact on the design process and thus design practice. Hence, the new information framework could facilitate information design and development of information systems.

C. By designers in order to communicate, elaborate and reflect upon their information behaviour; this would include their information needs, seeking and use. The framework could be used as a structure through which design managers and practitioners communicate their design process with their potential clients, co-workers and various stakeholders and highlight certain aspects of their practice.

A potential benefit may be to see how to feed information into the design process in an optimal way. However, it will require an understanding of whether the ways designers currently work with information is optimal, thus, this could be part of the further work.

8.3 Limitations

This PhD research adopted an exploratory and investigative approach towards further understanding of the information behaviour as an under-explored area in design. The aim was to both provide a structure for investigation and analysis of information behaviour in design, and to shed light on identified aspects of designers' information behaviour throughout a design process.

For this purpose, a number of empirical studies of various breadth, depth, level of control, scope and generalisability were carried out. Each of the studies had certain limitations specific to them, but together helped to enrich the investigations. Some of the limitations of each study were discussed under "Critique of research methods" section in the relevant chapters (Sections 4.5.2, 5.5.3, 6.5.3 and 7.5.2). Those identified limitations were based on the core characteristics of each study and the methods of data collection and analysis adopted.

It is important here to revisit the boundaries of this research and address its overall limitations. This thesis adopted a designer-centric approach to study of information behaviour. What the findings suggest in terms of information sub-dimensions predominantly reflect designers' perspective. Thus, it is worth considering the key issues below:

- Simply because designers stated or demonstrated specific information behaviour does not necessarily mean that such information behaviour is ideal or most suited for delivering good design.

- It was not the aim of this thesis to address the effectiveness with which designers approach and execute design information. This research aimed to understand and report designers' information behaviour.

- It was not the aim of this research to focus on discrepancies between the observed and self-reported information behaviour and to undertake a comparative analysis of these two aspects. However, the findings from all the studies identified and confirmed this as an area with a high potential for further research.

- This thesis had an exploratory approach towards identification of various dimensions to the information framework and then examining ways to record, detail, measure and interpret them. However, certain dimensions such as 'Intensity', proved elusive in their nature and thus more challenging to be detailed, measured and interpreted. Various studies and methods in this research helped identify some of these challenges and highlighted the need for further research on more effective ways to detail, measure and interpret certain dimensions.

- Not all studies contributed equally towards their three-fold aims (i.e., evaluating, refining, and detailing the framework. It could be argued that the first two studies (i.e., the interview and the Design Bugs Out) had more of an exploratory nature in that they helped 'identify' new dimensions and 'refine' the existing ones. The last two studies (i.e., the 24-hour Challenge and the survey) had more of a descriptive nature in that they helped 'evaluate' and 'detail' the information framework. For example, the time-pressured and speedy nature of the 24-hour Challenge study might not have helped to identify new dimensions primarily but did contribute considerably towards evaluating and detailing the framework.

- As Bruce *et al.* (2003) state, most studies of information behaviour (specifically information-seeking) provide generalisations describing the information behaviour of a specific group such as engineers, regardless of their background, level of expertise, etc. Aiming to avoid generalisation, this research specifically focused upon one group of designers (i.e., practicing designers). The research also focused on one type of design information (i.e., people information). However, it could be argued that information behaviour of practicing designers would hypothetically vary depending on factors such as culture, background, gender, etc., and other external factors. Each of these variants could be further investigated in future studies of designer's information behaviour.

8.4 Further work

Having revisited the core focus of this research and its boundaries, a number of areas to be explored based on this thesis are discussed here. Information behaviour is an under-explored area in design. Outlining and detailing the information framework was one initial step towards understanding and modelling designers' information behaviour in a systematic and comprehensive way. This brings forward a number of opportunities for further research to be carried out, a number of which are listed below.

8.4.1 Developing a model of information behaviour in design

This PhD research resulted in the creation and detailing of a framework for studying information behaviour in design. Findings from the survey study in Chapter Seven suggested a number of key refinements to the information framework. These included terminology, visual presentation, and linkage and hierarchy. While a framework identifies the elements that should guide analysis of a phenomenon (Ostrom, 1999), a model is defined as a set of assumptions about underlying processes between the elements which cause that phenomenon (Pitt, 1997). Thus, a model is more complete and complex in its explanation of a phenomenon compared to a framework which focuses on "capturing the variation and dimensionality of a phenomenon with the fewest dimensions" (Miller, 2006, p.6). A model of information behaviour in design could be developed building on the existing information framework; further research into linkage and hierarchy, chronology and visual representation of the information framework, together with integration of the 'Design Context', could result in the development of a model of information behaviour in design. This could be a significant additional contribution and a step forward in the under-explored area of information behaviour in design.

8.4.2 Comparative study of student and experienced designers' information behaviour

This research focused on detailing the information framework based on empirical studies of practicing designers, focusing on people information. However, as Ahmed (2003), Wallace (2004) and Cross (2006) clarified, student designers and experienced designers have different needs, attitudes and criteria when approaching a design task, and thus different information behaviour. Practice of design as a student in the educational context and application of design as a practitioner in the context of industry and business are two clearly distinguishable areas, often studied and compared for various research or business purposes. A comparative study of student and experienced designers' information behaviour adopting the information framework could shed light on similarities and differences between these two groups. This could provide a foundation for any further applications and connections between the two groups. This could be extended to a comparative study of novice and experienced designers. Also, the focus could be upon other types of design information.

8.4.3 Comparative analysis of observed and self-reported information behaviour in design

Adopting research triangulation, this research collected data on both observed and self-reported information behaviour of designers through observational studies alongside interview and survey. Also, within the observational studies, designers were furthermore asked to self-report on their information behaviour to complement the observations. The results from the above confirmed differences between the observed and self-reported information behaviour. While this PhD had an integrative and complementary (rather than comparative) approach towards the observed and self-reported data on information behaviour, a further comparative study could contrast these two aspects. This could further the understanding of similarities and differences between designers' observed and reported information behaviour and thus extend the knowledge of information behaviour in design.

8.4.4 Research on information intensity

'Intensity' is one novel and complex dimension of the information framework. It was first replaced with 'use' dimension in the initial framework and was further detailed and refined through three empirical studies. 'Depth', 'range' and 'frequency' were identified as three constituents of this dimension and semantic differential scale was adopted as the method for measuring and assessing each. As study results showed a high level of variance, further research is suggested to be carried out in terms of scaling methods for each constituent, weighting of each constituent, and also proposing an overall assessment for intensity dimension as a whole. Future research could focus on detailing and further developing this dimension, as one key dimension of the information framework that directly addresses information use.

8.4.5 Cultural differences in designers' information behaviour

This research had a western focus on studying designers' information behaviour in that the sample for interview, observational studies and the survey was largely UK-based (all nine interviewees, 22 out of 24 participants in the two observational studies, and 32 out of 64 survey participants were UK-based). This would give a western orientation to the collected data on designers' people information behaviour. Adopting the information framework from this PhD work, further research could explore and examine the role and significance of cultural differences in designers' information behaviour and how culture would influence designers' information needs, seeking and use.

8.5 Summary

This research has focused on one important but under-explored area in design research and practice: information behaviour in design. Key findings demonstrated a major lack of and the need for a holistic, integrated and systematic understanding of information behaviour in design. Adopting the research triangulation approach, a number of complementary studies were carried out to address three research objectives. The key conclusions regarding the research objectives are as follows:

1. Creation of 'Information Framework' in design and 'Design Context'

The research resulted in creating a comprehensive, integrated and systematic 'Information Framework' in design together with identification of 'Design Context'. These were identified as two complementary structures to facilitate the understanding and analysis of designers' information behaviour. The 'design context' consisted of four key elements. These included: Designer, Team, Client and Brief.

2. Refinement and evaluation of the 'Information Framework'

The initial information framework was refined and evaluated through four complementary studies. The refined and evaluated 'Information Framework' included seven key dimensions:

Purpose – Why information is used.

Source – How information is sourced.

Type – What type of information is used.

Format – What representation of information is used.

Attributes – What the qualities of information are.

Stage – When information is used.

Intensity – What range and depth of information is used and how frequently.

3. Detailing the 'Information Framework'

The research detailed information behaviour of practicing designers throughout the four stages of design process in regard to people information. The seven dimensions of the information framework were detailed through four complementary empirical studies of various breadth, depth and scope. Table 8.1.presents these key sub-dimensions.

To conclude, this research has made three distinctive contributions to the field of design research and practice:

- Creating a novel information framework for design which is comprehensive, integrated and systematic
- Detailing practicing designers' people information behaviour throughout a design process
- Facilitating investigation and communication of design information

Further work will focus on developing an information behaviour model in design, comparative study and analysis of student and experienced designers and observed and self-reported information behaviour. Future research could also address cultural differences and intensity dimension in greater detail.

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Appendix A1

Interview questions - interview with designers

A. Introduction

B. Design Process – General (10-15 minutes)

- To start off with, could you give us a brief introduction of your general design process at….?
- In a typical design process, what Support Tools and Techniques do you use (software, data bases for materials, engineering or modelling and…)?

C. Ergonomics & Anthropometrics – Specific (20-25 minutes)

C.1 Specifications – Current usage

- Let's say you are briefed to design a remote control/ blood sugar test kit. When and how would you look at ergonomics?
- What sort of ergonomics data do you use (anthropometric data, guidelines, straight data)?
- What are your sources (book, text book, actual measurements, software, etc)?
- Does it happen that the client, an ergonomist or another third party provides you the data?
- Do you communicate ergonomics research with clients?
- Do you know about any existing anthropometric data tool?
  If yes, Why don't you use it?
- You didn't mention using any (flexible depending on previous answers) specific anthropometric data source, why don't you use them?
- The reason why:
  A. The data itself
  B. The presentation format
- How happy are you with the existing anthropometric data?
- Do you generally trust the data in the resources?
- Do you think using an anthropometric data tool would be helpful in your design process? How?
- Considering 4D (Define, Design, Develop, Deliver) as a general design process, at which stage do you start looking at ergonomics & anthropometric data?

D. Conclusions – Specific (20-25 minutes)

D.1 Preferences

- What are your preferences in terms of Anthropometric data?
  Source (book, software, etc.)

  Presentation (numbers, charts, bars, diagrams, guidelines, etc.)

  1D, 2D, 3D

- If we could develop an effective tool for you to use in the design process, what feature do you want?
- What are your preferences among these 5 methods of data presentation?

D.2 Suggestions

- Going back to our question about 4D stages, do you think using (looking at) ergonomics data at an earlier (other) stage would be helpful in the whole design process? Could it make a change?
- For inclusive design, what ergonomics data would be helpful?

E. Background information – General (5 minutes)

- Working & educational background?
- How many years of working experience do you have? What disciplines

F. Closure

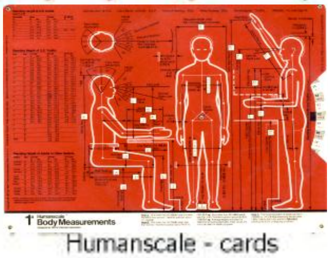
- Thanks a lot for the time / expertise shared
- Can we keep in touch with you regarding the outcomes of this research

Appendix A2

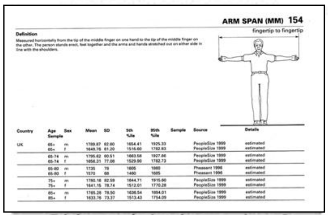
Ranking questionnaire - interview with designers

Visualisation of Anthropometric Data for Inclusive Design

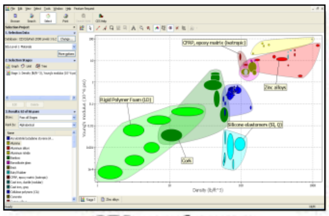
Below are five possible methods of presenting anthropometric data. Which do you find more assistive? Please rank from 1(highest) to 5(lowast) based on your preference.



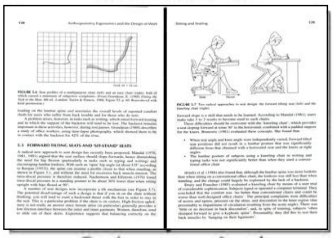
Humanscale - cards ☐



Older adult data - book ☐



CES - software ☐



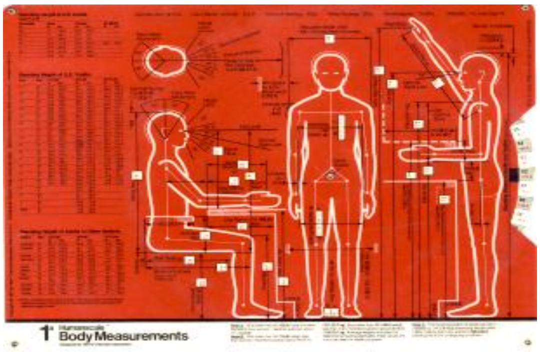
Bodyspace - book ☐

Dined - software ☐

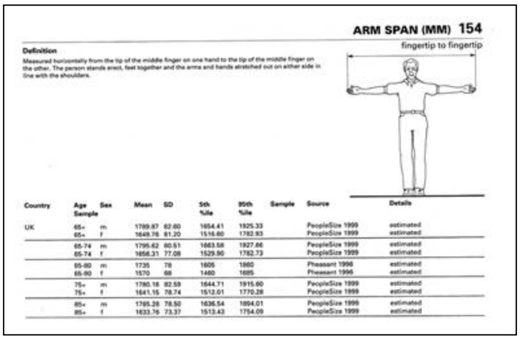
Appendix A3

Information tools presented to designers

Tool 1
Humanscale (cards)



Tool 2
Older Adultdata (handbook)



ARM SPAN (MM) 154

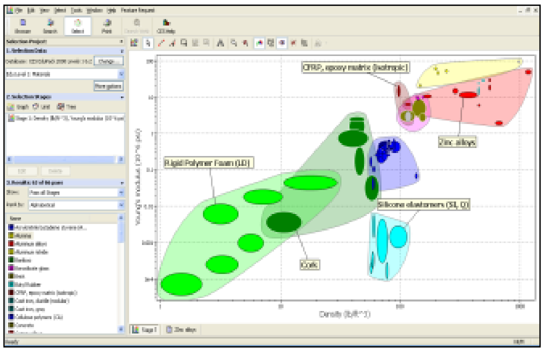
fingertip to fingertip

Definition

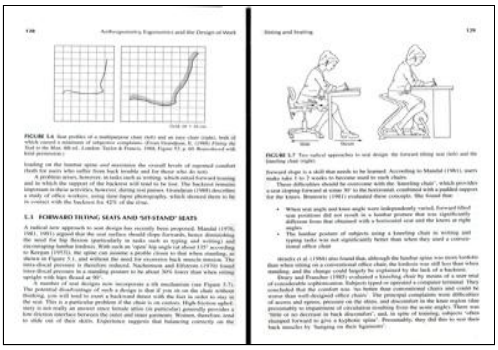
Measured horizontally from the tip of the middle finger on one hand to the tip of the middle finger on the other. The person stands erect, feet together and the arms and hands stretched out on either side in line with the shoulders.

Country	Age Sample	Sex	Mean	SD	5th %ile	95th %ile	Sample	Source	Details
UK	65+	m	1789.87	82.60	1654.41	1925.33		PeopleSize 1999	estimated
	65+	f	1649.76	81.20	1516.60	1782.93		PeopleSize 1999	estimated
	65-74	m	1795.62	80.51	1663.58	1927.66		PeopleSize 1999	estimated
	65-74	f	1656.31	77.08	1529.90	1782.73		PeopleSize 1999	estimated
	65-80	m	1735	78	1605	1860		Pheasant 1996	estimated
	65-80	f	1570	68	1460	1685		Pheasant 1996	estimated
	75+	m	1780.16	82.59	1644.71	1915.60		PeopleSize 1999	estimated
	75+	f	1641.15	78.74	1512.01	1770.28		PeopleSize 1999	estimated
	85+	m	1765.28	78.50	1636.54	1894.01		PeopleSize 1999	estimated
	85+	f	1633.76	73.37	1513.43	1754.09		PeopleSize 1999	estimated

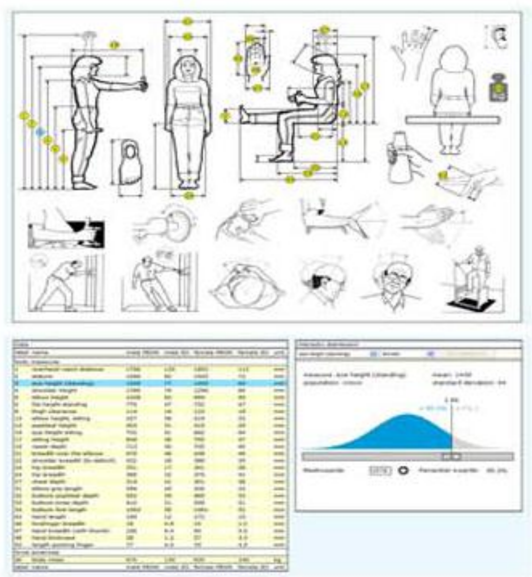
Tool 3
Ergo-CES (software)



Tool 4
Bodyspace (textbook)



Tool 5
Dined (website)



Appendix B1

The Design Bugs Out self-report questionnaire

Design Bugs Out - Lead designers' reflections

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Design Bugs Out - Design Council 2008
Use of ***people information*** in your ***design process***

All completed surveys will receive a hardcover copy of the **MADE IN BRUNEL** book together with an invitation to the **MADE IN BRUNEL** VIP reception at Bargehouse, South Bank in June 2012.
(Please leave your email address at the end of the survey.)

Focus of survey – *People Information*

There were various types of information that you used in your design process for Design Bugs Out project. The following questions all focus on one of these - *people information* (also known as *user information*).

***People information** is defined as all types of information that help designers to better understand people and their context.*

Stages of design process - *Discover*, *Define*, *Develop*, *Deliver*

The following are the four stages of the Design Council design process (2005):

Discover	*Define*	*Develop*	*Deliver*

Discover **Start of the project, exploring initial ideas or inspiration**

Define **Alignment of needs to project objectives, deciding project direction and management**

Develop **Development of design-led solutions, iteration and testing**

Deliver **Finalising the resulting product, presentation and feedback**

Next pages - Answering questions

Please answer the following questions for the *Discover*, *Define*, *Develop* & *Deliver* stages of your *Design Bugs Out* Design process.

All questions focus on *people information* (also known as *user information*).

Note - Please try to answer **all** questions.

Next

In order to avoid repetition, all the questions addressing each of the framework dimensions in the four stages of the design process are provided in pages 320 to 334 in Appendix D1 (the full survey questionnaire).

Design Bugs Out - Lead designers' reflections

Your General Information

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1. Age:

- Under 25
- 25-35
- 36-45
- 46-55
- Above 55

***2. Years of experience:**

- less than 2 years
- 2-3 years
- 3-5 years
- 5-8 years
- 8-10 years
- 10-20 years
- More than 20 years

***3. Role/Position:**
(If more than one applies to you, please choose the position that reflects the majority of your work.)

- Designer
- Design researcher
- Design academic
- Design student
- Design strategist
- Tool developer
- Ergonomist
- Other (please specify)

4. Which project partner were you?

- PearsonLloyds
- Kirton Healthcare

Thank you very much for your *expert insight* & *comments*.
Your participation is hugely appreciated.

Please leave your *email* below, should you wish to receive a complementary copy of the MADE IN BRUNEL book and VIP reception, or if you wish to receive the results of this study.

***5. Would you like to receive the results of this study?**

- Yes
- No

6. Contact details:

Prev   Submit

Appendix B2

Designer A and B responses to self-report questionnaire

Table B.1 Designer A (design consultancy) responses to research questions one to six, for the four stages of the Design Bugs Out project

Research Question	Discover	Define	Develop	Deliver
R.Q.1 **PURPOSE** of information use	Insights & Understanding Confirmation & Support	Inspiration & ideation Communication & discussion	Evaluation & refinement	Communication & discussion
R.Q. 2 **SOURCE** of information used	Client User Research Books, Manuals & handbooks Internet	Own intuition & experience Previous stage Guidelines & standards Other projects	Specialists & experts Specific user data tools	Internet
R.Q. 3 **TYPE** of information used	People problems People needs People behaviour People dimensions (physical)	People problems People needs People behaviour	General statistical information People dimensions (physical)	General statistical information People needs People problems People physical capability People behaviour People emotions & aspirations People socio-economic status, lifestyle & trends
R.Q. 4 **FORMAT** of information used	Raw Numerical & statistical Case studies	Raw Persona & Scenario	Processed (edited, structured or analysed) Photographic records Case studies	Infographics; graphs, maps, diagrams Photographic records Case studies

R.Q. 5 **ATTRIBUTES** of information used	Ease & speed of use Intuitiveness Visual representation Clarity Accessibly Validity & reliability	Accuracy	Accuracy Validity & reliability Up-to-datedness	Clarity Validity & reliability Visual representation Intuitiveness
R.Q. 6 **INTENSITY** of information use	Range 5 Depth 2 Frequency 4	Range 3 Depth 4 Frequency 3	Range 3 Depth 5 Frequency 3	Range 5 Depth 3 Frequency 5

Table B.2 Designer B (manufacturer company) responses to research questions one to six, for the four stages of the Design Bugs Out project

Research Question	Discover	Define	Develop	Deliver
R.Q.1 **PURPOSE** of information use	Inspiration & ideation Empathy Insights & understanding	Inspiration & ideation Empathy Insights & understanding Information & specification Evaluation & refinement Confirmation & support Communication & discussion	Inspiration & ideation Empathy Insights & understanding Information & specification Evaluation & refinement Confirmation & support Communication & discussion	Evaluation & refinement Confirmation & support

R.Q. 2 **SOURCE** of information used	Own intuition & experience Client Specialists & experts Colleagues & friends, etc. Books, Manuals & handbooks Internet Other projects Journals	Own intuition & experience Client Specialists & experts Colleagues & friends, etc. Books, manuals & handbooks Internet Other projects Journals Previous stage Guidelines & standards User research	Own intuition & experience Client Specialists & experts Colleagues & friends, etc. Books, manuals & handbooks Other projects Previous stages Guidelines & standards	User research Client Specialists & experts Colleagues & friends, etc
R.Q. 3 **TYPE** of information used	Personal-specific information on individuals People needs People problems People physical capability People behaviour People emotions & aspirations	Personal-specific information on individuals People needs People problems People physical capability People behaviour People emotions & aspirations General statistical information People experience People diversity People dimensions People cognitive capability People sensory capability	Personal-specific information on individuals People needs People problems People physical capability People behaviour General statistical information People dimensions People cognitive capability People sensory capability	Personal-specific information on individuals People needs People problems People physical capability People behaviour People emotions & aspirations General statistical information People experience People diversity People dimensions People cognitive capability People sensory capability

R.Q. 4 **FORMAT** of information used	Processed Qualitative Quotes and anecdotes Infographics Persona & scenario Photographic records Video	Processed Qualitative Quotes and anecdotes Infographics Persona & scenario Quantitative Transcripts Database & data tables Numeric & statistical Case studies	Qualitative Quantitative Quotes and anecdotes Database & data tables Numeric & statistical	Processed Qualitative Quotes and anecdotes Quantitative Persona & scenario Numeric & statistical Written report
R.Q. 5 **ATTRIBUTES** of information used	Relevance Ease & speed of use Intuitiveness Simplified into nuggets of information Simplicity Clarity	Relevance Ease & speed of use Intuitiveness Simplicity Accuracy Importance Validity & reliability Up-to-datedness Right level of detail Open-endedness	Relevance Ease & speed of use Intuitiveness Completeness Accuracy Validity & reliability Up-to-datedness Right level of detail Ease & speed of access & search Clarity Accessibility of information	Relevance Ease & speed of use Intuitiveness Simplicity Accuracy Validity & reliability Up-to-datedness Right level of detail Clarity Accessibility of information Clarity
R.Q. 6 **INTENSITY** of information use	Range 2 Depth 1 Frequency 5	Range 7 Depth 7 Frequency 7	Range 3 Depth 4 Frequency 5	Range 6 Depth 2 Frequency 7

Appendix B3

List of studies conducted to capture people information in the Design Bugs Out

Table B.3 List of studies conducted to capture people information in the Design Bugs Out

Month	Study and brief description
1	**Visit to local hospitals** Three hospital wards with different patient groups were visited. Nurses were shadowed, audio-recorded interviews were made on wards, pictures were taken of the environment and the specific items discussed. Video footage was also taken of the cleaning process typically carried out on commodes.
1	**Product and process analysis** Focus of the analysis was mainly on commode as design team had extensive previous experience in chair design. Benchmarking was carried out on existing products, detailing costs and features. Purchasing habits within hospitals were investigated. Most popular current commode in use was identified and purchased for further interrogation, treated as the datum product for comparison and analysis.
1	**Stakeholder interview (patients, carers, cleaners and nurses)** Five patients from different age groups and with experience in various hospital wards, three nurses, one cleaner and two carers were interviewed. Ten interviews altogether were conducted and video recorded. Interviews were based around 50 questions (10 general questions, 20 on bedside chairs, 20 on commodes).
1	**Expert Consultation** A meeting was arranged (by client) with an expert panel which consisted of 10 experts in related fields, such as nursing officers, infection specialists, and policy implementers. A set of questions informed by initial research were discussed with the expert panel and issues around the topics of concerns for the project were explored. New routes to 'expert' user groups (such as online forums and social networks) from which information could be gathered were also explored.
1	**Exploratory workshop with designers and manufacturers** An exploratory workshop was held by the research partner to discuss the key issues of concern.

2	**Detailed questionnaire to nurses** A detailed questionnaire (with 26 questions) was completed by six staff nurses from three different hospitals based on the identified issues. This helped to obtain more in-depth opinions and insights into the use of commodes and to compare the consistency of approaches and procedures.
2	**Work-in-progress workshop with patients and nurses** A workshop was organised with various stakeholders including two nurses, two recent patients and an occupational therapist. Designers from the consultancy and manufacturer attended the workshops. Group discussions were held afterwards followed by interaction with the bedside furniture through role-play. The full routine of commode use was demonstrated by a nurse using team members as ‘patients’.
3	**Mock up testing and Prototyping** Mock ups of both products were made and tested by various members of the design team. Issues arising were discussed and alterations were made to the mock-ups.

Appendix B4

Observed information dimensions in the Design Bugs Out study

Table B.4 OBSERVED 'Purpose' of people information use in the Design Bugs Out project (detailed stages and activities)

Stage & activities	PURPOSE of people information use/investigation
Hospital visits	Understand user problems Structure the design problem Understand differences between various stakeholders Understand users' viewpoint Insights into users' routines, issues, values Understand user and product interaction Identify key areas of focus
Product & process analysis	Testing with actual products Understanding the context of use Understanding user-product interaction and use scenarios
Stakeholder interview	Enhance understanding of user problems Detail understanding of various users Looking for specific information
Exploratory workshop	Inspire new ideas Inform design solutions Challenge existing thinking Support ideation Detail and expand existing ideas
Project development	Inform the design process Develop the user requirements specification
Brief development	Represent users' requirements into the brief Detail the brief Enhance the brief Re-define the brief
Design Phase I	Detail the design concept
Detailed questionnaire	Address specific details regarding the design Get feedback on design directions and ideas
Schematic modelling	Inform the understanding and details of the process
Feasibility phase I	-
Presentation	Support argumentation Complement design decision Communicate the progress Create a shared vision between parties Facilitate discussions between designers and the panel
Expert Consultation	Raise further detailed questions / feed into enquiry Gain insight and understanding into bigger picture Understand the user context
Design development I	Detail design Physical details, measurements
Work-in-progress workshop	Gain empathy with various users Test out ideas Get feedback on ideas
Mock up testing	Get feedback Test and trial the concept

Feedback phase	Evaluate the design concept Refine the design concept
Design development II	Confirm/decide final details of the product – mainly physical
CAD data (prototype)	-
Cost analysis	-
Presentation work	Support the final design Communicate the final design and its specifications Acknowledge the design decisions Create context, understanding and empathy for the audience
Prototype production	-

Table B.5 OBSERVED 'Purpose' of people information use in the Design Bugs Out project (four stages of the design process)

Stage	PURPOSE of people information use/investigation	Frequency
DISCOVER	Understand users (problems, viewpoint, diversity) and their product interaction	8
	Inspire new ideas and support ideation	6
	Develop specifications and detail the understanding	4
	Challenge existing thinking	1
	Testing with actual products	1
DEFINE	Re-define, detail and enhance the brief	5
	Detail the design concept and address specific aspects	4
	Communicate the progress and facilitate discussions	3
	Gain insight and understanding into bigger picture and context	2
	Support argumentation and complement design decision	2
	Get feedback on design directions and ideas	1
DEVELOP	Detail design	3
	Get feedback	2
	Evaluate and refine the design concept	2
	Test and trial the concepts	2
	Gain empathy with various users	1
DELIVER	Communicate the final design & create empathy for the audience	2
	Support the final design and acknowledge the design decisions	2

Table B.6 OBSERVED 'Source' of people information used in the Design Bugs Out project (detailed stages and activities)

Stage & activities	SOURCES of people information
Hospital visits	Observation of users Interview with users
Product & process analysis	Designers' prior knowledge and experience from other projects Designers' own use of existing products (self-observation) Information gathered from other projects Internet Online forums Client's provided information Literature review
Stakeholder interview	Interview with users
Exploratory workshop	Experts Other colleagues Internet search
Project development	Information from previous stages/activities Designers' own intuition and experience Literature and book search
Brief development	Information from previous stages/activities
Design Phase I	Information from previous stages/activities Information from previous relevant projects Designers' own intuition and experience
Presentation	Information from previous stages/activities
Expert Consultation	Experts
Detailed questionnaire	Questionnaire with users
Schematic modelling	-
Feasibility phase I	Information from previous stages/activities Designers' prior knowledge and experience from other projects
Work-in-progress workshop	Discussion with users User focus group Role-play / Shadowing users User feedback
Design development	Information from previous stages/activities Designers' prior knowledge and experience from other projects
Mock up testing	-
Feedback phase	Designers' own testing the product Colleagues and friends' feedback
Design development II	Ergonomics & anthropometrics handbooks Existing products
CAD data (prototype)	-
Cost analysis	-
Presentation work	Information from previous stages/activities Designers' prior knowledge and experience from other projects Designers' own intuition and experience
Prototype production	-

Table B.7 OBSERVED 'Source' of people information used in the Design Bugs Out project (four stages of the design process)

Stage	SOURCES of people information	Frequency
DISCOVER	User engagement (observation and interviews)	3
	Internet search	3
	Designers' prior knowledge and experience from other projects	2
	Literature review and book search	2
	Experts and other colleagues	1
	Client's provided information	1
	Designers' own intuition and experience	1
	Designers' testing of existing products	1
DEFINE	User engagement (focus group, questionnaire, shadowing)	5
	Information from previous stages/activities	3
	Experts	1
	Designers' own intuition and experience	1
DEVELOP	Information from previous stages/activities	2
	Designers' prior knowledge and experience from other projects	2
	Designers' own testing the mock-up	1
	Designers' own feedback of the mock-up	1
	Ergonomics & anthropometrics handbooks	1
DELIVER	Information from previous stages/activities	2
	Designers' own intuition and experience	1
	Designers' prior knowledge and experience from other projects	1

Table B.8 OBSERVED 'Type' of people information used in the Design Bugs Out project (detailed stages and activities)

Stage & activities	TYPES of people information used/investigated
Hospital visits	Diversity of users (stakeholders) User problems User needs User experiences User behaviour Context of use User-product interactions
Product & process analysis	User-product interactions User problems User journey Statistical information on user problems, user diversity and user needs
Stakeholder interview	User stories & scenarios of use User experiences User needs User problems User emotions and aspirations Personal information on individual users Statistical information on user-product interaction
Exploratory workshop	User-product interaction User problems User needs User experiences

	Statistical information on user-product interaction
Project development	User needs User problems User-product interaction User physical capabilities
Brief development	User needs User problems Statistical information on user-product interaction
Design Phase I	User dimensions User needs User problems User experiences
Presentation	User scenarios User needs Statistical and quantitative information on user-product interaction
Expert Consultation	User needs User-product interaction User physical and cognitive capability
Detailed questionnaire	Quantitative information on user-product interaction Statistical general information on users User scenarios User problems
Schematic modelling	User-product interaction
Feasibility phase I	-
Work-in-progress workshop	Diversity of users (stakeholders) User-product interaction details – qualitative and quantitative User scenarios User problems User needs User experiences Context of use
Design development	User capability – physical User dimensions
Mock up testing	-
Feedback phase	User-product interaction User problems User experience
Design development II	User physical measures User physical capabilities
CAD data (prototype)	-
Cost analysis	-
Presentation work	User needs User scenarios Statistical and numeric information on user-product interaction
Prototype production	-

Table B.9 OBSERVED 'Type' of people information used in the Design Bugs Out project (four stages of the design process)

Stage	TYPES of people information	Frequency
DISCOVER	User problems	5
	User needs	5
	User-product interaction	4
	User experiences & context of use	4
	Statistical information on user-product interaction	3
	User journey & scenarios of use	2
	User behaviour	1
	Personal information on individual users	1
	User emotions and aspirations	1
	User physical capabilities	1
DEFINE	User-product interaction – detailed (quantitative & qualitative)	6
	User needs (detailed)	5
	User problems (detailed)	4
	User experiences & context of use	3
	User scenarios	3
	User physical and cognitive capability & measurements	2
	Diversity of users (stakeholders)	1
	Statistical general information on users	1
DEVELOP	User physical capability & measurements	4
	User-product interaction	1
	User problems	1
	User experience	1
DELIVER	User needs	1
	User scenarios	1
	Statistical and numeric information on user-product interaction	1

Table B.10 OBSERVED 'Format' of people information used in the Design Bugs Out project (detailed stages and activities)

Stage & activities	FORMATS of people information used
Hospital visits	Raw information –not edited or analysed Unstructured information Quantitative information Quotes and anecdotes Written brief report with key findings and observations Video – highlight videos of user-product interaction Photographs of users, their environment and their product
Product & process analysis	Information interpreted and simplified into nuggets Scenarios Diagrams of user journey Images and photographs Textual information
Stakeholder interview	Audio visual recording Quotes and anecdotes Textual information - notes and key issues raised
Exploratory workshop	Personas Scenarios Journey maps Photographs Quotes and anecdotes

	Numerical and statistical information
Project development	Photographs and videos Scenarios Journey maps Diagrams of user needs Numerical and statistical information
Brief development	Scenarios Journey maps Diagrams of user needs Numerical and statistical information
Design Phase I	Written reports and records - previous projects Photographic records Numeric information - data-tables on measurements
Detailed questionnaire	Numeric and statistical information Textual information Quantitative information
Schematic modelling	Scenarios Journey maps
Feasibility phase I	-
Presentation	Basic diagrams and schematic tables Photographic records Journey maps
Expert Consultation	Audio – oral
Design development I	Scenarios Journey maps Measurements tables and diagrams
Work-in-progress workshop	Personas Oral Gestural Raw information Unstructured information Quantitative information Photographs Written report – key issues and highlight notes
Mock up testing	-
Feedback phase	Oral Gestural
Design development II	-
CAD data (prototype)	-
Cost analysis	-
Presentation work	Quotes Basic diagrams and schematic tables Photographic records Journey maps
Prototype production	-

Table B.11 OBSERVED ‘Format’ of people information used in the Design Bugs Out project (four stages of the design process)

Stage	FORMATS of people information	Frequency
DISCOVER	Infographics - diagrams and visual maps (user journey)	4
	Qualitative	4
	Video highlights	4
	Scenarios	3
	Quotes and anecdotes	3
	Photographic records	3
	Textual information (key points and summaries)	3
	Quantitative	2
	Raw information unstructured information	1
	Interpreted and formatted information (simplified into nuggets)	1
	Numerical and statistical information	1
	Personas	
DEFINE	Infographics (journey map, user needs)	5
	Numeric and statistical information	4
	Scenarios	2
	Photographic records	2
	Textual information (written report, summarised)	2
	Quantitative information	1
	Audio – oral	1
DEVELOP	Infographics	2
	Raw information Unstructured information	2
	Quantitative information	1
	Measurements tables	1
	Photographs	1
	Scenarios	1
	Textual information (written report, summarised)	1
	Oral & Gestural	1
DELIVER	Quotes	1
	Photographic records	1
	Journey maps	1
	Basic diagrams and schematic tables	1

Table B.12 OBSERVED 'Attributes' of people information used in the Design Bugs Out project (detailed stages and activities)

Stage & activities	ATTRIBUTES of people information used
Hospital visits	Value Openness – showing the raw data Open-endedness - open to interpretation Richness - unstructured Visual representation Simplified into nuggets of information Redundancy - multiple ways of presenting information Freedom of interpretation Anecdotal
Product & process analysis	Visual richness Mixed media Right level of detail
Stakeholder interview	Accessibility Openness – showing the raw data Open-endedness – open to interpretation Richness – unstructured Anecdotal
Exploratory workshop	Familiarity Value Visual richness Right level of detail Clarity Relevance
Project development	Accessibility Right level of detail Value Clarity Ease of access Reliability Validity Accuracy
Brief development	Accuracy Importance Right level of detail
Design Phase I	Accessibility Validity Usefulness Ease and speed of search and use
Detailed questionnaire	Right level of detail Reliability
Schematic modelling	Richness
Feasibility phase I	-
Presentation	Visual presentation Right level of detail Validity and reliability Accuracy Value
Expert Consultation	Relevance Level of detail Ease of retrieval
Design development I	Right level of detail Relevance Ease of search and access

Work-in-progress workshop	Value Richness -raw information Openness Open-endedness Mixed media Right level of detail Quantitative and qualitative
Mock up testing	-
Feedback phase	Anecdotal Objective versus subjective
Design development II	Availability Accessibility Right level of detail
CAD data (prototype)	-
Cost analysis	-
Presentation work	Value Relevance Importance Visual presentation Right level of detail Validity and reliability Accuracy Personification
Prototype production	-

Table B.13 OBSERVED 'Intensity' of people information use in the Design Bugs Out project (detailed stages and activities)

Stage & activities	INTENSITY of people information use	
Hospital visits	Range Depth Frequency	4 3 6
Product & process analysis	Range Depth Frequency	3 3 4
Stakeholder interview	Range Depth Frequency	4 5 6
Exploratory workshop	Range Depth Frequency	4 4 5
Project development	Range Depth Frequency	4 4 3
Brief development	Range Depth Frequency	5 4 3
Design Phase I	Range Depth Frequency	3 5 3
Detailed questionnaire	Range Depth Frequency	5 6 6
Schematic modelling	Range Depth Frequency	3 3 2

Feasibility phase I	Range Depth Frequency	3 4 3
Presentation	Range Depth Frequency	5 4 5
Expert Consultation	Range Depth Frequency	4 5 5
Design development I	Range Depth Frequency	4 4 3
Work-in-progress workshop	Range Depth Frequency	6 5 6
Mock up testing	Range Depth Frequency	3 6 5
Feedback phase	Range Depth Frequency	3 5 4
Design development II	Range Depth Frequency	2 6 3
CAD data (prototype)	Range Depth Frequency	2 6 2
Cost analysis	Range Depth Frequency	- - -
Presentation work	Range Depth Frequency	5 3 5
Prototype production	Range Depth Frequency	- - -

Table B.14 OBSERVED 'Intensity' of people information use in the Design Bugs Out project (four stages of the design process)

Stage	INTENSITY of people information use	Calculated	Observed
DISCOVER	Range Depth Frequency	3.8 3.8 4.8	4 3 5
DEFINE	Range Depth Frequency	4 4.4 3.8	5 6 4
DEVELOP	Range Depth Frequency	3.6 5.2 4.2	3 6 3
DELIVER	Range Depth Frequency	1.8 2.3 1.8	3 3 2

Appendix C1

The 24-hour Challenge self-report questionnaire

24-hour Inclusive Design Challenge 2011

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24-hour Inclusive Design Challenge 2011
Use of *people information* in your *team's design process*

All completed surveys will receive a hardcover copy of the **MADE IN BRUNEL** book together with an invitation to the **MADE IN BRUNEL** VIP reception at Bargehouse, South Bank in June 2012.
(Please leave your email address at the end of the survey.)

Focus of survey – *People Information*

There were various types of information that you used in your design process for 24-hour Challenge. The following questions all focus on one of these - *people information* (also known as *user information*).

***People information* is defined as all types of information that help designers to better understand people and their context.**

1. Do you think that this definition of people information is appropriate? Please identify any problems with, or additions to, this definition.

- Yes
- Maybe
- No

Please identify any problems or additions, here:

Stages of design process - *Discover, Define, Develop, Deliver*

The following are the four stages of the Design Council design process (2005):

Discover	*Define*	*Develop*	*Deliver*

Discover	**Start of the project, exploring initial ideas or inspiration**
Define	**Alignment of needs to project objectives, deciding project direction and management**
Develop	**Development of design-led solutions, iteration and testing**
Deliver	**Finalising the resulting product, presentation and feedback**

Next pages - *Answering questions*

Please answer the following questions for the ***Discover***, ***Define***, ***Develop*** and ***Deliver*** stages of your 24-hour Challenge design process.

All following questions focus on *people information* (also known as *user information*).

Note - Please try to answer to **ALL** questions.

Next

In order to avoid repetition, the 24-hour Challenge questionnaire questions addressing each of the framework dimensions in the four stages of the design process are provided in pages 320 to 334 in Appendix D1 (the full survey questionnaire).

24-hour Inclusive Design Challenge 2011

Your General Information

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1. Age:

- Under 25
- 25-35
- 36-45
- 46-55
- Above 55

***2. Role/Position:**
(If more than one applies to you, please choose the position that reflects the majority of your work.)

- Designer
- Design researcher
- Design academic
- Design student
- Design strategist
- Tool developer
- Ergonomist
- Other (please specify)

***3. Design discipline:**

- Industrial design
- Product design
- Engineering design
- Service design
- Graphic design
- Fashion design
- Textile design
- Design strategy
- Other (please specify)

***4. Years of experience:**

- less than 2 years
- 2-3 years
- 3-5 years
- 5-8 years
- 8-10 years
- 10-20 years
- More than 20 years

***5. Industry/Sector:**

- Design consultancy
- Design company
- Freelance
- Research institute
- Higher education
- Other (please specify)

***6. Which team were you?**

- Team All Sorts
- Team The Collective
- Team Umbrella

Thank you very much for your *expert insight* & *comments*.
Your participation is hugely appreciated.

Please leave your *email* below, should you wish to receive a complementary copy of the MADE IN BRUNEL book and VIP reception, or if you wish to receive the results of this study.

***7. Would you like to receive the results of this study?**

- Yes
- No

8. Contact details:

Prev Submit

Appendix C2

Teams A, B and C information dimensions in the 24-hour Challenge

Table C.1 Team A - Purpose of people information use in the 24-h Challenge project

Stage	PURPOSE of people information use/investigation	Frequency
DISCOVER	Insights & Understanding	3
	Empathy	2
	Inspiration & Ideation	3
	Information & Specification	3
	Communication & Discussion	2
	Confirmation & Support	1
	Evaluation & Refinement	1
DEFINE	Inspiration & Ideation	3
	Insights & Understanding	3
	Communication & Discussion	2
	Information & Specification	3
	Empathy	2
	Confirmation & Support	2
	Evaluation & refinement	0
DEVELOP	Evaluation & refinement	3
	Confirmation & Support	2
	Information & Specification	1
	Communication & Discussion	2
	Empathy	0
	Insights & Understanding	0
	Inspiration & Ideation	1
DELIVER	Confirmation & Support	3
	Communication & Discussion	3
	Evaluation & refinement	2
	Empathy	0
	Insights & Understanding	1
	Information & Specification	0
	Inspiration & Ideation	0

Table C.2 Team B –Purpose of people information use in the 24-h Challenge project

Stage	PURPOSE of people information use/investigation	Frequency
DISCOVER	Insights & Understanding	4
	Empathy	2
	Inspiration & Ideation	4
	Information & Specification	1
	Communication & Discussion	1
	Confirmation & Support	1
	Evaluation & Refinement	1
DEFINE	Inspiration & Ideation	4
	Insights & Understanding	3
	Communication & Discussion	2
	Information & Specification	1
	Empathy	1
	Confirmation & Support	1
	Evaluation & refinement	3
DEVELOP	Evaluation & refinement	4
	Confirmation & Support	1
	Information & Specification	2
	Communication & Discussion	2
	Empathy	1
	Insights & Understanding	3
	Inspiration & Ideation	3
DELIVER	Confirmation & Support	2
	Communication & Discussion	3
	Evaluation & refinement	4
	Empathy	1
	Insights & Understanding	3
	Information & Specification	2
	Inspiration & Ideation	2

Table C.3 Team C –Purpose of people information use in the 24-h Challenge project

Stage	PURPOSE of people information use/investigation	Frequency
DISCOVER	Insights & Understanding	3
	Empathy	3
	Inspiration & Ideation	3
	Information & Specification	2
	Communication & Discussion	1
	Confirmation & Support	1
	Evaluation & Refinement	0
DEFINE	Inspiration & Ideation	1
	Insights & Understanding	2
	Communication & Discussion	2
	Information & Specification	2
	Empathy	1
	Confirmation & Support	2
	Evaluation & refinement	2
DEVELOP	Evaluation & refinement	2
	Confirmation & Support	2
	Information & Specification	1
	Communication & Discussion	0
	Empathy	0
	Insights & Understanding	1
	Inspiration & Ideation	1
DELIVER	Confirmation & Support	3
	Communication & Discussion	1
	Evaluation & refinement	1
	Empathy	0
	Insights & Understanding	2
	Information & Specification	0
	Inspiration & Ideation	0

Table C.4 Team A - Source of people information used in the 24-h Challenge project

Stage	SOURCE of people information used	Frequency
DISCOVER	Own intuition, experience, common sense	3
	User research (observation, testing, focus group)	3
	Other projects - information gathered from other projects	1
	Client	1
	Co-design	1
	immersion	1
DEFINE	Own intuition, experience, common sense	3
	User research (observation, testing, focus group)	3
	Previous stage - information gathered from previous stage of the design process	2
	Colleagues, friends, etc.	1
	Other projects - information gathered from other projects	1
	Client	1
DEVELOP	Own intuition, experience, common sense	3
	Colleagues, friends, etc.	3
	Previous stages - information gathered from previous stages of the design process	3
	User research (observation, testing, focus group)	2
	Internet - search engines such as Google™	1
	Other projects - information gathered from other projects	1
	Client	1
	Direct observation / discussion	1
DELIVER	Previous stages - information gathered from previous stages of the design process	3
	Own intuition, experience, common sense	2
	Colleagues, friends, etc.	1

Table C.5 Team B - Source of people information used in the 24-h Challenge project

Stage	SOURCE of people information used	Frequency
DISCOVER	Own intuition, experience, common sense	2
	User research (observation, testing, focus group)	3
	Other projects - information gathered from other projects	2
	Client	1
	Co-design	1
	immersion	1
DEFINE	Own intuition, experience, common sense	3
	User research (observation, testing, focus group)	4
	Previous stage - information gathered from previous stage of the design process	2
	Colleagues, friends, etc.	1
	Other projects - information gathered from other projects	1
	Client	2
DEVELOP	Own intuition, experience, common sense	2
	Colleagues, friends, etc.	2
	Previous stages - information gathered from previous stages of the design process	2
	User research (observation, testing, focus group)	3
	Internet - search engines such as Google™	1
	Other projects - information gathered from other projects	1
	Client	1
	Direct observation / discussion	1
DELIVER	Previous stages - information gathered from previous stages of the design process	2
	Own intuition, experience, common sense	3
	Colleagues, friends, etc.	1

Table C.6 Team C - Source of people information used in the 24-h Challenge project

Stage	SOURCE of people information used	Frequency
DISCOVER	Own intuition, experience, common sense	2
	User research (observation, testing, focus group)	2
	Client	2
	Specialists & experts in the field	1
	Journals	1
DEFINE	Client	2
	Previous stage - information gathered from previous stage of the design process	2
	User research (observation, testing, focus group)	1
	Specialists & experts in the field	1
	Own intuition, experience, common sense	1
DEVELOP	Own intuition, experience, common sense	1
	Client	1
	Previous stages - information gathered from previous stages of the design process	1
	User research (observation, testing, focus group)	1
	NO USE OF PEOPLE INFORMATION AT THIS STAGE	---
DELIVER	Previous stages - information gathered from previous stages of the design process	2
	Client	2
	Colleagues, friends, etc.	1

Table C.7 Team A - Type of people information used in the 24-h Challenge project

Stage	TYPE of people information used	Frequency
DISCOVER	People needs	3
	People problems (problems facing the potential user)	3
	People emotions, aspirations & personality	3
	Personal - Specific information on individuals	2
	People experience & context of use	2
	People diversity	2
	People dimensions (physical)	2
	People capability – physical	2
	People capability – sensory	2
	People behaviour	2
	People socio-economic status, lifestyle & trends	2
	People capability – cognitive	1
DEFINE	People experience & context of use	3
	People problems (problems facing the potential user)	3
	People capability – physical	3
	People behaviour	2
	People needs	2
	People emotions, aspirations & personality	1
	People capability – sensory	1
	People capability – cognitive	1
	Personal - Specific information on individuals	1
	People diversity	1
	People dimensions (physical)	1
DEVELOP	People experience & context of use	2
	People needs	2
	People capability – physical	2
	People emotions, aspirations & personality	2
	Personal - Specific information on individuals	1
	People socio-economic status, lifestyle & trends	1
	People behaviour	1
	People diversity	1
	People dimensions (physical)	1
DELIVER	People diversity	2
	People socio-economic status, lifestyle & trends	2
	People emotions, aspirations & personality	2
	People experience & context of use	1
	People needs	1
	People capability – physical	1
	People behaviour	1

Table C.8 Team B - Type of people information used in the 24-h Challenge project

Stage	TYPE of people information used	Frequency
DISCOVER	People needs	3
	People problems (problems facing the potential user)	2
	People emotions, aspirations & personality	2
	People experience & context of use	2
	Personal - Specific information on individuals	2
	People dimensions (physical)	2
	People capability – physical	2
	People capability – sensory	1
	People behaviour	1
	People diversity	1
	People socio-economic status, lifestyle & trends	1
	People capability – cognitive	1
DEFINE	People needs	3
	People problems (problems facing the potential user)	3
	People emotions, aspirations & personality	3
	People experience & context of use	2
	Personal - Specific information on individuals	1
	People capability – physical	1
	People capability – sensory	1
	People behaviour	1
	People socio-economic status, lifestyle & trends	1
	People dimensions (physical)	1
	People diversity	1
	People capability – cognitive	1
DEVELOP	People experience & context of use	3
	Personal - Specific information on individuals	2
	People emotions, aspirations & personality	2
	People diversity	2
	People dimensions (physical)	2
	People socio-economic status, lifestyle & trends	2
	People behaviour	2
	People needs	1
	People capability – physical	1
	People capability – sensory	1
	People capability – cognitive	1
	People problems (problems facing the potential user)	1
	NO USE OF PEOPLE INFORMATION AT THIS STAGE	0
DELIVER	People experience & context of use	2
	Personal - Specific information on individuals	2
	People capability – sensory	2
	People emotions, aspirations & personality	2
	People needs	2
	People capability – physical	2
	People capability – sensory	1
	People capability – cognitive	1
	People diversity	1
	People socio-economic status, lifestyle & trends	1
	People emotions, aspirations & personality	1
	General - Statistical general information on people	1
	People behaviour	1

Table C.9 Team C - Type of people information used in the 24-h Challenge project

Stage	TYPE of people information used	Frequency
DISCOVER	People needs	3
	People problems (problems facing the potential user)	3
	People emotions, aspirations & personality	3
	People experience & context of use	2
	Personal - Specific information on individuals	2
	People dimensions (physical)	2
	People capability – physical	2
	People capability – sensory	2
	People behaviour	2
	People diversity	1
	People socio-economic status, lifestyle & trends	1
	People capability – cognitive	1
DEFINE	People needs	2
	People problems (problems facing the potential user)	2
	People emotions, aspirations & personality	2
	People experience & context of use	2
	Personal - Specific information on individuals	2
	People capability – physical	2
	People capability – sensory	2
	People behaviour	1
	People socio-economic status, lifestyle & trends	1
	People dimensions (physical)	1
	People diversity	1
	People capability – cognitive	1
DEVELOP	People experience & context of use	2
	Personal - Specific information on individuals	2
	People emotions, aspirations & personality	2
	People diversity	1
	People dimensions (physical)	1
	People socio-economic status, lifestyle & trends	1
	People behaviour	1
	People needs	1
	People capability – physical	1
	People capability – sensory	1
	People capability – cognitive	1
	People problems (problems facing the potential user)	1
	NO USE OF PEOPLE INFORMATION AT THIS STAGE	--
DELIVER	People experience & context of use	3
	Personal - Specific information on individuals	3
	People capability – sensory	2
	People emotions, aspirations & personality	2
	People needs	2
	People capability – physical	1
	People capability – sensory	1
	People capability – cognitive	1
	People diversity	1
	People socio-economic status, lifestyle & trends	1
	People emotions, aspirations & personality	1
	General - Statistical general information on people	1
	People behaviour	1

Table C.10 Team A - Format of people information used in the 24-h Challenge project

Stage	FORMAT of people information used	Frequency
DISCOVER	Photographic records	3
	Raw (not edited, structured or analysed)	2
	Quotes & Anecdotes	2
	video	2
	Audio (oral or recorded)	2
	Persona & Scenario	2
	Qualitative	1
DEFINE	Photographic records	3
	Raw (not edited, structured or analysed)	2
	Quotes & Anecdotes	2
	Audio (oral or recorded)	2
	Qualitative	1
	Persona & Scenario	1
	video	1
DEVELOP	Photographic records	3
	Video	2
	Processed (edited, structured or analysed)	1
	Quantitative	1
	Quotes & Anecdotes	1
	Infographics; graphs, maps, diagrams	1
	Persona & Scenario	1
	Case studies	1
DELIVER	Processed (edited, structured or analysed)	1
	Quotes & Anecdotes	1
	Photographic records	1
	video	1
	Persona & Scenario	1

Table C.11 Team B - Format of people information used in the 24-h Challenge project

Stage	FORMAT of people information used	Frequency
DISCOVER	Persona & Scenario	3
	Photographic records	3
	Quotes & Anecdotes	3
	Raw (not edited, structured or analysed)	2
	Audio (oral or recorded)	2
	Qualitative	2
DEFINE	Raw (not edited, structured or analysed)	3
	Quotes & Anecdotes	3
	Audio (oral or recorded)	2
	Qualitative	1
	Persona & Scenario	1
	video	1
DEVELOP	Photographic records	2
	Video	2
	Processed (edited, structured or analysed)	2
	Quantitative	2
	Quotes & Anecdotes	1
DELIVER	Qualitative	3
	Persona & Scenario	2
	Photographic records	1
	Processed (edited, structured or analysed)	1
	Quotes & Anecdotes	1

Table C.12 Team C - Format of people information used in the 24-h Challenge project

Stage	FORMAT of people information used	Frequency
DISCOVER	Persona & Scenario	3
	Photographic records	2
	Quotes & Anecdotes	2
	Raw (not edited, structured or analysed)	1
	Audio (oral or recorded)	1
	Qualitative	1
DEFINE	Persona & Scenario	2
	Quotes & Anecdotes	2
	Qualitative	1
	Audio (oral or recorded)	1
DEVELOP	Persona & Scenario	2
	Qualitative	1
	Quotes & Anecdotes	1
	Audio (oral or recorded)	1
	NO USE OF PEOPLE INFORMATION AT THIS STAGE	-
DELIVER	Qualitative	2
	Persona & Scenario	2
	Photographic records	1
	Processed (edited, structured or analysed)	1
	Quotes & Anecdotes	1

Table C.13 Team A - Attributes of people information used in the 24-h Challenge project

Stage	ATTRIBUTES of people information used	Frequency
DISCOVER	Intuitiveness	3
	Visual representation	2
	Relevance	2
	Simplicity	2
	Accessibility of information	1
	Accuracy	1
	Importance	1
	Clarity	1
	Validity & reliability	1
	Ease and speed of use	1
	Right level of detail	1
	Openness (showing the raw data)	1
DEFINE	Relevance	3
	Clarity	3
	Simplicity	3
	Importance	2
	Accuracy	1
	Validity & reliability	1
	Visual representation	1
	Non-scientific and nontechnical language	1
	Open-endedness - open to interpretation	1
	Intuitiveness	1
	Openness (showing the raw data)	1
DEVELOP	Clarity	3
	Importance	2
	Relevance	2
	Right level of detail	2
	Open-endedness - open to interpretation	2
	Simplicity	1
	Openness (showing the raw data)	1
	Intuitiveness	1
	Non-scientific and nontechnical language	1
	Visual representation	1
	Accessibility of information	1
	Accuracy	1
	Completeness	1
	Ease and speed of use	1
DELIVER	Relevance	2
	Clarity	2
	Right level of detail	2
	Non-scientific and nontechnical language	2
	Open-endedness - open to interpretation	2
	Simplicity	2
	Importance	1
	Validity & reliability	1
	Intuitiveness	1
	Openness (showing the raw data)	1
	Up-to-datedness	1
	Simplified into ‘nuggets’ of information	1

Table C.14 Team B - Attributes of people information used in the 24-h Challenge project

Stage	ATTRIBUTES of people information used	Frequency
DISCOVER	Validity & reliability	3
	Up-to-datedness	3
	Completeness	2
	Relevance	2
	Simplicity	2
	Openness (showing the raw data)	1
	Importance	1
	Clarity	1
	Simplified into ‘nuggets’ of information	1
	Ease and speed of access & search	1
	Right level of detail	1
	Open-endedness - open to interpretation	1
	Non-scientific and nontechnical language	1
DEFINE	Relevance	3
	Clarity	2
	Right level of detail	2
	Non-scientific and nontechnical language	2
	Importance	1
	Validity & reliability	1
	Simplicity	1
DEVELOP	Clarity	2
	Ease and speed of use	2
	Relevance	2
	Right level of detail	2
	Open-endedness - open to interpretation	2
	Simplicity	1
	Accessibility of information	1
	Accuracy	1
	Non-scientific and nontechnical language	1
	NO USE OF PEOPLE INFORMATION AT THIS STAGE	-
DELIVER	Relevance	3
	Importance	3
	Clarity	1
	Right level of detail	1
	Simplicity	1
	Accessibility of information	1
	Validity & reliability	1
	Visual representation	1
	Simplified into ‘nuggets’ of information	1

Table C.15 Team C - Attributes of people information used in the 24-h Challenge project

Stage	ATTRIBUTES of people information used	Frequency
DISCOVER	Validity & reliability	2
	Up-to-datedness	2
	Completeness	1
	Relevance	1
	Simplicity	1
	Openness (showing the raw data)	1
	Importance	1
	Clarity	1
	Simplified into 'nuggets' of information	1
	Ease and speed of access & search	1
	Right level of detail	1
	Open-endedness - open to interpretation	1
	Non-scientific and nontechnical language	1
DEFINE	Relevance	3
	Clarity	3
	Right level of detail	2
	Non-scientific and nontechnical language	1
	Importance	1
	Validity & reliability	1
	Simplicity	1
DEVELOP	Clarity	1
	Ease and speed of use	1
	Relevance	1
	Right level of detail	1
	Open-endedness - open to interpretation	1
	Simplicity	1
	Accessibility of information	1
	Accuracy	1
	Non-scientific and nontechnical language	1
	NO USE OF PEOPLE INFORMATION AT THIS STAGE	-
DELIVER	Relevance	2
	Importance	2
	Clarity	2
	Right level of detail	2
	Simplicity	2
	Accessibility of information	1
	Validity & reliability	1
	Visual representation	1
	Simplified into 'nuggets' of information	1

Table C.16 Team A - Intensity of people information use in the 24-h Challenge project

Stage & activities	INTENSITY of people information use	
Discover	Range	2, 3, 3
	Depth	5, 6, 7
	Frequency	5, 7, 7
Define	Range	2, 3, 4
	Depth	4, 5, 5
	Frequency	5, 6, 7
Develop	Range	2, 3, 6
	Depth	3, 4, 5
	Frequency	5, 6, 7
Deliver	Range	2, 3, 7
	Depth	1, 3, 5
	Frequency	3, 4, 7

Table C-17 Team B - Intensity of people information use in the 24-h Challenge project

Stage & activities	INTENSITY of people information use	
Discover	Range	3, 4, 4
	Depth	5, 5, 4
	Frequency	6, 5, 4
Define	Range	4, 4, 3
	Depth	6, 6, 5
	Frequency	5, 6, 5
Develop	Range	2, 4, 5
	Depth	4, 6, 3
	Frequency	4, 4, 3
Deliver	Range	4, 3, 3
	Depth	5, 3, 6
	Frequency	5, 3, 2

Table C-18 Team C - Intensity of people information use in the 24-h Challenge project

Stage & activities	INTENSITY of people information use	
Discover	Range	4, 4, 6
	Depth	4, 6, 6
	Frequency	3, 4, 7
Define	Range	2, 3, 4
	Depth	5, 6, 6
	Frequency	4, 5, 5
Develop	Range	0, 2, 5
	Depth	0, 5, 5
	Frequency	0, 2, 6
Deliver	Range	1, 2, 5
	Depth	4, 5, 5
	Frequency	1, 2, 6

Appendix D1

Survey for designers and design researchers

Information Behaviour in Design Exit this survey

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Information Behaviour in Design

A study of designers' needs, sources and use of information in the design process

This study aims to develop a *framework* for understanding and studying *Designers' Information Behaviour*.

The focus of the study is on *people information* as one key type of design information.

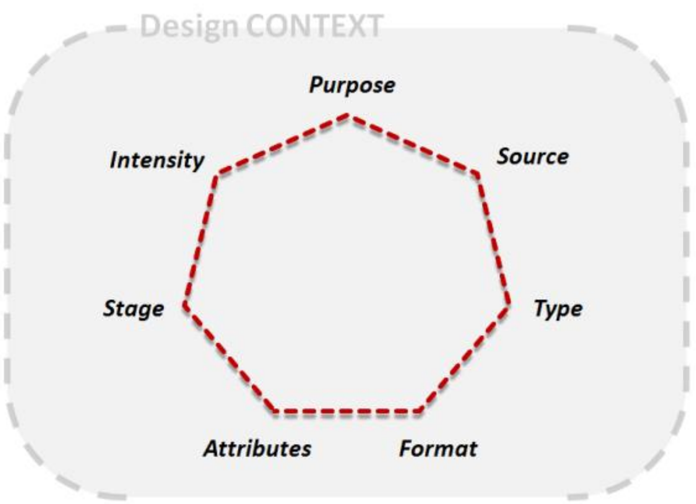
All completed surveys will receive a hardcover copy of the MADE IN BRUNEL book together with an invitation to the MADE IN BRUNEL VIP reception at Bargehouse, South Bank in June 2012.
(Please leave your email address at the end of the survey.)

"Information behaviour" is defined as human behaviour relating to information seeking, retrieving, organising and use.*

This study focuses on ***designers'*** information behaviour.
In order to better understand various aspects of designers' information behaviour, the following framework is suggested:

Information Behaviour in Design

Suggested framework dimensions:



Seven key dimensions are distinguished in terms of designers' information behaviour:
Purpose – **Why is the information used?**
Source – **How is the information sourced?**
Type – **What type of information is used?**
Format – **What representation of information is used?**
Attributes – **What are the qualities of the information used?**
Stage – **When is the information used?**
Intensity – **What range and depth of information is used and how frequently?**

***1. In your opinion, does this framework help you to understand designers' information behaviour?**

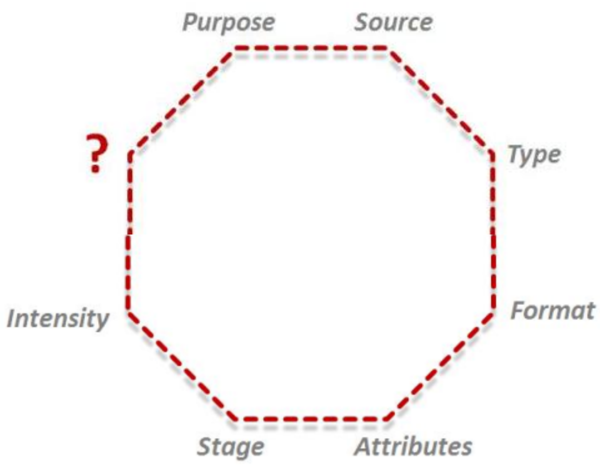
- Yes
- Maybe
- No

Please state why:

***2. The above framework currently has seven dimensions, in your opinion, do these dimensions address the key aspects of designers' information behaviour?**

- Yes
- Maybe
- No

Please state why:



***3. In your opinion, are there dimensions/aspects that are missing or that need to be refined or changed?**

- Yes
- Maybe
- No

Please explain why and/or state what dimension/s:

***4. Would you be willing to use the above framework?**

- Yes
- Maybe
- No

Please explain why:

Next

Information Behaviour in Design

Exit this survey

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Focus of survey – *People Information*

There are various types of information that designers use in the design process. The following questions all focus on one of these - *people information* (also known as *user information*).

***People information* is defined as all types of information that help designers to better understand people and their context.**

1. Do you think that this definition of people information is appropriate? Please identify any problems with, or additions to, this definition.

- Yes
- Maybe
- No

Please identify any problems or additions, here:

Stages of design process - *Discover*, *Define*, *Develop*, *Deliver*

Discover	*Define*	*Develop*	*Deliver*

Discover	Start of the project, exploring initial ideas or inspiration
Define	Alignment of needs to project objectives, deciding project direction and management
Develop	Development of design-led solutions, iteration and testing
Deliver	Finalising the resulting product, presentation and feedback

Next pages - Answering questions

Please answer the following questions for **each stage** of the design process: *Discover*, *Define*, *Develop* & *Deliver*

All questions focus on *people information* (also known as *user information*).

Note - Please try to answer **all** questions.

Prev Next

Information Behaviour in Design

A. DISCOVER stage

A. At the *discover* stage of the design process:

Discover

Discover stage: Start of the project, exploring initial ideas or inspiration

1. Tick this box and go straight to next page IF:
You DO NOT USE people information at the DISCOVER stage.

- ○ No use of people information at this stage

Information Behaviour in Design

2. WHY do you use people information?
Please tick all of the reasons that apply.

- ☐ Inspiration & Ideation
- ☐ Empathy
- ☐ Communication & Discussion
- ☐ Information & Specification
- ☐ Insights & Understanding
- ☐ Confirmation & Support
- ☐ Evaluation & Refinement

Other (please list):

Discover

Information Behaviour in Design

3. WHERE do you obtain people information from?
Please tick all of the sources that apply.

- [ ] User research (observation, testing, focus group)
- [ ] Colleagues, friends, etc.
- [ ] Other projects - information gathered from other projects
- [ ] Own intuition, experience, common sense
- [ ] Books, manuals, handbooks
- [ ] Journals
- [ ] Client
- [ ] Specific user data tools
- [ ] Guidelines, standards, regulations
- [ ] Specialists & experts in the field
- [ ] Internet - search engines such as Google™

Other (please list):

Discover

Information Behaviour in Design

4. WHAT KIND of people information do you use?
Please tick all of the options that apply.

- [ ] People emotions, aspirations & personality
- [ ] People dimensions (physical)
- [ ] People capability – physical
- [ ] People needs
- [ ] General - Statistical general information on people
- [ ] People experience & context of use
- [ ] People capability – cognitive
- [ ] People problems (problems facing the potential user)
- [ ] Personal - Specific information on individuals
- [ ] People socio-economic status, lifestyle & trends
- [ ] People diversity
- [ ] People capability – sensory
- [ ] People behaviour

Other (please list):

Information Behaviour in Design

Discover

5. What FORMAT of people information do you use? Please tick all of the formats that apply.

- [ ] Raw (not edited, structured or analysed)
- [ ] Transcripts
- [ ] Audio (oral or recorded)
- [ ] Written report
- [ ] Infographics; graphs, maps, diagrams
- [ ] Processed (edited, structured or analysed)
- [ ] Qualitative
- [ ] Quotes & Anecdotes
- [ ] Quantitative
- [ ] video
- [ ] Numerical & Statistical
- [ ] Database & Data tables
- [ ] Photographic records
- [ ] Case studies
- [ ] Persona & Scenario

Other (please list):

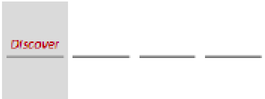
Information Behaviour in Design

6. What ATTRIBUTES you consider as important for the people information you use? Please tick all of the options that apply.

- [ ] Accessibility of information
- [ ] Up-to-datedness
- [ ] Relevance
- [ ] Intuitiveness
- [ ] Visual representation
- [ ] Ease and speed of access & search
- [ ] Open-ended-ness (freedom of interpretation)
- [ ] Accuracy
- [ ] Completeness
- [ ] Importance
- [ ] Clarity
- [ ] Non-scientific and nontechnical language
- [ ] Openness (showing the raw data)
- [ ] Ease and speed of use
- [ ] Validity & reliability
- [ ] Simplicity
- [ ] Cost
- [ ] Simplified into 'nuggets' of information
- [ ] Right level of detail

Other (please list):

Information Behaviour in Design



7. Please rate on a scale of 1 to 7 (1= least , 7= most):

(In-depth: depth is level of detail & completeness of information)
(Diverse: diversity is variety & different kinds of information)
(Frequent: frequency is how often you use the information)

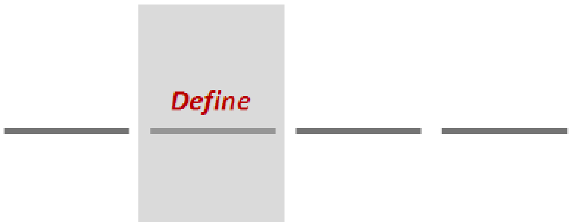
At the DISCOVER stage of the design process:

	1 (least)	2	3	4	5	6	7 (most)
How IN-DEPTH is the people information you use?	○	○	○	○	○	○	○
How DIVERSE is the people information you use?	○	○	○	○	○	○	○
How FREQUENTLY do you use the people information?	○	○	○	○	○	○	○

Information Behaviour in Design

B. DEFINE stage

B. At the ***define*** stage of the design process:



Define stage: Alignment of needs to project objectives, deciding project direction and management

Information Behaviour in Design

1. Tick this box and go straight to next page IF:
You DO NOT USE people information at the DEFINE stage.

- [ ] No use of people information at this stage

2. WHY do you use people information?
Please tick all of the reasons that apply.

- [ ] Empathy
- [ ] Communication & Discussion
- [ ] Confirmation & Support
- [ ] Insights & Understanding
- [ ] Information & Specification
- [ ] Inspiration & Ideation
- [ ] Evaluation & Refinement

Other (please list):

Define

Information Behaviour in Design

3. WHERE do you obtain people information from?
Please tick all of the sources that apply.

- [ ] Guidelines, standards, regulations
- [ ] Specific user data tools
- [ ] Previous stage - information gathered from previous stage of the design process
- [ ] Books, manuals, handbooks
- [ ] Specialists & experts in the field
- [ ] Internet - search engines such as Google™
- [ ] Own intuition, experience, common sense
- [ ] Colleagues, friends, etc.
- [ ] Client
- [ ] Journals
- [ ] Other projects - information gathered from other projects
- [ ] User research (observation, testing, focus group)

Other (please list):

Define

Information Behaviour in Design

4. WHAT KIND of people information do you use?
Please tick all of the options that apply.

- [ ] People dimensions (physical)
- [ ] People problems (problems facing the potential user)
- [ ] People needs
- [ ] People emotions, aspirations & personality
- [ ] People capability – physical
- [ ] Personal - Specific information on individuals
- [ ] People socio-economic status, lifestyle & trends
- [ ] People behaviour
- [ ] People capability – sensory
- [ ] People experience & context of use
- [ ] People capability – cognitive
- [ ] People diversity
- [ ] General - Statistical general information on people

Other (please list):

Information Behaviour in Design

Define

5. What FORMAT of people information do you use?
Please tick all of the formats that apply.

- [ ] Transcripts
- [ ] Written report
- [ ] Photographic records
- [ ] Qualitative
- [ ] Processed (edited, structured or analysed)
- [ ] Numerical & Statistical
- [ ] Quotes & Anecdotes
- [ ] Persona & Scenario
- [ ] Quantitative
- [ ] Infographics; graphs, maps, diagrams
- [ ] Raw (not edited, structured or analysed)
- [ ] Database & Data tables
- [ ] video
- [ ] Case studies
- [ ] Audio (oral or recorded)

Other (please list):

Information Behaviour in Design

6. What ATTRIBUTES you consider as important for the people information you use? Please tick all of the options that apply.

- ☐ Simplified into 'nuggets' of information
- ☐ Visual representation
- ☐ Validity & reliability
- ☐ Simplicity
- ☐ Ease and speed of use
- ☐ Accuracy
- ☐ Open-ended-ness (freedom of interpretation)
- ☐ Accessibility of information
- ☐ Openness (showing the raw data)
- ☐ Cost
- ☐ Up-to-datedness
- ☐ Right level of detail
- ☐ Completeness
- ☐ Intuitiveness
- ☐ Relevance
- ☐ Non-scientific and nontechnical language
- ☐ Importance
- ☐ Clarity
- ☐ Ease and speed of access & search

Other (please list):

Information Behaviour in Design

Define

7. Please rate on a scale of 1 to 7 (1= least , 7= most):

(In-depth: depth is level of detail & completeness of information)
(Diverse: diversity is variety & different kinds of information)
(Frequent: frequency is how often you use the information)

At the DEFINE stage of the design process:

	1 (least)	2	3	4	5	6	7 (most)
How IN-DEPTH is the people information you use?	○	○	○	○	○	○	○
How DIVERSE is the people information you use?	○	○	○	○	○	○	○
How FREQUENTLY do you use the people information?	○	○	○	○	○	○	○

Information Behaviour in Design

C. DEVELOP stage

C. At the *develop* stage of the design process:

Develop stage: Development of design-led solutions, iteration and testing

1. Tick this box and go straight to next page IF:
You DO NOT USE people information at the DEVELOP stage.

- [ ] No use of people information at this stage

Information Behaviour in Design

2. WHY do you use people information?
Please tick all of the reasons that apply.

- [ ] Information & Specification
- [ ] Inspiration & Ideation
- [ ] Insights & Understanding
- [ ] Empathy
- [ ] Confirmation & Support
- [ ] Evaluation & Refinement
- [ ] Communication & Discussion

Other (please list):

Information Behaviour in Design

3. WHERE do you obtain people information from? Please tick all of the sources that apply.

- [ ] Specialists & experts in the field
- [ ] Colleagues, friends, etc.
- [ ] Books, manuals, handbooks
- [ ] User research (observation, testing, focus group)
- [ ] Specific user data tools
- [ ] Guidelines, standards, regulations
- [ ] Other projects - information gathered from other projects
- [ ] Own intuition, experience, common sense
- [ ] Client
- [ ] Previous stage/s - information gathered from previous stages of the design process
- [ ] Internet - search engines such as Google™
- [ ] Journals

Other (please list):

Develop

Information Behaviour in Design

4. WHAT KIND of people information do you use? Please tick all of the options that apply.

- [ ] People behaviour
- [ ] People emotions, aspirations & personality
- [ ] People capability – sensory
- [ ] General - Statistical general information on people
- [ ] People socio-economic status, lifestyle & trends
- [ ] People dimensions (physical)
- [ ] People problems (problems facing the potential user)
- [ ] People capability – cognitive
- [ ] People diversity
- [ ] Personal - Specific information on individuals
- [ ] People capability – physical
- [ ] People experience & context of use
- [ ] People needs

Other (please list):

Information Behaviour in Design

Develop

5. What FORMAT of people information do you use? Please tick all of the formats that apply.

- [ ] Case studies
- [ ] Written report
- [ ] video
- [ ] Processed (edited, structured or analysed)
- [ ] Infographics; graphs, maps, diagrams
- [ ] Quantitative
- [ ] Transcripts
- [ ] Database & Data tables
- [ ] Raw (not edited, structured or analysed)
- [ ] Persona & Scenario
- [ ] Audio (oral or recorded)
- [ ] Numerical & Statistical
- [ ] Qualitative
- [ ] Quotes & Anecdotes
- [ ] Photographic records

Other (please list):

Information Behaviour in Design

Develop

Information Behaviour in Design

6. What ATTRIBUTES you consider as important for the people information you use? Please tick all of the options that apply.

- [ ] Validity & reliability
- [ ] Ease and speed of access & search
- [ ] Openness (showing the raw data)
- [ ] Accuracy
- [ ] Right level of detail
- [ ] Simplified into 'nuggets' of information
- [ ] Simplicity
- [ ] Intuitiveness
- [ ] Non-scientific and nontechnical language
- [ ] Ease and speed of use
- [ ] Clarity
- [ ] Open-ended-ness (freedom of interpretation)
- [ ] Visual representation
- [ ] Relevance
- [ ] Accessibility of information
- [ ] Up-to-datedness
- [ ] Completeness
- [ ] Importance
- [ ] Cost

Other (please list):

Information Behaviour in Design

7. Please rate on a scale of 1 to 7 (1= least , 7= most):

(In-depth: depth is level of detail & completeness of information)
(Diverse: diversity is variety & different kinds of information)
(Frequent: frequency is how often you use the information)

At the DEVELOP stage of the design process:

	1 (least)	2	3	4	5	6	7 (most)
How IN-DEPTH is the people information you use?	○	○	○	○	○	○	○
How DIVERSE is the people information you use?	○	○	○	○	○	○	○
How FREQUENTLY do you use the people information?	○	○	○	○	○	○	○

Information Behaviour in Design

D. DELIVER stage

D. At the *deliver* stage of the design process:

Deliver stage: Finalising the resulting product, launch and feedback

1. Tick this box and go straight to next page IF:
You DO NOT USE people information at the DELIVER stage.

- [ ] No use of people information at this stage

Information Behaviour in Design

2. WHY do you use people information?
Please tick all of the reasons that apply.

- [ ] Inspiration & Ideation
- [ ] Communication & Discussion
- [ ] Evaluation & Refinement
- [ ] Confirmation & Support
- [ ] Empathy
- [ ] Insights & Understanding
- [ ] Information & Specification

Other (please list):

Information Behaviour in Design

3. WHERE do you obtain people information from?
Please tick all of the sources that apply.

- [ ] Client
- [ ] Guidelines, standards, regulations
- [ ] Books, manuals, handbooks
- [ ] Journals
- [ ] Specific user data tools
- [ ] Internet - search engines such as Google™
- [ ] Own intuition, experience, common sense
- [ ] Other projects - information gathered from other projects
- [ ] Specialists & experts in the field
- [ ] User research (observation, testing, focus group)
- [ ] Colleagues, friends, etc.
- [ ] Previous stage/s - information gathered from previous stages of the design process

Other (please list):

Deliver

Information Behaviour in Design

4. WHAT KIND of people information do you use?
Please tick all of the options that apply.

- [ ] People dimensions (physical)
- [ ] People capability – physical
- [ ] General - Statistical general information on people
- [ ] People emotions, aspirations & personality
- [ ] People problems (problems facing the potential user)
- [ ] People diversity
- [ ] People socio-economic status, lifestyle & trends
- [ ] People capability – sensory
- [ ] People needs
- [ ] People behaviour
- [ ] People experience & context of use
- [ ] People capability – cognitive
- [ ] Personal - Specific information on individuals

Other (please list):

Information Behaviour in Design

Deliver

5. What FORMAT of people information do you use? Please tick all of the formats that apply.

- [ ] Processed (edited, structured or analysed)
- [ ] Persona & Scenario
- [ ] Photographic records
- [ ] Raw (not edited, structured or analysed)
- [ ] video
- [ ] Written report
- [ ] Numerical & Statistical
- [ ] Quantitative
- [ ] Infographics; graphs, maps, diagrams
- [ ] Quotes & Anecdotes
- [ ] Audio (oral or recorded)
- [ ] Qualitative
- [ ] Database & Data tables
- [ ] Case studies
- [ ] Transcripts

Other (please list):

Information Behaviour in Design

Deliver

Information Behaviour in Design

6. What ATTRIBUTES you consider as important for the people information you use? Please tick all of the options that apply.

- Accuracy
- Ease and speed of use
- Cost
- Simplified into 'nuggets' of information
- Relevance
- Non-scientific and nontechnical language
- Up-to-datedness
- Accessibility of information
- Open-ended-ness (freedom of interpretation)
- Importance
- Clarity
- Right level of detail
- Openness (showing the raw data)
- Visual representation
- Intuitiveness
- Ease and speed of access & search
- Validity & reliability
- Simplicity
- Completeness

Other (please list):

Information Behaviour in Design

Deliver

7. Please rate on a scale of 1 to 7 (1= least , 7= most):

(In-depth: depth is level of detail & completeness of information)
(Diverse: diversity is variety & different kinds of information)
(Frequent: frequency is how often you use the information)

At the DELIVER stage of the design process:

	1 (least)	2	3	4	5	6	7 (most)
How IN-DEPTH is the people information you use?							
How DIVERSE is the people information you use?							
How FREQUENTLY do you use the people information?							

Information Behaviour in Design

Your General Information

7 / 7

1. Age:

- Under 25
- 25-35
- 36-45
- 46-55
- Above 55

***2. Role/Position:**
(If more than one applies to you, please choose the position that reflects the majority of your work.)

- Designer
- Design researcher
- Design academic
- Design student
- Design strategist
- Tool developer
- Ergonomist
- Other (please specify)

***3. Design discipline:**

- Industrial design
- Product design
- Engineering design
- Service design
- Graphic design
- Fashion design
- Textile design
- Design strategy
- Other (please specify)

***4. Years of experience:**

- less than 2 years
- 2-3 years
- 3-5 years
- 5-8 years
- 8-10 years
- 10-20 years
- More than 20 years

***5. Industry/Sector:**

- Design consultancy
- Design company
- Freelance
- Research institute
- Higher education
- Other (please specify)

***6. Which country are you based in (professionally)?**

- UK
- Other

Thank you very much for your *expert insight* & *comments*.
Your participation is hugely appreciated.

Please leave your *email* below, should you wish to receive a complementary copy of the **MADE IN BRUNEL** book and VIP reception, or if you wish to receive the results of this study.

***7. Would you like to receive the results of this study?**

- Yes
- No

8. Contact details:

Prev Submit

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Appendix D2

Refinements suggested by survey participants

Table D.1 Respondents' comments on dimensions that need to be included or refined and refinement of overall framework

Are there dimensions/aspects that are missing or that need to be refined or changed?	Frequency
To be included	
Behaviour - related	
Acts	
Processing and filtering	6
Evaluation and appraisal- further sourcing	3
Storage and retrieval – overall & from designers' own systems	2
Search	2
Interpretation and translation	2
Collaboration - arising amidst the interactive IB of design team	2
Display or provision	1
Transposing	1
Synthesis	1
Management	1
Sharing, collocating and refining	1
Reflection - effectiveness and whether any lessons were learnt	1
Questioning - how requirements are identified before sourcing	1
Iteration - repetitive nature of design enquiry	1
Innovation / inspiration - sourcing out of curiosity	1
Other	
Time - temporal	4
Urgency (of need)	2
Duration	1
Frequency	1
Ethics - key part of anyone's behaviour	1
Goals and sub-goals	1
Emotion/empathy	1
Love	1
Information - related	
Attributes	
Relevance	4
Quality	3
Usability and perceptibility	3
Credibility and Justifiability	3
Availability	1
Validity	2
Integrity and authenticity	2
Temporality - how stable or dynamic is information over time?	2
Other	
Impact - what happens as a result of using information	3
Origins	1
Social aspect	1
Spurious information in designers' heads	1
Type	1
legal rights (copyright)	1
End result – how the information is displayed in the final product	1
Scope, fit, resilience, sensitivity to changing contexts, etc.	1
Development and hierarchy	1
Prior use	1
Cultural relevance – junk, passé, of the moment, static	1
Evolution (throughout the design process)	1
Context - related	
Context	5

Who – aimed at/collected/provided/paid for the information	5
Target audience	5
Client	2
Domain - who is using the information may support it better	1
Where	1
Design language	1
Design personality	1
Design style	1
Individual - related	
Iterative process of the designer	1
Personal lenses: culture/personal experience/intuition	1
Previous experience - shaping the behaviour	1
Subjective engagement	1
To be refined	
Attributes	
Needs to be more clearly defined	4
'Qualities' more obvious than 'Attributes'	1
Intensity	
Too broad - separate frequency from range and depth	1
Odd term - quality of information more fitting	1
Divide into two - information breadth + depth	1
Source	
Divide into: 1. Type of support (books, internet, etc.) 2. Theoretical vs. empirical information (books vs. interview)	1
Not only 'how' (method) but also 'where' (location) sourced	1
Type	
Difference between type and format not fully clear	1
Type considered an Attribute too?	1
Purpose	
Not why is it used - why is it needed? what is it used for?	1
Format	
Format less important than the communication aspect of it	1
Overall Framework	
Relationship between dimensions	
Linkage	4
Priority/importance/hierarchy	3
Iterative loops - interaction of dimensions	2
Different timing	1
Where to start	1
Visual representation	
Misleading - not linear	1
Graphical analysis	1
Difficult for visual dyslexic	1
Terminology	
Vague and inaccurate	1
Unfamiliar	1
Too academic – use of simple English	1
'Dimension' suggests bi-polar adjective pairs - replace with 'facet'	1
'Dimensions' not appropriate	1
Content	
Too many dimensions	2
Reduce: 'type', 'source', 'purpose' or 'need' and 'format'	1
Behaviour - what happens WITHIN the head of the designer	1
Needs to be redefined	1
Needs to be refined	1
The purpose and intent of the framework	1

Appendix D3

Statistical analysis of survey results

Table D.2 Chi-squared test for 'Purpose' dimension - DESIGNERS' responses

PURPOSE								
sTAGE 1		*Inspiration*	*Empathy*	*Insight*	*Information*	*Evaluation*	*Confirmation*	*Communication*
	Observed	27	24	32	19	11	14	16
	Expected	16.5	16.5	16.5	16.5	16.5	16.5	16.5
	Deviation	10.5	7.5	15.5	2.5	-5.5	-2.5	-0.5
	Deviation2	110.25	56.25	240.25	6.25	30.25	6.25	0.25
27.25758	D2/E	6.681818182	3.409090909	14.56060606	0.378787879	1.833333333	0.378787879	0.015151515
sTAGE 2		*Inspiration*	*Empathy*	*Insight*	*Information*	*Evaluation*	*Confirmation*	*Communication*
	Observed	15	11	22	24	16	20	25
	Expected	16	16	16	16	16	16	16
	Deviation	-1	-5	6	8	0	4	9
	Deviation2	1	25	36	64	0	16	81
13.9375	D2/E	0.0625	1.5625	2.25	4	0	1	5.0625
sTAGE3		*Inspiration*	*Empathy*	*Insight*	*Information*	*Evaluation*	*Confirmation*	*Communication*
	Observed	14	15	13	16	21	24	17
	Expected	14.5	14.5	14.5	14.5	14.5	14.5	14.5
	Deviation	-0.5	0.5	-1.5	1.5	6.5	9.5	2.5
	Deviation2	0.25	0.25	2.25	2.25	42.25	90.25	6.25
9.913793	D2/E	0.017241379	0.017241379	0.155172414	0.155172414	2.913793103	6.224137931	0.431034483
sTAGE4		*Inspiration*	*Empathy*	*Insight*	*Information*	*Evaluation*	*Confirmation*	*Communication*
	Observed	4	8	6	9	19	21	17
	Expected	14.5	14.5	14.5	14.5	14.5	14.5	14.5
	Deviation	-10.5	-6.5	-8.5	-5.5	4.5	6.5	2.5
	Deviation2	110.25	42.25	72.25	30.25	20.25	42.25	6.25
22.32759	D2/E	7.603448276	2.913793103	4.982758621	2.086206897	1.396551724	2.913793103	0.431034483

Table D.3 Chi-squared test for 'Source' dimension - DESIGNERS' responses

SOURCES													
sTAGE 1		*intuition*	*client*	*specialist*	*colleagues*	*user research*	*books*	*Internet*	*guidelines*	*otherproe*	*Journals*	*specifci user data tools*	
	Observed	26	20	20	19	28	11	20	14	26	10	14	
	Expected	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	
	Deviation	9.5	3.5	3.5	2.5	11.5	-5.5	3.5	-2.5	9.5	-6.5	-2.5	
	Deviation2	90.25	12.25	12.25	6.25	132.25	30.25	12.25	6.25	90.25	42.25	6.25	
26.71212	D2/E	5.46969697	0.742424242	0.742424242	0.378787879	8.015151515	1.833333333	0.742424242	0.378787879	5.469697	2.560606061	0.378788	
sTAGE 2		*intuition*	*client*	*specialist*	*colleagues*	*user research*	*books*	*Internet*	*guidelines*	*otherproe*	*Journals*	*specifci us*	*Previous stage*
	Observed	18	22	23	19	16	24	8	13	16	15	6	16
	Expected	16	16	16	16	16	16	16	16	16	16	16	16
	Deviation	2	6	7	3	0	8	-8	-3	0	-1	-10	0
	Deviation2	4	36	49	9	0	64	64	9	0	1	100	0
21	D2/E	0.25	2.25	3.0625	0.5625	0	4	4	0.5625	0	0.0625	6.25	0
sTAGE 3		*intuition*	*client*	*specialist*	*colleagues*	*user research*	*books*	*Internet*	*guidelines*	*otherproe*	*Journals*	*specifci us*	*Previous stage*
	Observed	18	17	23	17	9	21	11	6	15	10	6	11
	Expected	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
	Deviation	3.5	2.5	8.5	2.5	-5.5	6.5	-3.5	-8.5	0.5	-4.5	-8.5	-3.5
	Deviation2	12.25	6.25	72.25	6.25	30.25	42.25	12.25	72.25	0.25	20.25	72.25	12.25
24.75862	D2/E	0.844827586	0.431034483	4.982758621	0.431034483	2.086206897	2.913793103	0.844827586	4.982758621	0.017241	1.396551724	4.982759	0.844828
sTAGE 4		*intuition*	*client*	*specialist*	*colleagues*	*user research*	*books*	*Internet*	*guidelines*	*otherproe*	*Journals*	*specifci us*	*Previous stage*
	Observed	6	14	15	13	4	19	2	4	7	6	2	8
	Expected	14	14	14	14	14	14	14	14	14	14	14	14
	Deviation	-8	0	1	-1	-10	5	-12	-10	-7	-8	-12	-6
	Deviation2	64	0	1	1	100	25	144	100	49	64	144	36
52	D2/E	4.571428571	0	0.071428571	0.071428571	7.142857143	1.785714286	10.28571429	7.142857143	3.5	4.571428571	10.28571	2.571429

Table D.4 Chi-squared test for 'Type' dimension - DESIGNERS' responses

TYPE														
sTAGE 1		General	Persoanl	People exprience	People diversity	People dimensions	People needs	People problems	Capabilty-phys	capabilty-	Capabilty sen	People be	socio-ecor	emotions
	Observed	14	15	29	16	13	27	29	16	19	17	28	26	25
	Expected	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
	Deviation	-2.5	-1.5	12.5	-0.5	-3.5	10.5	12.5	-0.5	2.5	0.5	11.5	9.5	8.5
	Deviation2	6.25	2.25	156.25	0.25	12.25	110.25	156.25	0.25	6.25	0.25	132.25	90.25	72.25
45.16667	D2/E	0.378787879	0.136363636	9.46969697	0.015151515	0.742424242	6.681818182	9.46969697	0.015151515	0.378788	0.015151515	8.015152	5.469697	4.378788
sTAGE 2		General	Persoanl	People exprience	People diversity	People dimensions	People needs	People problems	Capabilty-phys	capabilty-	Capabilty sen	People be	socio-ecor	emotions
	Observed	13	14	24	11	13	28	17	14	15	13	19	17	16
	Expected	15	15	15	15	15	15	15	15	15	15	15	15	15
	Deviation	-2	-1	9	-4	-2	13	2	-1	0	-2	4	2	1
	Deviation2	4	1	81	16	4	169	4	1	0	4	16	4	1
20.33333	D2/E	0.266666667	0.066666667	5.4	1.066666667	0.266666667	11.26666667	0.266666667	0.066666667	0	0.266666667	1.066667	0.266667	0.066667
sTAGE 3		General	Persoanl	People exprience	People diversity	People dimensions	People needs	People problems	Capabilty-phys	capabilty-	Capabilty sen	People be	socio-ecor	emotions
	Observed	9	14	17	10	15	22	16	14	18	15	21	9	14
	Expected	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
	Deviation	-4.5	0.5	3.5	-3.5	1.5	8.5	2.5	0.5	4.5	1.5	7.5	-4.5	0.5
	Deviation2	20.25	0.25	12.25	12.25	2.25	72.25	6.25	0.25	20.25	2.25	56.25	20.25	0.25
16.68519	D2/E	1.5	0.018518519	0.907407407	0.907407407	0.166666667	5.351851852	0.462962963	0.018518519	1.5	0.166666667	4.166667	1.5	0.018519
sTAGE 4		General	Persoanl	People exprience	People diversity	People dimensions	People needs	People problems	Capabilty-phys	capabilty-	Capabilty sen	People be	socio-ecor	emotions
	Observed	6	8	20	6	5	12	11	6	13	12	18	8	14
	Expected	14	14	14	14	14	14	14	14	14	14	14	14	14
	Deviation	-8	-6	6	-8	-9	-2	-3	-8	-1	-2	4	-6	0
	Deviation2	64	36	36	64	81	4	9	64	1	4	16	36	0
29.64286	D2/E	4.571428571	2.571428571	2.571428571	4.571428571	5.785714286	0.285714286	0.642857143	4.571428571	0.071429	0.285714286	1.142857	2.571429	0

Table D.5 Chi-squared test for 'Format' dimension - DESIGNERS' responses

FORMAT																
sTAGE 1		Raw	Processed	Qualitative	Quantitative	Transcripts	Quotes &Anecd	Photographic reco	Video	Audio	Written repor	Infograph	Database	Numerical	Persona	Casestudies
	Observed	15	19	26	21	17	20	19	19	11	17	21	10	16	29	23
	Expected	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
	Deviation	-1.5	2.5	9.5	4.5	0.5	3.5	2.5	2.5	-5.5	0.5	4.5	-6.5	-0.5	12.5	6.5
	Deviation2	2.25	6.25	90.25	20.25	0.25	12.25	6.25	6.25	30.25	0.25	20.25	42.25	0.25	156.25	42.25
26.40909	D2/E	0.136363636	0.378787879	5.46969697	1.227272727	0.015151515	0.742424242	0.378787879	0.378787879	1.833333	0.015151515	1.227273	2.560606	0.015152	9.469697	2.560606
sTAGE 2		Raw	Processed	Qualitative	Quantitative	Transcripts	Quotes &Anecd	Photographic reco	Video	Audio	Written repor	Infograph	Database	Numerical	Persona	Casestudies
	Observed	10	20	23	18	7	12	13	11	4	18	16	8	17	23	14
	Expected	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
	Deviation	-5.5	4.5	7.5	2.5	-8.5	-3.5	-2.5	-4.5	-11.5	2.5	0.5	-7.5	1.5	7.5	-1.5
	Deviation2	30.25	20.25	56.25	6.25	72.25	12.25	6.25	20.25	132.25	6.25	0.25	56.25	2.25	56.25	2.25
30.95161	D2/E	1.951612903	1.306451613	3.629032258	0.403225806	4.661290323	0.790322581	0.403225806	1.306451613	8.532258	0.403225806	0.016129	3.629032	0.145161	3.629032	0.145161
sTAGE 3		Raw	Processed	Qualitative	Quantitative	Transcripts	Quotes &Anecd	Photographic reco	Video	Audio	Written repor	Infograph	Database	Numerical	Persona	Casestudies
	Observed	8	16	21	14	4	12	12	9	6	13	10	8	12	19	10
	Expected	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	Deviation	-6	2	7	0	-10	-2	-2	-5	-8	-1	-4	-6	-2	5	-4
	Deviation2	36	4	49	0	100	4	4	25	64	1	16	36	4	25	16
27.42857	D2/E	2.571428571	0.285714286	3.5	0	7.142857143	0.285714286	0.285714286	1.785714286	4.571429	0.071428571	1.142857	2.571429	0.285714	1.785714	1.142857
sTAGE 4		Raw	Processed	Qualitative	Quantitative	Transcripts	Quotes &Anecd	Photographic reco	Video	Audio	Written repor	Infograph	Database	Numerical	Persona	Casestudies
	Observed	6	15	17	12	7	14	11	9	5	15	9	6	14	10	10
	Expected	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
	Deviation	-7.5	1.5	3.5	-1.5	-6.5	0.5	-2.5	-4.5	-8.5	1.5	-4.5	-7.5	0.5	-3.5	-3.5
	Deviation2	56.25	2.25	12.25	2.25	42.25	0.25	6.25	20.25	72.25	2.25	20.25	56.25	0.25	12.25	12.25
23.53704	D2/E	4.166666667	0.166666667	0.907407407	0.166666667	3.12962963	0.018518519	0.462962963	1.5	5.351852	0.166666667	1.5	4.166667	0.018519	0.907407	0.907407

Table D.6 Chi-squared test for 'Attributes' dimension - DESIGNERS' responses

ATTRIBUTES																					
sTAGE 1		acesibilty	accuracy	completeness	relevance	importance	clarity	cost	validity	up-to-dat	ease and spee	ease and s	visual rep	right level	nuggetsoj	non-scien	open-end	intuitivene	simplicitiy	openess
	Observed	15	14	7	27	16	21	15	20	17	20	15	19	23	16	11	13	16	14	11
	Expected	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
	Deviation	-1	-2	-9	11	0	5	-1	4	1	4	-1	3	7	0	-5	-3	0	-2	-5
	Deviation2	1	4	81	121	0	25	1	16	1	16	1	9	49	0	25	9	0	4	25
24.25	D2/E	0.0625	0.25	5.0625	7.5625	0	1.5625	0.0625	1	0.0625	1	0.0625	0.5625	3.0625	0	1.5625	0.5625	0	0.25	1.5625
sTAGE 2		acesibilty	accuracy	completeness	relevance	importance	clarity	cost	validity	up-to-dat	ease and spee	ease and s	visual rep	right level	nuggetsoj	non-scien	open-end	intuitivene	simplicitiy	openess
	Observed	13	18	14	26	18	19	12	18	15	15	8	14	20	14	6	5	13	15	10
	Expected	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	Deviation	-2	3	-1	11	3	4	-3	3	0	0	-7	-1	5	-1	-9	-10	-2	0	-5
	Deviation2	4	9	1	121	9	16	9	9	0	0	49	1	25	1	81	100	4	0	25
30.93333	D2/E	0.266666667	0.6	0.066666667	8.066666667	0.6	1.066666667	0.6	0.6	0	0	3.266667	0.066667	1.666667	0.066667	5.4	6.666667	0.266667	0	1.666667
sTAGE 3		acesibilty	accuracy	completeness	relevance	importance	clarity	cost	validity	up-to-dat	ease and spee	ease and s	visual rep	right level	nuggetsoj	non-scien	open-end	intuitivene	simplicitiy	openess
	Observed	9	18	13	19	13	17	11	17	11	14	11	8	16	7	5	5	11	11	6
	Expected	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
	Deviation	-4.5	4.5	-0.5	5.5	-0.5	3.5	-2.5	3.5	-2.5	0.5	-2.5	-5.5	2.5	-6.5	-8.5	-8.5	-2.5	-2.5	-7.5
	Deviation2	20.25	20.25	0.25	30.25	0.25	12.25	6.25	12.25	6.25	0.25	6.25	30.25	6.25	42.25	72.25	72.25	6.25	6.25	56.25
30.12963	D2/E	1.5	1.5	0.018518519	2.240740741	0.018518519	0.907407407	0.462962963	0.907407407	0.462963	0.018518519	0.462963	2.240741	0.462963	3.12963	5.351852	5.351852	0.462963	0.462963	4.166667
sTAGE 4		acesibilty	accuracy	completeness	relevance	importance	clarity	cost	validity	up-to-dat	ease and spee	ease and s	visual rep	right level	nuggetsoj	non-scien	open-end	intuitivene	simplicitiy	openess
	Observed	9	14	14	17	15	15	6	14	11	7	8	15	17	7	9	5	7	10	4
	Expected	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
	Deviation	-4.5	0.5	0.5	3.5	1.5	1.5	-7.5	0.5	-2.5	-6.5	-5.5	1.5	3.5	-6.5	-4.5	-8.5	-6.5	-3.5	-9.5
	Deviation2	20.25	0.25	0.25	12.25	2.25	2.25	56.25	0.25	6.25	42.25	30.25	2.25	12.25	42.25	20.25	72.25	42.25	12.25	90.25
34.57407	D2/E	1.5	0.018518519	0.018518519	0.907407407	0.166666667	0.166666667	4.166666667	0.018518519	0.462963	3.12962963	2.240741	0.166667	0.907407	3.12963	1.5	5.351852	3.12963	0.907407	6.685185

Table D.7 Chi-squared test for 'Intensity' dimension - DESIGNERS' responses on Depth, Diversity and Frequency categories

Depth

STAGE 1		1	2	3	4	5	6	7
	Observed	1	2	3	8	8	4	7
32	Expected	4.57	4.57	4.57	4.57	4.57	4.57	4.57
	Deviation	-3.57	-2.57	-1.57	3.43	3.43	-0.57	2.43
	Deviation2	12.7449	6.6049	2.4649	11.7649	11.7649	0.3249	5.9049
11.2854	D2/E	2.788818381	1.445273523	0.539365427	2.574376368	2.574376368	0.071094092	1.292100656

STAGE 2		1	2	3	4	5	6	7
	Observed	0	1	4	5	11	4	7
32	Expected	4.57	4.57	4.57	4.57	4.57	4.57	4.57
	Deviation	-4.57	-3.57	-0.57	0.43	6.43	-0.57	2.43
	Deviation2	20.8849	12.7449	0.3249	0.1849	41.3449	0.3249	5.9049
17.88059	D2/E	4.57	2.788818381	0.071094092	0.040459519	9.04702407	0.071094092	1.292100656

STAGE 3		1	2	3	4	5	6	7
	Observed	0	1	4	2	8	5	9
29	Expected	4.14	4.14	4.14	4.14	4.14	4.14	4.14
	Deviation	-4.14	-3.14	-0.14	-2.14	3.86	0.86	4.86
	Deviation2	17.1396	9.8596	0.0196	4.5796	14.8996	0.7396	23.6196
17.11527	D2/E	4.14	2.381545894	0.0047343	1.106183575	3.598937198	0.178647343	5.705217391

STAGE 4		1	2	3	4	5	6	7
	Observed	0	2	6	5	5	3	8
29	Expected	4.14	4.14	4.14	4.14	4.14	4.14	4.14
	Deviation	-4.14	-2.14	1.86	0.86	0.86	-1.14	3.86
	Deviation2	17.1396	4.5796	3.4596	0.7396	0.7396	1.2996	14.8996
10.35198	D2/E	4.14	1.106183575	0.835652174	0.178647343	0.178647343	0.313913043	3.598937198

Diversity

STAGE 1		1	2	3	4	5	6	7
	Observed	0	1	2	6	9	5	9
32	Expected	4.57	4.57	4.57	4.57	4.57	4.57	4.57
	Deviation	-4.57	-3.57	-2.57	1.43	4.43	0.43	4.43
	Deviation2	20.8849	12.7449	6.6049	2.0449	19.6249	0.1849	19.6249
17.88059	D2/E	4.57	2.788818381	1.445273523	0.447461707	4.29428884	0.040459519	4.29428884

STAGE 2		1	2	3	4	5	6	7
	Observed	1	1	8	4	6	4	7
31	Expected	4.42	4.42	4.42	4.42	4.42	4.42	4.42
	Deviation	-3.42	-3.42	3.58	-0.42	1.58	-0.42	2.58
	Deviation2	11.6964	11.6964	12.8164	0.1764	2.4964	0.1764	6.6564
10.34271	D2/E	2.646244344	2.646244344	2.899638009	0.039909502	0.56479638	0.039909502	1.505972851

STAGE 3		1	2	3	4	5	6	7
	Observed	1	3	5	6	6	3	5
29	Expected	4.14	4.14	4.14	4.14	4.14	4.14	4.14
	Deviation	-3.14	-1.14	0.86	1.86	1.86	-1.14	0.86
	Deviation2	9.8596	1.2996	0.7396	3.4596	3.4596	1.2996	0.7396
5.037971	D2/E	2.381545894	0.313913043	0.178647343	0.835652174	0.835652174	0.313913043	0.178647343

STAGE 4		1	2	3	4	5	6	7
	Observed	2	4	4	7	3	4	5
29	Expected	4.14	4.14	4.14	4.14	4.14	4.14	4.14
	Deviation	-2.14	-0.14	-0.14	2.86	-1.14	-0.14	0.86
	Deviation2	4.5796	0.0196	0.0196	8.1796	1.2996	0.0196	0.7396
3.588696	D2/E	1.106183575	0.0047343	0.0047343	1.975748792	0.313913043	0.0047343	0.178647343

Frequency

STAGE 1		1	2	3	4	5	6	7
	Observed	1	0	0	6	6	8	11
32	Expected	4.57	4.57	4.57	4.57	4.57	4.57	4.57
	Deviation	-3.57	-4.57	-4.57	1.43	1.43	3.43	6.43
	Deviation2	12.7449	20.8849	20.8849	2.0449	2.0449	11.7649	41.3449
24.44514	D2/E	2.788818381	4.57	4.57	0.447461707	0.447461707	2.574376368	9.04702407

STAGE 2		1	2	3	4	5	6	7
	Observed	1	1	2	7	7	5	8
31	Expected	4.42	4.42	4.42	4.42	4.42	4.42	4.42
	Deviation	-3.42	-3.42	-2.42	2.58	2.58	0.58	3.58
	Deviation2	11.6964	11.6964	5.8564	6.6564	6.6564	0.3364	12.8164
12.60516	D2/E	2.646244344	2.646244344	1.324977376	1.505972851	1.505972851	0.076108597	2.899638009

STAGE 3		1	2	3	4	5	6	7
	Observed	0	2	4	7	5	4	7
29	Expected	4.14	4.14	4.14	4.14	4.14	4.14	4.14
	Deviation	-4.14	-2.14	-0.14	2.86	0.86	-0.14	2.86
	Deviation2	17.1396	4.5796	0.0196	8.1796	0.7396	0.0196	8.1796
9.385797	D2/E	4.14	1.106183575	0.0047343	1.975748792	0.178647343	0.0047343	1.975748792

STAGE 4		1	2	3	4	5	6	7
	Observed	1	4	3	5	5	4	7
29	Expected	4.14	4.14	4.14	4.14	4.14	4.14	4.14
	Deviation	-3.14	-0.14	-1.14	0.86	0.86	-0.14	2.86
	Deviation2	9.8596	0.0196	1.2996	0.7396	0.7396	0.0196	8.1796
5.037971	D2/E	2.381545894	0.0047343	0.313913043	0.178647343	0.178647343	0.0047343	1.975748792

Table D.8 Chi-squared test for ‘Purpose’ dimension - OVERALL responses

PURPOSE								
sTAGE 3		Inspiration	Empathy	Insight	Information	Evaluation	Confirmation	Communication
	Observed	30	23	29	33	43	43	34
	Expected	28.5	28.5	28.5	28.5	28.5	28.5	28.5
	Deviation	1.5	-5.5	0.5	4.5	14.5	14.5	5.5
	Deviation2	2.25	30.25	0.25	20.25	210.25	210.25	30.25
17.67544	D2/E	0.078947368	1.061403509	0.00877193	0.710526316	7.377192982	7.377192982	1.061403509
STAGE 1		Inspiration	Empathy	Insight	Information	Evaluation	Confirmation	Communication
	Observed	50	46	62	40	18	26	31
	Expected	32	32	32	32	32	32	32
	Deviation	18	14	30	8	-14	-6	-1
	Deviation2	324	196	900	64	196	36	1
53.65625	D2/E	10.125	6.125	28.125	2	6.125	1.125	0.03125
sTAGE4		Inspiration	Empathy	Insight	Information	Evaluation	Confirmation	Communication
	Observed	8	13	15	16	40	41	35
	Expected	27	27	27	27	27	27	27
	Deviation	-19	-14	-12	-11	13	14	8
	Deviation2	361	196	144	121	169	196	64
46.33333	D2/E	13.37037037	7.259259259	5.333333333	4.481481481	6.259259259	7.259259259	2.37037037
sTAGE2		Inspiration	Empathy	Insight	Information	Evaluation	Confirmation	Communication
	Observed	33	24	46	47	31	41	45
	Expected	31	31	31	31	31	31	31
	Deviation	2	-7	15	16	0	10	14
	Deviation2	4	49	225	256	0	100	196
26.77419	D2/E	0.129032258	1.580645161	7.258064516	8.258064516	0	3.225806452	6.322580645

Table D.9 Chi-squared test for ‘Source’ dimension - OVERALL responses

SOURCES													
sTAGE 1		intuition	client	specialist	colleagues	user research	books	Internet	guidelines	otherproe	Journals	specifci user data tools	
	Observed	45	39	40	37	56	22	35	32	45	21	30	
	Expected	32	32	32	32	32	32	32	32	32	32	32	
	Deviation	13	7	8	5	24	-10	3	0	13	-11	-2	
	Deviation2	169	49	64	25	576	100	9	0	169	121	4	
40.1875	D2/E	5.28125	1.53125	2	0.78125	18	3.125	0.28125	0	5.28125	3.78125	0.125	
sTAGE 2		intuition	client	specialist	colleagues	user research	books	Internet	guidelines	otherproe	Journals	specifci us	Previous stage
	Observed	37	36	36	33	48	19	27	32	35	16	29	47
	Expected	31	31	31	31	31	31	31	31	31	31	31	31
	Deviation	6	5	5	2	17	-12	-4	1	4	-15	-2	16
	Deviation2	36	25	25	4	289	144	16	1	16	225	4	256
33.58065	D2/E	1.161290323	0.806451613	0.806451613	0.129032258	9.322580645	4.64516129	0.516129032	0.032258065	0.516129	7.258064516	0.129032	8.258065
sTAGE 3		intuition	client	specialist	colleagues	user research	books	Internet	guidelines	otherproe	Journals	specifci us	Previous stage
	Observed	31	31	30	23	40	21	15	28	24	12	22	46
	Expected	28	28	28	28	28	28	28	28	28	28	28	28
	Deviation	3	3	2	-5	12	-7	-13	0	-4	-16	-6	18
	Deviation2	9	9	4	25	144	49	169	0	16	256	36	324
37.17857	D2/E	0.321428571	0.321428571	0.142857143	0.892857143	5.142857143	1.75	6.035714286	0	0.571429	9.142857143	1.285714	11.57143
sTAGE 4		intuition	client	specialist	colleagues	user research	books	Internet	guidelines	otherproe	Journals	specifci us	Previous stage
	Observed	13	28	25	15	34	7	9	15	12	6	14	27
	Expected	26	26	26	26	26	26	26	26	26	26	26	26
	Deviation	-13	2	-1	-11	8	-19	-17	-11	-14	-20	-12	1
	Deviation2	169	4	1	121	64	361	289	121	196	400	144	1
71.96154	D2/E	6.5	0.153846154	0.038461538	4.653846154	2.461538462	13.88461538	11.11538462	4.653846154	7.538462	15.38461538	5.538462	0.038462

Table D.10 Chi-squared test for ‘Type’ dimension - OVERALL responses

TYPE														
sTAGE 1		*General*	*Persoanl*	*People exprience*	*People diversity*	*People dimensions*	*People needs*	*People problems*	*Capabilty-phys*	*capabilty-*	*Capabilty sen*	*People be*	*socio-ecor*	*emotions*
	Observed	34	30	57	36	33	54	55	35	38	35	56	44	44
	Expected	32	32	32	32	32	32	32	32	32	32	32	32	32
	Deviation	2	-2	25	4	1	22	23	3	6	3	24	12	12
	Deviation2	4	4	625	16	1	484	529	9	36	9	576	144	144
80.65625	D2/E	0.125	0.125	19.53125	0.5	0.03125	15.125	16.53125	0.28125	1.125	0.28125	18	4.5	4.5
sTAGE 2		*General*	*Persoanl*	*People exprience*	*People diversity*	*People dimensions*	*People needs*	*People problems*	*Capabilty-phys*	*capabilty-*	*Capabilty sen*	*People be*	*socio-ecor*	*emotions*
	Observed	27	27	46	28	31	51	37	33	33	28	42	30	34
	Expected	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
	Deviation	-2.5	-2.5	16.5	-1.5	1.5	21.5	7.5	3.5	3.5	-1.5	12.5	0.5	4.5
	Deviation2	6.25	6.25	272.25	2.25	2.25	462.25	56.25	12.25	12.25	2.25	156.25	0.25	20.25
34.27966	D2/E	0.211864407	0.211864407	9.228813559	0.076271186	0.076271186	15.66949153	1.906779661	0.415254237	0.415254	0.076271186	5.29661	0.008475	0.686441
sTAGE 3		*General*	*Persoanl*	*People exprience*	*People diversity*	*People dimensions*	*People needs*	*People problems*	*Capabilty-phys*	*capabilty-*	*Capabilty sen*	*People be*	*socio-ecor*	*emotions*
	Observed	18	25	34	19	32	41	30	33	35	28	41	17	28
	Expected	27	27	27	27	27	27	27	27	27	27	27	27	27
	Deviation	-9	-2	7	-8	5	14	3	6	8	1	14	-10	1
	Deviation2	81	4	49	64	25	196	9	36	64	1	196	100	1
30.59259	D2/E	3	0.148148148	1.814814815	2.37037037	0.925925926	7.259259259	0.333333333	1.333333333	2.37037	0.037037037	7.259259	3.703704	0.037037
sTAGE 4		*General*	*Persoanl*	*People exprience*	*People diversity*	*People dimensions*	*People needs*	*People problems*	*Capabilty-phys*	*capabilty-*	*Capabilty sen*	*People be*	*socio-ecor*	*emotions*
	Observed	12	15	38	15	12	24	20	15	20	23	37	17	24
	Expected	26	26	26	26	26	26	26	26	26	26	26	26	26
	Deviation	-14	-11	12	-11	-14	-2	-6	-11	-6	-3	11	-9	-2
	Deviation2	196	121	144	121	196	4	36	121	36	9	121	81	4
45.76923	D2/E	7.538461538	4.653846154	5.538461538	4.653846154	7.538461538	0.153846154	1.384615385	4.653846154	1.384615	0.346153846	4.653846	3.115385	0.153846
FORMAT														
sTAGE 1		*Raw*	*Processed*	*Qualitative*	*Quantitative*	*Transcripts*	*Quotes &Anecd*	*Photographic reco*	*Video*	*Audio*	*Written repor*	*Infograph*	*Database*	*Numerica*
	Observed	29	36	52	42	30	39	38	37	26	35	39	26	35
	Expected	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
	Deviation	-2.5	4.5	20.5	10.5	-1.5	7.5	6.5	5.5	-5.5	3.5	7.5	-5.5	3.5
	Deviation2	6.25	20.25	420.25	110.25	2.25	56.25	42.25	30.25	30.25	12.25	56.25	30.25	12.25
42.59524	D2/E	0.198412698	0.642857143	13.34126984	3.5	0.071428571	1.785714286	1.341269841	0.96031746	0.960317	0.388888889	1.785714	0.960317	0.388889

Table D.11 Chi-squared test for ‘Format’ dimension - OVERALL responses

FORMAT																
sTAGE 1		*Raw*	*Processed*	*Qualitative*	*Quantitative*	*Transcripts*	*Quotes &Anecd*	*Photographic reco*	*Video*	*Audio*	*Written repor*	*Infograph*	*Database*	*Numerica*	*Persona*	*Casestudies*
	Observed	29	36	52	42	30	39	38	37	26	35	39	26	35	51	43
	Expected	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
	Deviation	-2.5	4.5	20.5	10.5	-1.5	7.5	6.5	5.5	-5.5	3.5	7.5	-5.5	3.5	19.5	11.5
	Deviation2	6.25	20.25	420.25	110.25	2.25	56.25	42.25	30.25	30.25	12.25	56.25	30.25	12.25	380.25	132.25
42.59524	D2/E	0.198412698	0.642857143	13.34126984	3.5	0.071428571	1.785714286	1.341269841	0.96031746	0.960317	0.388888889	1.785714	0.960317	0.388889	12.07143	4.198413
sTAGE 2		*Raw*	*Processed*	*Qualitative*	*Quantitative*	*Transcripts*	*Quotes &Anecd*	*Photographic reco*	*Video*	*Audio*	*Written repor*	*Infograph*	*Database*	*Numerica*	*Persona*	*Casestudies*
	Observed	21	37	46	37	20	27	30	25	16	32	31	21	34	44	29
	Expected	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5
	Deviation	-9.5	6.5	15.5	6.5	-10.5	-3.5	-0.5	-5.5	-14.5	1.5	0.5	-9.5	3.5	13.5	-1.5
	Deviation2	90.25	42.25	240.25	42.25	110.25	12.25	0.25	30.25	210.25	2.25	0.25	90.25	12.25	182.25	2.25
35.0082	D2/E	2.959016393	1.385245902	7.87704918	1.385245902	3.614754098	0.401639344	0.008196721	0.991803279	6.893443	0.073770492	0.008197	2.959016	0.401639	5.97541	0.07377
sTAGE 3		*Raw*	*Processed*	*Qualitative*	*Quantitative*	*Transcripts*	*Quotes &Anecd*	*Photographic reco*	*Video*	*Audio*	*Written repor*	*Infograph*	*Database*	*Numerica*	*Persona*	*Casestudies*
	Observed	11	29	40	30	8	2	26	19	14	24	20	18	23	31	22
	Expected	29	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5
	Deviation	-18	1.5	12.5	2.5	-19.5	-25.5	-1.5	-8.5	-13.5	-3.5	-7.5	-9.5	-4.5	3.5	-5.5
	Deviation2	324	2.25	156.25	6.25	380.25	650.25	2.25	72.25	182.25	12.25	56.25	90.25	20.25	12.25	30.25
72.02696	D2/E	11.17241379	0.081818182	5.681818182	0.227272727	13.82727273	23.64545455	0.081818182	2.627272727	6.627273	0.445454545	2.045455	3.281818	0.736364	0.445455	1.1
sTAGE 4		*Raw*	*Processed*	*Qualitative*	*Quantitative*	*Transcripts*	*Quotes &Anecd*	*Photographic reco*	*Video*	*Audio*	*Written repor*	*Infograph*	*Database*	*Numerica*	*Persona*	*Casestudies*
	Observed	9	28	32	22	14	22	21	18	11	22	19	12	23	22	19
	Expected	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5
	Deviation	-15.5	3.5	7.5	-2.5	-10.5	-2.5	-3.5	-6.5	-13.5	-2.5	-5.5	-12.5	-1.5	-2.5	-5.5
	Deviation2	240.25	12.25	56.25	6.25	110.25	6.25	12.25	42.25	182.25	6.25	30.25	156.25	2.25	6.25	30.25
36.72449	D2/E	9.806122449	0.5	2.295918367	0.255102041	4.5	0.255102041	0.5	1.724489796	7.438776	0.255102041	1.234694	6.377551	0.091837	0.255102	1.234694

Table D.12 Chi-squared test for ‘Attributes’ dimension - OVERALL responses

ATTRIBUTES																				
sTAGE 1		*acesibilty*	*accuracy*	*completeness*	*relevance*	*importance*	*clarity*	*cost*	*validity*	*up-to-dat*	*ease and spee*	*ease and s*	*visual rep*	*right level*	*nuggetsoj*	*non-scien*	*open-end*	*intuitivene*	*simplicitiy*	*openess*
	Observed	30	31	19	50	27	41	26	42	31	31	27	33	37	26	20	23	26	25	22
	Expected	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	Deviation	-1	0	-12	19	-4	10	-5	11	0	0	-4	2	6	-5	-11	-8	-5	-6	-9
	Deviation2	1	0	144	361	16	100	25	121	0	0	16	4	36	25	121	64	25	36	81
37.93548	D2/E	0.032258065	0	4.64516129	11.64516129	0.516129032	3.225806452	0.806451613	3.903225806	0	0	0.516129	0.129032	1.16129	0.806452	3.903226	2.064516	0.806452	1.16129	2.612903
sTAGE 2		*acesibilty*	*accuracy*	*completeness*	*relevance*	*importance*	*clarity*	*cost*	*validity*	*up-to-dat*	*ease and spee*	*ease and s*	*visual rep*	*right level*	*nuggetsoj*	*non-scien*	*open-end*	*intuitivene*	*simplicitiy*	*openess*
	Observed	29	31	26	48	31	33	24	40	28	26	20	27	39	25	15	14	21	28	19
	Expected	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
	Deviation	-1	1	-4	18	1	3	-6	10	-2	-4	-10	-3	9	-5	-15	-16	-9	-2	-11
	Deviation2	1	1	16	324	1	9	36	100	4	16	100	9	81	25	225	256	81	4	121
47	D2/E	0.033333333	0.033333333	0.533333333	10.8	0.033333333	0.3	1.2	3.333333333	0.133333	0.533333333	3.333333	0.3	2.7	0.833333	7.5	8.533333	2.7	0.133333	4.033333
sTAGE 3		*acesibilty*	*accuracy*	*completeness*	*relevance*	*importance*	*clarity*	*cost*	*validity*	*up-to-dat*	*ease and spee*	*ease and s*	*visual rep*	*right level*	*nuggetsoj*	*non-scien*	*open-end*	*intuitivene*	*simplicitiy*	*openess*
	Observed	21	33	23	35	28	30	17	37	20	24	17	20	29	13	9	9	20	22	11
	Expected	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
	Deviation	-6	6	-4	8	1	3	-10	10	-7	-3	-10	-7	2	-14	-18	-18	-7	-5	-16
	Deviation2	36	36	16	64	1	9	100	100	49	9	100	49	4	196	324	324	49	25	256
64.7037	D2/E	1.333333333	1.333333333	0.592592593	2.37037037	0.037037037	0.333333333	3.703703704	3.703703704	1.814815	0.333333333	3.703704	1.814815	0.148148	7.259259	12	12	1.814815	0.925926	9.481481
sTAGE 4		*acesibilty*	*accuracy*	*completeness*	*relevance*	*importance*	*clarity*	*cost*	*validity*	*up-to-dat*	*ease and spee*	*ease and s*	*visual rep*	*right level*	*nuggetsoj*	*non-scien*	*open-end*	*intuitivene*	*simplicitiy*	*openess*
	Observed	18	23	20	33	23	22	13	28	21	14	14	25	27	15	14	10	13	19	10
	Expected	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
	Deviation	-7.5	-2.5	-5.5	7.5	-2.5	-3.5	-12.5	2.5	-4.5	-11.5	-11.5	-0.5	1.5	-10.5	-11.5	-15.5	-12.5	-6.5	-15.5
	Deviation2	56.25	6.25	30.25	56.25	6.25	12.25	156.25	6.25	20.25	132.25	132.25	0.25	2.25	110.25	132.25	240.25	156.25	42.25	240.25
60.34314	D2/E	2.205882353	0.245098039	1.18627451	2.205882353	0.245098039	0.480392157	6.12745098	0.245098039	0.794118	5.18627451	5.186275	0.009804	0.088235	4.323529	5.186275	9.421569	6.127451	1.656863	9.421569

Table D.13 Chi-squared test for ‘Intensity’ dimension - OVERALL responses on Depth, Diversity and Frequency categories

Depth

STAGE 1		1	2	3	4	5	6	7
	Observed	2	2	11	13	13	9	14
	Expected	9.14	9.14	9.14	9.14	9.14	9.14	9.14
	Deviation	-7.14	-7.14	1.86	3.86	3.86	-0.14	4.86
	Deviation2	50.9796	50.9796	3.4596	14.8996	14.8996	0.0196	23.6196
17.38044	D2/E	5.577636761	5.577636761	0.378512035	1.630153173	1.630153173	0.00214442	2.584201313

STAGE 2		1	2	3	4	5	6	7
	Observed	1	2	5	10	18	14	13
	Expected	9	9	9	9	9	9	9
	Deviation	-8	-7	-4	1	9	5	4
	Deviation2	64	49	16	1	81	25	16
28	D2/E	7.111111111	5.444444444	1.777777778	0.111111111	9	2.777777778	1.777777778

STAGE 3		1	2	3	4	5	6	7
	Observed	1	2	6	8	15	8	17
	Expected	8.14	8.14	8.14	8.14	8.14	8.14	8.14
	Deviation	-7.14	-6.14	-2.14	-0.14	6.86	-0.14	8.86
	Deviation2	50.9796	37.6996	4.5796	0.0196	47.0596	0.0196	78.4996
26.88663	D2/E	6.262850123	4.631400491	0.562604423	0.002407862	5.781277641	0.002407862	9.643685504

STAGE 4		1	2	3	4	5	6	7
	Observed	1	2	9	15	7	8	12
	Expected	7.71	7.71	7.71	7.71	7.71	7.71	7.71
	Deviation	-6.71	-5.71	1.29	7.29	-0.71	0.29	4.29
	Deviation2	45.0241	32.6041	1.6641	53.1441	0.5041	0.0841	18.4041
19.64056	D2/E	5.839701686	4.228806744	0.215836576	6.892879377	0.06538262	0.010907912	2.387042802

Diversity

STAGE 1		1	2	3	4	5	6	7
	Observed	0	2	7	12	14	14	14
	Expected	9	9	9	9	9	9	9
	Deviation	-9	-7	-2	3	5	5	5
	Deviation2	81	49	4	9	25	25	25
24.22222	D2/E	9	5.444444444	0.444444444	1	2.777777778	2.777777778	2.777777778

STAGE 2		1	2	3	4	5	6	7
	Observed	1	3	15	11	9	11	12
	Expected	8.85	8.85	8.85	8.85	8.85	8.85	8.85
	Deviation	-7.85	-5.85	6.15	2.15	0.15	2.15	3.15
	Deviation2	61.6225	34.2225	37.8225	4.6225	0.0225	4.6225	9.9225
17.27203	D2/E	6.96299435	3.866949153	4.273728814	0.522316384	0.002542373	0.522316384	1.121186441

STAGE 3		1	2	3	4	5	6	7
	Observed	1	8	9	12	11	5	10
	Expected	8	8	8	8	8	8	8
	Deviation	-7	0	1	4	3	-3	2
	Deviation2	49	0	1	16	9	9	4
11	D2/E	6.125	0	0.125	2	1.125	1.125	0.5

STAGE 4		1	2	3	4	5	6	7
	Observed	5	8	8	12	6	7	8
	Expected	7.71	7.71	7.71	7.71	7.71	7.71	7.71
	Deviation	-2.71	0.29	0.29	4.29	-1.71	-0.71	0.29
	Deviation2	7.3441	0.0841	0.0841	18.4041	2.9241	0.5041	0.0841
3.816952	D2/E	0.952542153	0.010907912	0.010907912	2.387042802	0.3792607	0.06538262	0.010907912

Frequency

STAGE 1		1	2	3	4	5	6	7
	Observed	1	1	3	14	10	14	20
	Expected	9	9	9	9	9	9	9
	Deviation	-8	-8	-6	5	1	5	11
	Deviation2	64	64	36	25	1	25	121
37.33333	D2/E	7.111111111	7.111111111	4	2.777777778	0.111111111	2.777777778	13.44444444

STAGE 2		1	2	3	4	5	6	7
	Observed	1	1	6	9	16	14	15
	Expected	8.85	8.85	8.85	8.85	8.85	8.85	8.85
	Deviation	-7.85	-7.85	-2.85	0.15	7.15	5.15	6.15
	Deviation2	61.6225	61.6225	8.1225	0.0225	51.1225	26.5225	37.8225
27.8935	D2/E	6.96299435	6.96299435	0.91779661	0.002542373	5.776553672	2.996892655	4.273728814

STAGE 3		1	2	3	4	5	6	7
	Observed	0	4	8	12	15	7	11
	Expected	8.14	8.14	8.14	8.14	8.14	8.14	8.14
	Deviation	-8.14	-4.14	-0.14	3.86	6.86	-1.14	2.86
	Deviation2	66.2596	17.1396	0.0196	14.8996	47.0596	1.2996	8.1796
19.02423	D2/E	8.14	2.105601966	0.002407862	1.83041769	5.781277641	0.15965602	1.004864865

STAGE 4		1	2	3	4	5	6	7
	Observed	2	5	9	9	10	10	9
	Expected	7.71	7.71	7.71	7.71	7.71	7.71	7.71
	Deviation	-5.71	-2.71	1.29	1.29	2.29	2.29	1.29
	Deviation2	32.6041	7.3441	1.6641	1.6641	5.2441	5.2441	1.6641
7.189196	D2/E	4.228806744	0.952542153	0.215836576	0.215836576	0.680168612	0.680168612	0.215836576

Appendix E

Key finding from each research study in regards to detailing the information framework

Table E.1 Key findings from each research study in regards to detailing the framework

Dimension	Result	
Purpose	***Discover ----***	
	Interview	-
	Design Bugs Out	*Insight, Inspiration, Information*
	24-hour Challenge	*Insight, Empathy, Inspiration*
	Survey	*Insight, Inspiration, Empathy*
	Define----	
	Interview	-
	Design Bugs Out	*Information, Communication*
	24-hour Challenge	*Inspiration, Insight, Communication, Information*
	Survey	*Communication, Information, Insight*
	Develop ----	
	Interview	-
	Design Bugs Out	*Evaluation, Information, Empathy*
	24-hour Challenge	*Evaluation, Confirmation, Information*
	Survey	*Confirmation, Evaluation, Communication*
	Deliver ----	
	Interview	-
	Design Bugs Out	*Communication, Confirmation*
	24-hour Challenge	*Confirmation, Communication, Evaluation*
	Survey	*Communication, Confirmation support*
Source	***Discover ----***	
	Interview	*Explicit , Tacit*
	Design Bugs Out	*User research, Previous experience, Internet, Books*
	24-hour Challenge	*User research, Intuition, Internet, Client*
	Survey	*User research, Intuition & experience, Other projects*
	Define ----	
	Interview	*Explicit , Tacit*
	Design Bugs Out	*User research, Previous stage, Intuition*
	24-hour Challenge	*User research, Intuition, Previous stage*
	Survey	*User research + Previous stage, Intuition, Client*
	Develop ----	
	Interview	*Explicit , Tacit*
	Design Bugs Out	*Other projects, Previous stages, Specialists*
	24-hour Challenge	*User research, Previous stages, Intuition*
	Survey	*Previous stages, User research, Client + Intuition*
	Deliver ----	
	Interview	*Explicit , Tacit*
	Design Bugs Out	*Previous stages, Other projects, Intuition*
	24-hour Challenge	*Previous stages, User research, Intuition, Client*
	Survey	*User research, Client, Previous stages + Specialists*

Type	***Discover ----***	
	Interview	-
	Design Bugs Out	*Experience & context of use, Needs, Problems*
	24-hour Challenge	*Problems, Needs, Experience & context of use*
	Survey	*Experience & context of use, Needs + Problems + Behaviour, Emotions & aspirations*
	Define ----	
	Interview	-
	Design Bugs Out	*Experience & context of use, Needs, Problems*
	24-hour Challenge	*Physical & sensory capabilities, Experience & context of use, Problems*
	Survey	*Needs, Experience, context of use, Behaviour*
	Develop ----	
	Interview	-
	Design Bugs Out	*Dimension, Physical capability, Experience, Statistics*
	24-hour Challenge	*Experience & context of use, Physical & sensory capabilities, Emotions, Needs*
	Survey	*Needs, Behaviour, Cognitive capability*
	Deliver ----	
	Interview	-
	Design Bugs Out	*Statistics, Needs, Problems, Behaviour*
	24-hour Challenge	*Emotions, Behaviour, Needs, Problems, Experience*
	Survey	*Experience, context of use, Behaviour, Needs + Emotions, aspirations & personality*
Format	***Discover ----***	
	Interview	*Formal, Informal*
	Design Bugs Out	*Qualitative, Info-graphics, Video, Quotes & anecdote*
	24-hour Challenge	*Qualitative, Raw, Persona & scenario, Photographic records, Audio-oral*
	Survey	*Qualitative, Persona, scenario, Case studies*
	Define ----	
	Interview	*Formal, Informal*
	Design Bugs Out	*Info-graphics, Numerical, Persona & scenario*
	24-hour Challenge	*Qualitative, Quotes & anecdotes, Persona & scenario, Photographic records, Audio-oral*
	Survey	*Qualitative, Persona, scenario, Quantitative + Processed*
	Develop ----	
	Interview	*Formal, Informal*
	Design Bugs Out	*Info-graphics, Raw*
	24-hour Challenge	*Qualitative, Persona & scenario, Photographic records, Video*
	Survey	*Qualitative, Persona, scenario + Quantitative, Processed, structured*
	Deliver ----	
	Interview	*Formal, Informal*
	Design Bugs Out	*Info-graphics, Photographic records, Quotes*
	24-hour Challenge	*Qualitative, Photographic records, Video, Quotes & anecdotes, Persona & scenario*
	Survey	*Qualitative, Processed, structured, Quantitative + Numerical + Written report*
Attributes	***Discover ----***	
	Interview	*Usefulness, Usability, Desirability*
	Design Bugs Out	*Accessibility, Right level of detail, Value, Presentation*
	24-hour Challenge	*Relevance, Validity, Ease of use & search, Clarity*
	Survey	*Relevance, Validity & reliability, Clarity*
	Define ----	
	Interview	*Usefulness, Usability, Desirability*
	Design Bugs Out	*Importance, Level of detail, Validity*

	24-hour Challenge	*Relevance, Clarity, Simplicity, Importance*		
	Survey	*Relevance, Validity & reliability, Right level of detail*		
	Develop ----			
	Interview	*Usefulness, Usability, Desirability*		
	Design Bugs Out	*Accessibility, Relevance, Validity, Accuracy*		
	24-hour Challenge	*Relevance, Importance, Accuracy*		
	Survey	*Validity & reliability, Relevance, Accuracy*		
	Deliver ----			
	Interview	*Usefulness, Usability, Desirability*		
	Design Bugs Out	*Importance, Validity, Clarity*		
	24-hour Challenge	*Relevance, Simplicity, Clarity*		
	Survey	*Relevance, Validity & reliability, Right level of detail*		
Intensity	***Discover ----***			
	Interview	-		
	Design Bugs Out	Depth 2.65	Range 3.65	Frequency 4.65
	24-hour Challenge	Depth 5.41	Range 4.13	Frequency 5.75
	Survey	Depth 4.50	Range 4.97	Frequency 5.14
	Define ----			
	Interview	-		
	Design Bugs Out	Depth 4.95	Range 4.50	Frequency 4.40
	24-hour Challenge	Depth 5.25	Range 3.15	Frequency 5.63
	Survey	Depth 5.18	Range 4.67	Frequency 5.24
	Develop ----			
	Interview	-		
	Design Bugs Out	Depth 5.10	Range 3.30	Frequency 4.10
	24-hour Challenge	Depth 4.61	Range 4.11	Frequency 5.11
	Survey	Depth 5.20	Range -	Frequency 4.76
	Deliver ----			
	Interview	-		
	Design Bugs Out	Depth 2.40	Range 3.65	Frequency 3.90
	24-hour Challenge	Depth 3.61	Range 3.90	Frequency 4.10
	Survey	Depth 4.80	Range -	Frequency -
Stage	Interview	-		
	Design Bugs Out	*Discover, Define, Develop, Deliver*		
	24-hour Challenge	*Discover, Define, Develop, Deliver*		
	Survey	*Discover, Define, Develop, Deliver*		