Information Behaviour in Design;
A Conceptual Framework

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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 paper.

Keywords: Information behaviour · Designers · Designers' information behaviour

1 Introduction, Motivation and Scope

'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 2004; 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 a research was 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 was hoped that through this, the limited understanding of designerly ways of knowing could be improved, new and existing design approaches were better supported and their uptake by designers was facilitated, and the design and development of new information tools was better informed.

- **Scope of research**

In studying designers' information behaviour, this research specifically focused 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 were focused upon.

- **Practicing designers**

Student designers and design practitioners have different needs, attitudes and criteria when approaching a design task (Ahmed et al. 2003) and thus different information behaviour. This research focused 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 focused on 'people information' as a major type of information used throughout the design process. Here, people information is broadly defined as 'all types of information that help designers better understand people and their context'.

2   Methodology and Methods

After the review of a number of relevant social sciences and design research methodologies, 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 adopted an integrative approach to existing research methodologies where the general elements of DRM (Blessing and Chakrabarti 2009) and Case's stages of research process (2008) were applied and Robson's (2002) research methodology was also implemented in specifying research methods and techniques of data collection and analysis.

The study adopted a convergent methodology (Goodman et al. 2006) through employing a number of research methods. The research triangulation (Jick 1979; Creswell and Clark 2007) approach was 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 was 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 varied 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 was hoped to be improved. Figure 1 presents the schematic research methodology adopted by this research. Table 1 presents a breakdown of studies and relevant methods used in the second stage of the research.
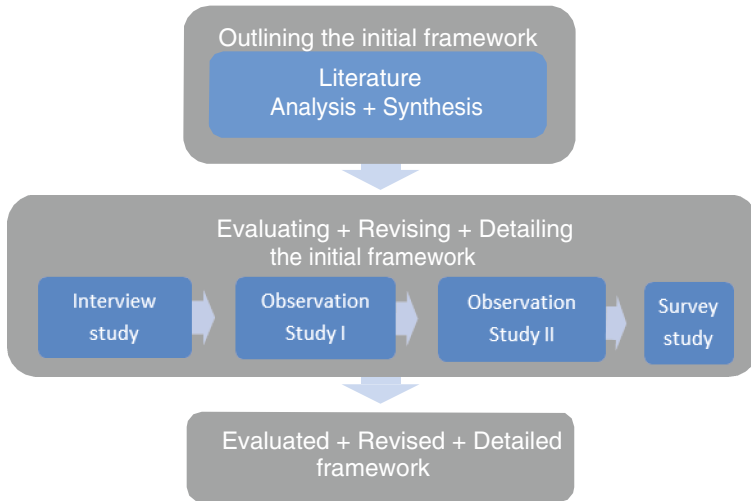

Fig. 1. Research methodology in this research

Table 1. Research strategies and methods 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 Results and Findings

3.1 Literature Analysis + Synthesis

An illustrative review of knowledge of information behaviour was carried out on the library and information sciences and design respectively. The existing knowledge of information behaviour in these two fields was then analysed. The key identified aspects and facets of information behaviour in these two fields were then synthesised and linked 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.

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 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'.
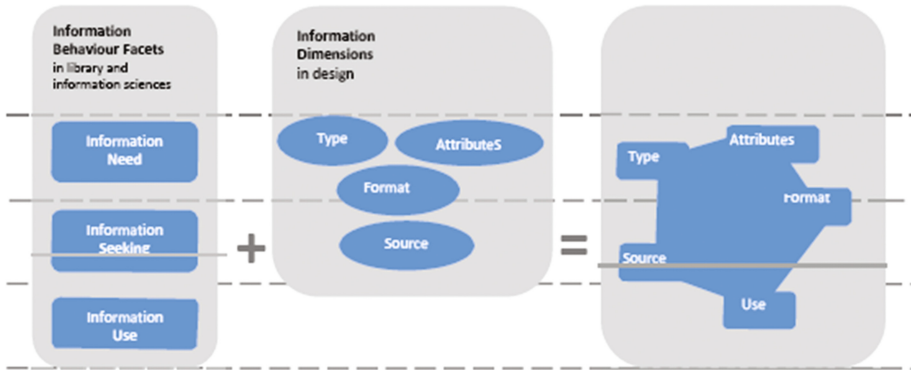
Fig. 2. Synthesis of 'Initial Information Framework' for information behaviour in design

3.2 Interviews with Designers

This study built on the findings from the literature analysis in two areas of library and information sciences and design. The initial information framework was implemented in this study and evaluated, refined and detailed. Using interviews and ranking questionnaire with nine selected UK-based design companies each of the five dimensions of the initial framework were explored and further detailed them by identifying sub-dimensions to each. Also, head designers' responses to five selected design support tools in form of comments and numerical ranking in order of preference were collected.

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 made 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.

3.3   Observation of Designers – Two Studies

After conducting interview and ranking questionnaire (as the first of the three research methods), the framework was refined, evaluated and detailed in a second iterative cycle through conducting observation together with self report follow-up questionnaire. Two separate real- world field studies were partaken in order to observe designers' information behaviour. The first study aimed to 'observe designers in practice' through observing the design process of one real- world design project. 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 and the first Observational study, a second real-world observational study was conducted. This included observation of three teams of designers responding to one design brief in the context of a design competition. In line with previous studies, 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.

Findings from both observational studies 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.

3.4   Survey of Designers and Design Researchers

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. An online survey was designed and completed by 90 participants overall (67 participants detailing the framework and 90 participants evaluating and refining 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 three main aspects:

- Visual representation of the framework
- The relationship between its dimensions
- The terminology used to communicate the framework. The dimensions with an unclear terminology included 'Attributes', 'Intensity', 'Purpose', and 'Type' versus 'Format'.

Figure 3 shows the Information Framework based on interview and observational studies and the suggested refinements to the framework based on survey study.
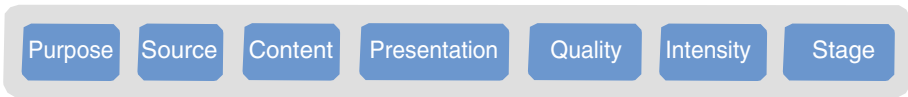

Fig. 3. Information Framework based on interview, observational studies and survey results

4 Conclusion and Further Work

4.1 Conclusion

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

The research reported in this paper has made three contributions to the knowledge in this field:

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

4.2 Further Work

Having revisited the core focus of this research and its boundaries, a number of areas to be explored 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.

- **Developing a model of information behaviour in design.** This research resulted in the creation and detailing of a framework for studying information behaviour in design. Findings 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, a model is defined as a set of assumptions about underlying processes between the elements which cause that phenomenon. 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. This could be a significant additional contribution and a step forward in the under- explored area of information behaviour in design.
- **Comparative study of student and experienced designers' information behavior.** This research focused on detailing the information framework based on empirical studies of practicing designers, focusing on people information. However, as Ahmed et al. (2003) 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. 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.
- **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. 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.
- **Research on information intensity.** 'Intensity' was 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.

- **Cultural differences in designers' information behavior.** 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 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.

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