IMPROVING WAYFINDING IN OLD AND COMPLEX HOSPITAL ENVIRONMENTS

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All photographs in this thesis were taken by the author except for the four which appear in Figure 63. The floor plan of the Red Zone was produced by a colleague (Dr Raju Pathmeswaran) during the collaboration exercise described in the experimentation document in Appendix 4 and the design of the actual Wayfinding Wheel seen in Appendix 6 and at the result of collaborative work between the author and the graphic designer team at Blue Apple Printing, Manchester, UK

ABBREVIATIONS

A&E: Accident and Emergency

AI: Archinnovations

CMFT: Central Manchester Foundation Trust

CR: Constructive Research

CUD: Center for Universal Design

CUH: Cambridge University Hospitals

DCE: Deputy Chief Executive

DDA: Disability Discrimination Act

DMP: Decision Making Point

DOH: Department of Health

DRSP: Design science research process

DS: Design science

DSR: Design science research

ECDU: Emergency Clinical Decision Unit

EM: Ethnomethodology

EPSRC: Engineering and Physical Research Council

HHC: Health and Hospitals Corporation

ICT: Information and Communication Technology

IT: Information Technology

KIM: Knowledge and Information Management

KM: Knowledge management

MRI: Manchester Royal Infirmary

ND: No Date

NHS: National Health Service

NRES: National Research Ethics Service

NYU: New York University

NYUDOH: New York University Department of Health

PALS: Patient Advice and Liaison Services

PE: Passini Era

PFI: Private Finance Initiative

PoPE: Post Passini Era

PrePE: Pre Passini Era

RIBA: Royal Institute of British Architects

TFV: Transformation Flow Value

TPS: Toyota Production System

UA: Unique Adequacy

UHB: University Hospitals Birmingham

UHSM: University Hospitals South Manchester

VM: Virginia Mason

WCF: Wayfinding Conceptual Framework

WRVS: Women's Royal Voluntary Service

ABSTRACT

Many hospitals have developed over a number of years in a piecemeal fashion. This has resulted in complex environments made up of long and confusing corridor systems with bends, turns, and confusing signs. Such settings challenge and frustrate those who visit them. The importance of wayfinding to building use, costs and safety and the growth in terms of theories, principles, guidelines, and methodologies over the years does not appear to have made an impact on wayfinding performance in complex hospitals. Thus, there remains a need to find more effective wayfinding solutions to the problems that continue to occur in complex hospitals. This research aims at improving methods for developing wayfinding systems and strategies in old and complex hospital environments. The study adopts a design science research approach informed by uniquely adequate observations of how wayfinders make sense of wayfinding information embedded in the complex built environments they have to navigate. The approach includes an extensive review of literature on wayfinding supported by that of the fields of knowledge management, design (architectural and industrial), and production and operations management. The research brings together the disciplines of design and knowledge management to sensitise designers to the varied needs and knowledge levels of wayfinders when designing wayfinding systems. Drawing on findings from both the review of literature and extensive ethnographic fieldwork the research has produced prescriptive and evaluative wayfinding frameworks to aid the design of effective and efficient wayfinding systems and strategies. The outcome of successfully applying the design science research approach to researching the problems of wayfinding and mapping the approach research process with the unique adequacy approach is the Wayfinding Conceptual framework. It represents a methodological contribution, aimed at helping to mitigate the problem of relevance often associated with academic management research.

INTRODUCTION

1.1 INTRODUCTION

This Chapter provides an introduction to this research which focuses on the need to solve the problems of wayfinding that continue to occur in old and complex hospital environments in spite of the developments in the field of wayfinding since the term was first used in the 1960s. The background to the research is discussed first, followed by the choice of research focus. The aim and objectives of the research are presented prior to a brief summary of the methodological approach adopted for the study. The structure of the entire thesis is offered last.

1.2 BACKGROUND TO THE RESEARCH

Evidence suggests that people often blame themselves for lacking the acumen to navigate complex environments (Arthur and Passini 1992, Department of Health (DOH) 2005, Rooke et al. 2009, 2010a, 2010b). However, several scholars (e.g. Arthur and Passini, 1992, Butler et al. 1993, Haq and Zimring 2003, Baskaya et al. 2004) shift the blame away from the wayfinder. They assert that getting lost is an indication of either a poorly designed environment or wayfinding systems/strategies designed to guide people and not inadequacy on the part of the wayfinder. Arthur and Passini (1992) observe that society is increasingly becoming less tolerant of the idea that people's inability to find their way in the built environment is either trivial or unimportant. The emergence of theories, principles, guidelines, and methodologies aimed at solving the problems of getting lost can be seen as sufficient evidence to support this observation. However, Arthur and Passini (1992) caution that although the notion of wayfinding is accepted by many people, it is yet to make a full impact on the design profession.

But whose responsibility is it to give careful consideration to wayfinding matters? Arthur and Passini (1992) represent the views of many where they point out that such responsibility not only lies with the design profession (e.g. architects and graphic designers) but with management too (e.g. building owners and building managers). The latter was found to be true of the hospital used as the main case study for this research. The representatives of the hospital's Redevelopment team made it clear from the outset that due to time constraints and lack of expertise in the area of wayfinding they tended to rely on the expertise of architects,

graphic designers or wayfinding consultants.

However, the challenges associated with designing for the wayfinding needs of the different groups of users (e.g. the blind, elderly, children, newcomers, foreign visitors, wheelchair users etc.) who visit complex environments such as hospitals are immense. Huelat (2004:4) observes that these people bring with them 'different levels of knowing' which 'invoke different needs'. The first time visitors, for example, may find the healthcare facility more foreign to them than a distant country. Their lack of experience and knowledge of the setting may, therefore, lead to greater confusion, she contends. Some will enter the setting aware of their ignorance but refuse to learn. This kind will insist on being escorted all the way to their destination. Then there are those who will choose to navigate on their own because they are too embarrassed to be seen as lacking in appropriate knowledge. These often end up lost due to the complex layout of the environment with large volumes of signs designed to explain the complex routes to the wayfinders (Rooke et al 2010a). Others will enter fully aware of their ignorance and will be proactive in seeking out information.

With such a varied range of needs, abilities and knowledge levels, one may be forgiven for questioning the possibility of designing an effective and efficient wayfinding system/strategy or indeed buildings that will meet the needs of all. Take for example one wayfinding principle for positioning direction giving signs; *the sign must not be too high or too low the eye level* (DOH, 2005). Whose eye level one may be permitted to ask? Is it that of; an average height able-bodied visitor, a child or a wheelchair user? The tension highlighted here reaffirms the long standing emphasis on the need to give careful consideration to issues of wayfinding when designing both buildings and wayfinding strategies/systems (Arthur and Passini, 1992).

Despite the impressive developments in wayfinding, visitors to old and complex environments such as hospitals continue to be frustrated by confusing wayfinding systems designed to aid them in finding their way. In the United Kingdom alone a large volume of NHS hospitals are in need of urgent repair. This is evident in the day-today conversations of the general public about their experiences of visiting NHS hospitals. The author's vast knowledge of NHS hospital settings gained as a nurse, visitor and patient also bears witness to the assertion above. It, however, remains unclear how wayfinding guidance [e.g. Wayfinding: Effective wayfinding and signing systems (DOH 2005)] aimed specifically at improving wayfinding in existing NHS hospitals appears to have made so little impact given that the

guidance is more than a decade old.

From what has been said so far three points are suggested: 1) that despite the positive growth in the fast emerging field of wayfinding there remains a need to find a solution to the problems that continue to occur in old and complex environments; 2) that solving such problems requires more than the input of architects and graphic designers and 3) that successful wayfinding is a result of effectively communicating wayfinding information to visitors throughout the building's lifecycle.

1.3 CHOICE OF RESEARCH FOCUS

Evidence gathered from the review of literature on wayfinding indicates that most wayfinding systems in older and more complex environments tend to heavily rely on coded information and the social practice of giving directions by word of mouth (see section 3.2). Little attention is paid to the role played by the physical properties of the environment itself in communicating wayfinding information with its visitors (Arthur and Passini 1992). This thesis offers insight into the invaluable role of the physical (including among others visual and tactile) properties of older and complex built environments in the preservation and transfer of knowledge through subsequent stages of its life-cycle. In particular, it seeks to explicate the relationship between the physical features of the built environment and the coded wayfinding information (signage and graphics).

In addition, the need to learn from the behaviour of the wayfinders in order to develop better wayfinding design is emphasised. It is argued that this should lead to the identification of barriers faced and an in-depth understanding of the needs of all types of visitors and the consequent production of guidelines for realising effective wayfinding solutions. This thinking resonates with Carpman and Grant's (2003) call for people-centred methodologies and techniques which should allow the effective study of how wayfinders find their way (see section 3.2.3).

The core argument of this thesis is that from uniquely adequate descriptions of the behaviour of wayfinders it is possible to make contextual recommendations for improvement and develop generic wayfinding guidelines. Sections 2.4, 2.5 and Chapter 5.0 offer insights into the ethnomethodologically informed unique adequacy criteria which is believed to be a

suitable people-centred methodology. In its attempt to develop guidelines for solving wayfinding problems occurring in old and complex environments such as hospitals the study makes the following assumption: that a sound understanding of the actions of the wayfinders is fundamental to the design of effective and efficient wayfinding systems. This understanding, as will be argued later, can be gained through observing the requirements of unique adequacy, a concept informed by the practice of ethnomethodology.

The unit of analysis of the study is older and complex hospital environments. The large complex hospital environment of Salford Royal National Health Service (NHS) Foundation Trust is used as the main case study. Here the inadequacy of the wayfinding system is recognized by management, staff and users alike. In addition brief ethnographic studies were conducted in other hospitals in the UK, Europe and the USA. Furthermore, other complex settings such as hotels, airports, the London underground tube network and railway stations became available for study thus providing useful comparison on a more generic level.

1.4 AIM AND OBJECTIVES

The overall aim of this research is to improve methods for developing the process of the design of wayfinding systems and strategies in old and complex environments such as hospitals. Specific objectives include:

1. Gaining an understanding into how wayfinders make sense of wayfinding information embedded in the physical properties of the built environments.
2. Establishing an effective and efficient way of managing knowledge/information for the purposes of improving wayfinding performance in old and complex hospitals
3. Developing generic guidelines for improving wayfinding in old and complex hospital environments.
4. Establishing the value or utility of suggested guidelines through testing them in real life.

1.5 METHODOLOGICAL APPROACH

Figure 1 shows a graphical representation of the main activities of this research.

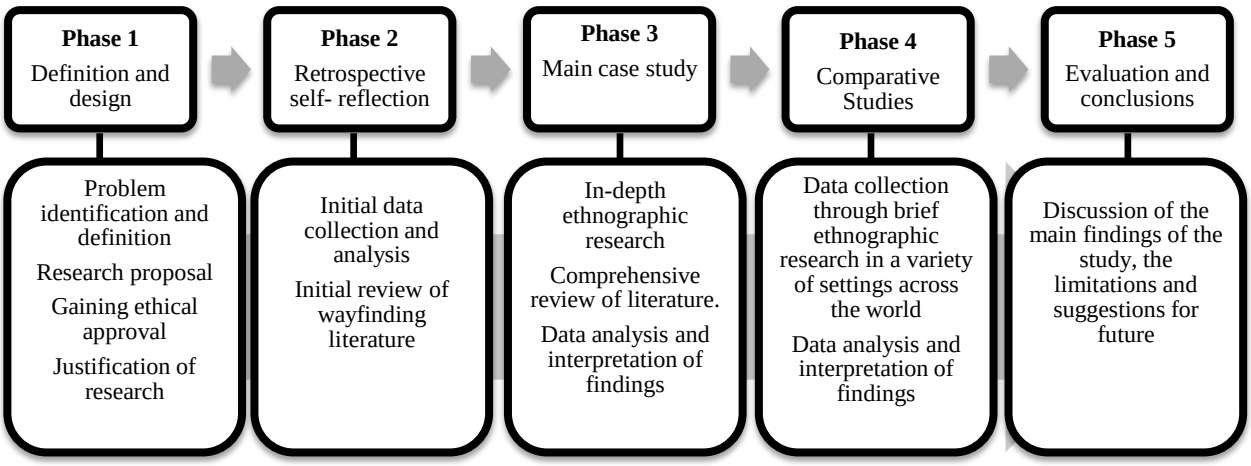


Figure 1. A graphical summary of the research design and methodology

The activities of the research are divided into five phases. In the first phase initial problem identification and definition occurred. It was a collaborative activity which involved researchers from the University of Salford and representatives of the Salford Royal NHS Foundation Trust. The wayfinding problems of the old and complex Salford Royal hospital were described by those representing the hospital's redevelopment team in a manner that made it apparent that the organisation was having difficulty in communicating wayfinding information to its visitors. This was followed by the development of a proposal, justification of the research and gaining ethical approval from the appropriate bodies.

Having decided on the main research focus, the objectives of the study and the research design, the second, third and fourth phases reviewed relevant literature and conducted ethnographic fieldwork simultaneously. Fieldwork findings were constantly compared with those from the review of literature from the outset. In the fifth phase the proposed solutions to the problems of wayfinding were evaluated and conclusions were drawn

The study adopts the problem solving research method of Design Science (DS) also known as Constructive Research (CR). The study departs from the traditional practice of conducting an extensive review of literature prior to problem identification. The decision to do so was influenced by three factors: 1) the author's own knowledge of the current and persistent nature of wayfinding problems in UK hospitals; 2) the demands of the unique adequacy approach and 3) the demands of the design science research approach which advocates an in-depth understanding of situated problems and the development of solutions that are relevant

to the problems identified. A detailed discussion of both the research design and process is offered in Chapter 2.0

1.6 STRUCTURE OF THE THESIS

This thesis is divided into eight Chapters which are summarised as follows.

Chapter one presents a general introduction to the thesis and the background to the study prior to outlining the research problem, the need for research and its aim and objectives. A brief description of the methodological approach adopted for the study is given.

Chapter two presents a detailed discussion of the Design Science Research approach. The discussion includes a brief justification of the choice of the research method, the historical background of its emergence, its main concepts and how it is complemented by the approach of unique adequacy.

Chapter three presents a review of literature paying particular attention to the historical developments, the importance of good wayfinding design and solutions (e.g. theories, methodologies, guidelines and principles) that have been developed over the years. A discussion of relevant literature from supporting disciplines of knowledge management, production and operations management and design is also offered.

Chapter four reports on the uniquely adequate ethnographic fieldwork conducted in three phases:

1. A self-reflective retrospective study of the author's own wayfinding experience prior to commencing this study
2. An in-depth study of the problems of wayfinding at Salford Royal hospital the main case study
3. Brief ethnographic studies carried out in selected hospitals in other parts of the United Kingdom (Manchester, London, Birmingham and Scotland), the world (Denmark, Italy, USA and Germany) including also other complex environments such as airports, hotels, the London underground tube network and railway stations connected to the visits.

Chapter five concentrates on giving a detailed analysis of the uniquely adequate data presented in the Chapter four. The primary goal of the exercise is to produce rich uniquely

adequate descriptions of the behaviour of wayfinders upon which suitable wayfinding guidelines can be developed.

In Chapters six and seven the focus is on the process of developing and evaluating wayfinding guidelines in accordance with the requirements the DSR approach. The exercise brings together findings from the review of literature and empirical research. Solutions to the problems identified are articulated and the evaluation of the utility of some of the proposed solutions is performed.

Chapter eight presents an overview of the entire process of conducting the research, examining the extent to which the aim and objectives of the research have been achieved. The main findings of the research are discussed highlighting the contextual implications of the results. Suitable recommendations are suggested including the limitations of the research with a view to assisting future research in the field of wayfinding summary

Additional information to do with the research which would other disrupt the smooth flow of the thesis is presented separately in appendices (see section Appendix 6).

1.7 SUMMARY

This Chapter has presented an introduction to the research presented in this thesis starting with the background to the research. The need to find more suitable solutions for wayfinding problems that continue to occur in old and complex hospitals has been emphasised. The choice of research focus, research problem, the aim and objectives of the study have been discussed. A summary of the methodology employed throughout the research process has been given and the importance of both a human-centred and problem centred research method has been highlighted.

The next Chapter presents a detailed discussion of the research method.

2 RESEARCH METHOD

2.1 INTRODUCTION

This Chapter presents a detailed discussion of the Design Science Research (DSR) methodology, a problem solving research approach whose main preoccupation is with designing artefacts of value/utility. It considers in brief the emergence of the approach followed by a discussion of theoretical concepts in the second part. A discussion of how the approach is complemented by the ethnomethodologically informed approach of unique adequacy is offered in the third part. Here it is asserted that the latter approach can be relied upon during both the problem identification and evaluation stages.

The forth part considers in detail the relationship between Design Science, Unique Adequacy (UA) and wayfinding. It focuses on how the DSR approach can be usefully applied to solving the problems of wayfinding and how effective problem identification and evaluation can be achieved by adhering to the demands of the unique adequacy approach. Here a contribution made to DSR by demonstrating the ways in which ethnographic fieldwork can contribute, both to the development of design principles and directly to the design of wayfinding systems in complex built facilities is outlined. The fifth presents the research process discussing in detail the research activities of each main phase of the study. The Chapter concludes with a summary of the main points.

2.2 JUSTIFICATION OF CHOICE OF RESEARCH METHOD

Over the years, different methodologies that can be used in the design and execution of research have been developed and used. However, evidence suggests that issues around research methodology continue to be debated across several academic disciplines. For example, Vygotsky (1931/1991:241) cited in Loftus (2006), when referring to the practice in the field of psychology, wrote:

> *Methodology is currently in a state of deep crisis … If this crisis goes unresolved, then radical developments in the field … will encounter the greatest obstacle of all, that is, its practical insignificance, the limited utility of its results. But if a way out of the crisis is to be found, then the methodology … must confront the enormous historical meaning of its tasks*

He also argued that the:

> *Blind transportation of the experiment, the mathematical method from the natural sciences, created in psychology the outward appearances of science, under which, in reality was hidden a complete powerlessness before the phenomena under study. (Vygotsky, cited in Van der Veer and Valsiner, 1991, p. 149).*

More than two decades later Vygotsky's sentiments were echoed by Wittgenstein (1958 #xiv), the philosopher of language:

> *'The existence of the experimental method makes us think that we have the means of solving the problems which trouble us; though problem and method pass one another by'*

Interestingly, Vygotsky and Wittgenstein's concerns continue to be expressed today. Dainty (2008: 10), for example, bemoans '...the apparent narrowness of the construction management research community's methodological outlook...' arguing that this is largely due to an enduring adherence to the positivist paradigm. His analysis of every paper published by *Construction Management and Economics* in Volume 24, 2006 reveals that 76 (71%) of the 107 papers sampled have their methodology firmly rooted within the positivist tradition. The belief that human organisation and human desires can be understood in terms of generalisations that function like laws of physics appears to be wide spread in the construction management research community. Runeson and Skitmore's (2008:75) statement below, for example, is fairly representative:

> *"To some, reality is governed by a set of rules of how variables inter-relate and science aims to uncover these rules so that we can understand and describe, through our theories, an objective reality that exists independent of us. To others, reality is subjective, a social construct, changing depending on who views it and existing only in our minds as our constructs."*

Dainty warns that an entrenched adherence to positivism will do little to enable construction management researchers to grasp the meaning of social action from the perspective of the actors involved**.** His observations endorse earlier arguments by Seymour and Rooke (1995) and Seymour et al (1997) who question the apparent dominance of positivism and criticize the '…scientific theorizing associated with realist ontological and epistemological positions, given that the 'object' of most construction management research is people' (Dainty 2008:1).

The above sentiments are also echoed in Hutchinson et al (2008:69) who assert that as true

Wittgenstenians (or any good 'human scientist') they:

> **'...** *do not confront the task of 'understanding other people' as any kind of general project, and find that any difficulties we meet in our studies do not arise from the impossibility of transcending conceptual disjunctions but from the substantive nature of the situations, practices, cultures etc., we are dealing with'*

Here Hutchinson et al reiterate Winch's (1990) earlier arguments that social studies investigations are very different in character from scientific ones and that the scientific mode of understanding is often wrongly used as a standard for understanding human action. Hutchinson et al (2008: 34) remind us, as Winch does, that as long as we are not blinded by philosophical misconceptions '...social actors can gradually be understood in their actions, without imposition of irony'. They point out that a sound understanding of human action involves more that interpretation/explanation. It involves descriptions of taken-for-granted understanding and understanding-in-practice, they argue.

From the arguments presented above an issue worthy of emphasis is that the pursuit of a radical approach that would challenge what appears to be an across the board entrenched adherence to positivism is ongoing. This begs an answer to the question of whether the methodological crisis will ever be resolved. The developments under the auspices of interpretivism (an alternative to positivism) can be seen as evidence that Vygotsky's initial call for radical methodological developments has not gone unheeded.

Hughes and Sharrock (1997) follow the rise of interpretivism from the early debates of German scholars such as Gottfried Herder (1744-1803), Gorge W. F. Hegel (1770-1831) and Karl Max (1818-1883). These debates, note Hughes and Sharrock (1997:96) extended the ideas of Giovanni Batista Vico (1660-1744) and Jean-Jacques Rousseau (1712-1778) both of whom rejected the conception of the rational individual in favour of the one of an individual '...as belonging to a wider social and cultural entity, namely, the moral and political association of society...' Thus interpretivism espouses the importance of understanding human behaviour (Bryman and Bell 2003). It is said to encompass other paradigms whose central tenet is that people are constantly involved in the interpretation of their ever-changing world (Pickard and Dixon 2004) where the topic of inquiry focuses on everyday activity (McNeill and Chapman 2005). Constructivism and pragmatism are cited as good examples of such paradigms (Williamson 2005). According to Koro-Ljungberg (2009) researchers

adopting this paradigm tend to use research methods such as action research, case studies, ethnographic studies, phenomenographic studies, and ethnomethodological studies.

The tendency in construction management research to position research in either the positivist or interpretivist camps is common and wide spread, notes Dainty (2008). He warns that by not nailing '...their colours to a particular philosophical mast and...' rooting '...their work within methodological paradigm' researchers within this field run the risk of finding themselves in methodological 'no mans land', (p: 10). Knight and Turnball (2008: 64) also caution against being '... bogged-down in irresolvable philosophical problems' stating that such an occupation is likely to slow down the progress of a research project especially where the researcher has never studied philosophy before. Dainty (2008: 10) urges researchers to have the courage to challenge historical views and entrenched attitudes if they are to obtain 'a richer understanding of the practice of construction management and the workings of the industry's organisations and projects...'

Dainty's (2008) arguments for methodological pluralism, an approach he sees as radical, is yet another attempt aimed at resolving the methodological crisis. The approach, inspired by '...the challenge to the positivist orthodoxy by the emergence of phenomenological and structuralist epistemological positions', advocates the use of multiple theoretical models and multiple methodological approaches (Dainty 2008 p: 8). According to Dainty adopting methodological pluralism rejects traditional dualisms by '...suggesting that no single methodology can ever provide a complete picture of the projects and organisations that form the arenas for construction management research' (p: 11). However, Hughes and Sharrock (1997:203) caution as Wittgenstein (1958) does against the thinking that '...the way in which to disagree with a given philosophical position is to develop an alternative solution to its problems' Doing so, they assert, is to perpetuate elements of the initial philosophical position by retaining and carrying forward some of its key misconceptions.

To his credit, Dainty (2008) is fully aware that the idea of mixing methodologies is not without its critics. The author acknowledges that advocating the combination of methods and methodologies is not a straightforward undertaking. He points to '...a range of philosophical, cultural and psychological hurdles...' which may confront researchers. For example, he notes that because research methods tend to be inexorably connected to the paradigm from which they originate mixing research methods may be seen as risky. This is in view of the current practice of expecting researchers to choose the rules that govern their research based on the

fundamental assumptions that they bring into their inquiry (Mingers 1997). Another challenge, notes Dainty, is the widely accepted practice of treating qualitative and quantitative research as separate paradigms even though areas of commonality exist between them. With this kind of background, how could one possibly think of mixing qualitative and quantitative methods once the paradigm (qualitative or quantitative) to govern the research has been decided from the outset?

The approach adopted for this research combines two sets of criteria in a manner that could be seen as addressing Dainty's (2008) concerns to an extent. It addresses the topic of inquiry by following two sets of criteria: 1) that which is prescribed by the design science research paradigm and 2) the ethnonomethodologically informed criteria of unique adequacy. As the discussion progresses, it will become apparent that design science research emphasises the importance of starting from the need to solve an existing problem rather than from philosophical positions. The problem must be identified in conjunction with a particular organisation or community in need of a solution and the latter must be tested for its usefulness.

As Dainty (2008) observes, it is common, if not expected, practice that a study must clearly define its philosophical grounding from the outset. The ideas presented in Crotty (2004), Creswell (2003) and Easterby-Smith et al (2004) bear testimony to this. According to some of these authors the researcher must make clear what their position is regarding: *ontology* (what is real), *epistemology* (what is knowledge), *axiology* (what is of value) and *methodology* (how do we go about studying it). Whilst this research distances itself from this practice and remains mindful of the pitfalls highlighted above, it fully recognises the merits of grounding one's approach in some form of philosophy. The philosophical grounding of design science research is summarised by Vaishnavi and Kuechler (2008: 17) for the purposes of ICT research (see Table 1 below).

Basic belief	*Explanation*
Ontology	Multiple, contextually situated alternative world-states Socio-technologically enabled
Epistemology	Knowing through making: objectively constrained construction within a context Iterative circumspection reveals meaning
Methodology	Developmental Measure artefactual impacts on the composite system
Axiology: what is of value	Control; creation; progress (i.e., improvement); understanding

Table 1. Philosophical Assumptions of the Design Research Perspectives adapted from Vaishnavi and Kuechler (2008)

The approach of unique adequacy is rooted in the philosophical arguments of Alfred Schutz (1898-1959), a social phenomenologist who stressed the intersubjectivity of social life and the fact that although meaning is imputed by individuals, it is nevertheless shared. Schutz (1973 p: 44) suggested the *Postulate of Adequacy* where he argued that:

> *Each term in a scientific model of human action must be constructed in such a way that a human act performed within the life-world by an individual actor in the way indicated by the typical construct would be understandable for the actor himself as well as for his fellow-men in terms of common-sense interpretation of everyday life. Compliance with this postulate warrants the consistency of the construct of the social scientist with the constructs of common-science experience of the social reality.*

Similar arguments can be seen in the work of Wittgenstein (1958) who questions all traditional philosophical approaches contending that most philosophical puzzles are the product of linguistic confusion. Wittgenstein focused on the intimate relationship between language and the context within which it is used or produced arguing that the meaning of words and utterances depends entirely on the way they are used in a particular context (Loftus 2006). He frequently encouraged that attention be paid to the unarticulated and usually ignored "ways of going on" and believed that ignoring these ways led to a misunderstanding of the ways in which we achieve our goals (Loftus 2006).

This section has highlighted the methodological crisis that continues to exist to this day and that this is largely due to the contested practice of adhering to either positivism or interpretivism when conducting research. The problem is more marked in construction

management research where it is clear that the application of practices borrowed from either the natural sciences or social sciences is not always appropriate. Dainty's (2008) offer of a solution to the construction management researcher dilemma ought to be applauded as a valiant attempt at offering something of value. His concerns are echoed by the proponents of design science research an approach which advocates the importance of making products of value. The next section focuses on a detailed discussion of the design science research approach which includes a brief historical account, theoretical concepts and how it is complemented by the unique adequacy approach.

2.3 DESIGN SCIENCE RESEARCH

2.3.1 The Emergence of Design Science

Cross (2001:49) follows the emergence of design science noting that preoccupation with the need to 'scientise' design dates back to ideas in the 20th-Century modern movement. This is seen in the work of Theo van Doesburg, the *De Stijl* protagonist and the architect Le Corbusier in the 1920s. The former argued that in order to construct a new object a scientific method was needed and a little later, the latter wrote about the house as an objectively-designed 'machine for living' (Cross 2001). In the 1960s the same preoccupation can be seen in the 'design methods movement' which viewed design methodology as a subject or field of enquiry. The scholars of the era, influenced by 'the application of novel, scientific and computational methods to the novel and pressing problems of the 2nd World War' were keen to prove that the design process (as well as the products of design) had a base in objectivity and rationality (Cross 2001:49).

Buckminster Fuller, a technologist, termed the preoccupation of the 1960s the '***design science decade'*** and called for a '***design science revolution'***, based on science, technology and rationalism. He argued that this was necessary if human and environmental problems that neither politics nor economics could address were to be successfully solved (Cross 2001). The work of Herbert Simon (1969) outlined in the ***sciences of the artificial*** reiterated this perspective observes Cross. Herbert Simon encouraged in academia the development of a *science of design*: 'a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process' (Cross 2001: 49). Cross observes that this attracted severe criticism from the early pioneers of the movement such as Christopher

Alexander and Christopher Jones. The former is quoted as having said:

> *'I've disassociated myself from the field...There is so little in what is called "design methods" that has anything useful to say about how to design buildings that I never even read the literature anymore... I would say forget it, forget the whole thing.'* (Cross 2001: 49-50)

The latter is said to have said:

> *'In the 1970s I reacted against design methods. I dislike the machine language, the behaviourism, the continual attempt to fix the whole of life into a logical framework.'*(Cross 2001: 49-50)

Needless to point out that despite the backlash against design methodology and a rejection of its underlying values the movement is still alive today in particular in the applied discipline of Information systems (IS), Information and communication technology (ICT) and in the engineering discipline. Next is a broader discussion of the characteristics of design science and its products.

2.3.2 Characteristics of design science

Design science is distinguishable from the formal sciences (e.g. philosophy and mathematics) and explanatory sciences (e.g. natural sciences and social sciences) in that it concerns itself with creating artefacts that serve human purpose (van Aken 2004, Järvinen 2005). The formal sciences, observes van Aken (2004: 224), are mostly interested in building 'systems of proposition whose main test is their internal logical consistency'. Explanatory sciences, he further observes, differ from formal ones in that they are interested in describing, explaining and possibly predicting observable phenomena and research should lead to propositions accepted as scientifically true on the basis of evidence provided (for example the causal model). Subjects keen on theory building such as physics and sociology are firmly rooted in the explanatory paradigm. Scientists are preoccupied with finding out the nature of what exists and how things are (Cross 2001).

Unlike both the formal and explanatory sciences, the goal of design science is to develop valid general knowledge to support the design of solutions to field problems (March and Smith 1995, van Aken 2004, van Aken and Romme 2009, Wieringa 2009, Hevner and Chatterjee 2010). It is more concerned with how things ought to be and the pattern of behaviour employed in inventing things...which do not yet exist (Cross 2001). Rather than

produce theoretical knowledge, design science produces and applies knowledge 'tasks or situations in order to create effective artifacts' (March and Smith 1995: 253). Venable (2006) describes design science research as an inventive or creative problem solving activity which focuses on how to develop and produce artefacts and artificial systems having desired properties. Its mission, notes va Aken (2004), '...is to develop knowledge for the design and realisation of artefacts, i.e. to solve *construction problems*, or to be used in the improvement of performance of existing entities, i.e. to solve *improvement problems'*. The fields of architecture and civil engineering are mostly concerned with construction problems whilst those of medicine and psychotherapy deal mainly with improvement problems.

According to van Aken and Romme (2009) the approach's emphasis is on: research questions that are driven by field problems; solution-oriented knowledge linking interventions to outcomes and proving that the actions based on this knowledge indeed produce desired outcomes. Effective problem identification, construction/building of artefacts and evaluating their effectiveness in real life are its core activities (Venable 2006, Iivari and Venable 2009). Järvinen (2007) summarises the fundamental characteristics of design science as follows:

- ✓ Its products are assessed against criteria of value or utility;
- ✓ It produces design knowledge (concepts, constructs, models and methods);
- ✓ Building and evaluation are the two main activities of design science;
- ✓ Design science research is initiated by the researcher(s) interested in developing technological rules for a certain type of issue. Each individual case is primarily oriented at solving the local problem in close collaboration with the local people;
- ✓ It solves construction problems (producing new innovations) and improvement problems (improving the performance of existing entities);
- ✓ Knowledge is generated, used and evaluated through the building/construction.

2.3.2.1 The Descriptive/Prescriptive distinction

van Aken (2004: 221) highlights that

> *'Management theory is either scientifically proven, but then too reductionistic and hence too broad or too trivial to be of much practical relevance, or relevant to practice, but then lacking sufficient rigorous justification'*

This problem of utilisation (Susman and Evered 1978) also described as the rigor-relevance

dilemma (Argyris and Schon 1991) is widespread in academic management research. In order to mitigate the relevance problem of academic management research, van Aken (2004) argues that *Organization Theory* should be complemented with *Management Theory*. The former results 'from description-driven research, having an explanatory nature and to be used largely in a conceptual way' and the latter 'from prescription-driven research, used largely in an instrumental way to design solutions for management problems' (p: 221). The differences between the two types of research are summarised as follows

Characteristic	***Description-driven research programmes***	***Prescription-driven research programmes***
Dominant paradigm	Explanatory sciences	Design sciences
Focus	Problem focused	Solution focused
Perspective	Observer	Player
Logic	Hindsight	Intervention-outcome
Typical research question	Explanation	Alternative solutions for a class of problems
Typical research product	Causal model; quantitative law	Tested and grounded technological rule
Nature of research product	Algorithm	Heuristic
Justification	Proof	Saturated evidence
Type of resulting theory	Organization Theory	Management Theory

Table 2 The main differences between description-driven and prescription-driven research programmes by van Aken (2004: 236)

van Aken (2004: 241) argues that space should be created so as to allow Management Theory and Organizational Theory to 'operate in a profitable partnership' where the latter

> *'could provide understanding of the problem as a basis for developing technological rules and insight in causal mechanisms as a basis to uncover generative mechanisms, while Management Theory could provide further insight into the nature of managerial processes and generating new research questions'*

In advocating this approach the author is fully aware of the tensions between descriptive and prescriptive research. Debates regarding what constitutes legitimate scientific research continue to rage in fields that encompass research activities that are both descriptive-driven

and prescriptive driven like IT (March and Smith 1995) and in engineering and physical sciences (van Aken 2004). In the latter the pure sciences normally have the upper hand because they are seen as knowledge-producing (March and Smith 1995). An analysis of the nature of academic research products derived from both description-driven (knowledge producing) and prescription-driven (knowledge using) research leads van Aken (2004) to conclude that the later has diminished academic respectability.

March and Smith (1995: 226) observe, as van Aken does, that the diminished status is 'fostered in part by the prestige attached to science in modern societies and the belief that the term science should be reserved for research that produces theoretical knowledge'. van Aken (2004: 225) highlights that the term 'science' in English is often taken to be synonymous with 'natural science' which leads to notion that the mission of all science 'is to merely describe, explain and predict and that such descriptive knowledge is sufficient for practitioners to solve their problems.' This thinking is also wide-spread in the field of construction management research, as noted in section 2.2.

What has been made apparent so far is that the strength of a design science approach is in its emphasis on designing products that can be assessed against criteria of value or utility. The next section presents what the design scientists say about what constitutes a design science product.

2.3.3 Products of design science

The products or outputs of DSR are perceived to contain knowledge ranging from design logic, construction methods and tools to assumptions about the context in which the artefact is intended to function (Gregor, 2002). They can broadly include:

1. models, methods, constructs, instantiations and theories (March and Smith 1995, Gregor 2002, Vaishnavi and Kuechler 2008, March and Storey 2008),
2. social innovations, new or previously unknown properties of technical/social/informational resources (March and Storey 2008),
3. new explanatory theories, new design and development models and implementation processes or methods (Ellis and Levy 2010)

March and Smith (1995: 256) provide working definitions of some of the categories of design knowledge. Constructs or concepts form the vocabulary of a domain and '...constitute a

conceptualization used to describe problems within the domain and to specify their solutions' A model is a '...set of propositions or statements expressing relationships among constructs' and in design activities they '...represent situations as problems and solutions as statements...can be viewed simply as a description, that is, as a representation of how things are' (p. 256). It is noted that natural scientists often use the term model in reference to theory (March and Smith 1995). A method is defined as a set of steps used to perform a task and is '...based on a set of underlying constructs (language) and representation (model) of the solution space' (p.256). Finally, an instantiation is the realisation of an artefact in its environment (March and Smith, 1995).

The typical research product is the heuristic prescription, technological rule or solution concept (van Aken 2004). According to Bunge (1967:132) a technological rule is 'an instruction to perform a finite number of acts in a given order within a given aim'. van Aken (2004: 228) defines it as 'a chunk of general knowledge, linking an intervention or artefact with a desired outcome or performance in a certain field of application' He highlights mankind's long tradition of developing technological rules seen in ancient practices such as s bow and arrow making and the making of rain through performing the rain dance.

van Aken emphasises the need to differentiate between two types of prescriptions: 1) those that operate like a recipe (algorithmic) which has a quantitative format and whose effects can be proven and 2) those which are heuristic in nature taking a qualitative format. van Aken's (2004) simple formulation of either is as follows- ...in order to achieve goal Y in situation Z then action X is needed (quantitative) or- in order to achieve goal Y in situation Z then something like action X will help (qualitative). Examples of the former are identified by van Aken (2004:230) follows:

- If you want to realise a large-scale, complex strategic change, use a process of logical incrementalism (Quinn, 1980)
- If you want effective realization of the outcomes of strategic decision-making, promote perceived procedural fairness (Korsgaard, Schweiger and Sapienza, 1995) and active participation of middle management (Woolridge and Floyd, 1990)
- If you want to manage the activities within the operational core of a professional organisation, use standardisation of skills rather than direct supervision (Mintzberg, 1983).

However, these rules differ from those derived from prescription-driven research in that they do not necessarily require testing as is the norm in research based on the paradigm of the design sciences (van Aken 2004). Testing technological rules, asserts van Aken, is a key element of the design science research strategy. This, he further asserts, should ensure that the research which is driven by and take place around local problems leads to solutions which should be applicable to similar problems in similar contexts. Van Aken is convinced that the academic worthiness of prescription-driven research lies in the rigorous testing and grounding of technological rules. In the section that follows the process that should lead to a meaningful production of products of which heuristic technological rules is one is considered closely.

2.3.4 Design Science Research Process (DSRP)

Design Science literature is inundated with suggestions on how the design research process ought to progress starting from problem identification all the way through to evaluation of proposed solutions. These appear to be based on what van Aken (2004) refers to as the *problem solving cycle* also called the *regulative cycle* (problem identification, name and frame, plan intervention, apply, and evaluate). Table 3 below compares some these at a glance.

Takeda et al. (1990)	**Nunamaker et al. (1991)**	**March and Smith (1995)**	**Vaishnavi and Keuchler (2008)**	**Peffers et al (2008)**
Enumeration of problems	Construct a conceptual framework		Awareness of problem	Problem Identification and motivation Define the objectives of a solution
Suggestion Development	Develop a System Architecture Analyze and design the System Build the System	Build	Suggestion Development	Design and development
Evaluation to confirm the solution Decision on solution to be adopted	Observe and evaluate the system	Evaluate	Evaluation Conclusion	Demonstration Evaluation
				Communication

Table 3 Design science research processes at a glance.

What is clear from the table above is the emphasis on *problem identification*, *building* and *evaluation.* Although March and Smith (1995) insist that DS consists of only two activities they highlight the demerit of insufficient understanding of the environment for which the artefact is intended stating that this can result in inappropriately designed artefacts with undesirable side-effects. Needless to emphasise that such sufficient understanding is to be gained during the problem identification stage. This section considers Peffers et al's (2008) six steps (see Figure 2) in more detail. This framework was chosen out of the ones given above because it was found to be more suited to the nature of the problem being researched. In addition it was found to be a straight forward framework aiding easy identification of the precise stages of the design science process to be complemented by the ethnomethodologically informed approach of unique adequacy.

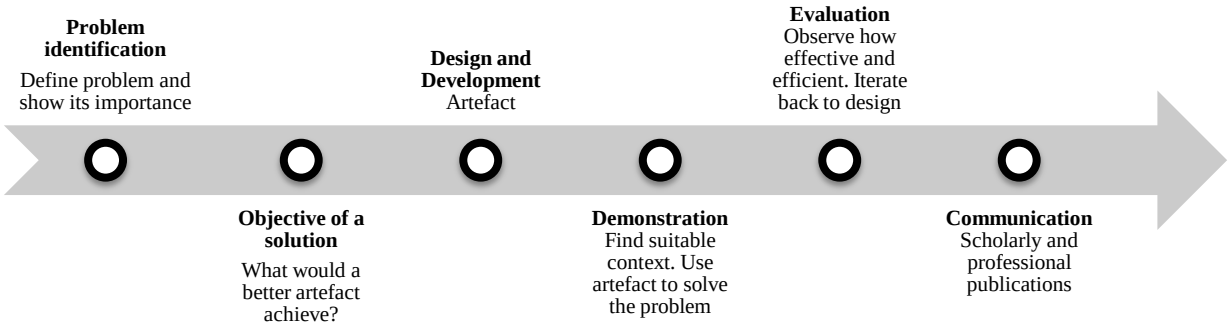


Figure 2 Design science research process adapted from Peffers et al's (2006: 93).

The authors designed the process in response to what they perceived as the 'lack of a generally accepted process for DS research in IS' (p: 84). This gap, they contend, is partly the reason why the uptake of the design science research is poor more than a decade on. Peffers et al (2008) assert that their model is designed to provide a mental model for doing, presenting and appreciating DS research in IS. Although the intention of the above DSRP model is to improve the production of utilisable artefacts within the IS field, it can be usefully applied to solving problems generically. In this study it is applied to solving the problems of wayfinding in old and complex settings. In addition the model is used as a basis upon which the relationship between design science, unique adequacy and wayfinding is examined. The examination is offered in section 2.4. Each step of the DSRP model is explained in detail next.

Effective problem definition, observe Peffers et al (2008), is fundamental to the development of an effective artefactual solution. They contend that atomizing the problem conceptually

should lead to a solution that will capture the problem's complexity. Resources required for this activity include an in-depth knowledge of the state of the problem and the importance of its solution, they further note. According to the same authors, justifying the value of a solution can motivate the researcher and the audience of the research to pursue the solution and accepting the results. They also observe that it helps the researcher to understand the reasoning associated with his or her understanding of the problem. However, Peffers et al. (2008 p: 55), point out that 'because the process of design is necessarily one of partial and incremental solutions' researchers ought to be aware that 'identified problems do not necessarily translate directly into objectives of the artifact'

The second step is to infer the objectives of a solution from the identified problem. These should be inferred rationally from the problem specification and the resources required for this include an in-depth understanding of the state of problems and current solutions and their efficacy, if any (Peffers et al. 2008). They '...can be quantitative, e.g., terms in which a desirable solution would be better than current ones, or qualitative, e.g., where a new artefact is expected to support solutions to problems not hitherto addressed' (p: 90).

The third step is concerned with the actual building/construction of the artefact. Hevner et al (2004) point out that the key to designing artefacts that will solve an identified problem is to determine the desired functionality of the artefact and its architecture before creating the actual artefact. To them constructs, models, methods, or instantiations fall under the description of artefact. Conceptually, observe Peffers et al. (2008), a design research product can be anything in which a research concept is embedded in the design. They point out that the resources needed to move from objectives to design and development include knowledge of theory that can be used to underpin a solution.

The fourth (demonstration) and fifth (evaluation) steps are closely linked. The former is about demonstrating the use of the artefact to solve the identified problem. This could involve an experiment, simulation, a case study, proof, or other appropriate activity (Peffers et al 2006, 2008). Effective knowledge of how the artefact is used to solve the problem in question is vital (Peffers et al. (2008). The latter activity involves the measurement of the deployed artefact in order to establish how well it supports a solution to the problem. According to Järvinen (2005, 2007) the success or failure of a solution can be quantified in both technical and social terms. Peffers et al, (2008) note that the activity of evaluation involves comparing the objectives of a solution to actual observed results from use of the artefact in the

demonstration phase. They also note that the nature of the problem, venue and the artefact dictate what the activity of evaluation could include. For example, they further note, a comparison of the artefact's functionality with the solution objectives, objective quantitative performance measures, such as budgets or items produced satisfaction surveys, client feedback, or simulations could all be seen as forms of evaluation.

In the final step the problem and its importance, the artefact, its utility and novelty, the rigour of its design, and its effectiveness is communicated to relevant audiences such as researchers and practising professionals (Peffers 2008). The audience could include researchers and practicing professionals. Communication can take many forms, e.g. scholarly research publications, reports.

Noteworthy is Peffers et al's (2008) acknowledgement that although the design science process is structured in a nominally sequential order, such as that represented in Figure 2.1, it is not a hard and fast rule that researcher(s) proceed from activity 1 through to 6 in that order. One may start with almost any activity and move outward depending on the emphasis of the study. For example a problem-centred approach would start on 1, an objective centred on 2, a design and development centred on 3 or observing a practical solution that worked on 4. The latter might result in a design science solution if rigour is applied to the process retroactively they note.

This section has explained the six steps that could be generically applied to solving a wider range of problems. As previously indicated, for the purposes of this study, the process is applied to solving the problems of wayfinding. Particular attention is paid to how it can be complemented by the ethnomethodologically informed unique adequacy approach. Ethnomethodology provides the unique adequacy requirement of methods as a guide to study sense-making by members of a setting. The next section offers a discussion of the unique adequacy approach prior to arguing that design science research and unique adequacy complement each other in a manner that helps mitigate the utilisation problem highlighted by van Aken's (2004) above.

2.4 DESIGN SCIENCE RESEARCH AND UNIQUE ADEQUACY

The practice of Ethnomethodology (EM) was founded by Harold Garfinkel in the 1950s and 1960s. It originated partly as a response to Alfred Schutz's (1973) call for the need for sociological analysis to pay attention to the ways in which persons, as members of society experience social life (Francis and Hester, 2004). Garfinkel refined this experiential focus to pose the question of how members of society produce observable social order free from the influences of traditional sociological theories. Here people are seen as rational actors, who employ practical reasoning rather than formal logic to make sense of, and function in, society (Francis and Hester, 2004). Garfinkel (1984:vii) goes so far as to observe that "In doing sociology, lay and professional, every reference to the 'real world,' even where the reference is to physical or biological events, is a reference to the organized activities of everyday life.

EM is distinct from traditional sociological approaches in that it concerns itself solely with *observable* features of social life, eschewing attempts to theorise those features (Francis and Hester, 2004). It focuses on how observable social activities are produced, accomplished and understood by ordinary members of society. Put in a different way, it sets out to investigate how members of society (individuals within organizations) make sense of and function in society by creating social facts or understandings of how society works. It seeks to explicate this achievement by specifying the local, situated methods used in the production of observable social activities. Thus, the approach is appropriate for a study which seeks to understand how people find their way in complex environments.

2.4.1 Unique Adequacy

Rooke and Kagioglou (2007) trace the concept of unique adequacy back to Garfinkel and Weider (1992) who point out that it does not prescribe specific methods for conducting research. Unique adequacy draws attention to the fact that members of a setting or organisation have their own ideas about what they are doing regardless of what theorists may say about them (Rooke, 2007). Rooke (2007) observes that it

> *'...addresses problems stemming from the significance of conscious action in constituting human organisation. These may be summarised as: first, that objectivity is a problematic concept in such studies; second, that the determination of meaning is their primary goal; and third, that formal procedures, whether as methods of research or explanation, have significant limitations' (p. 140).*

The concept of scientific objectivity, observes Rooke (1997), denotes an attitude of neutrality or indifference to the data, a suspension of our ideas about what-should-be, in order to better investigate what-is. It entails that the world is observed and described from no-particular-point-of-view, thus giving rise to an account/description that is true from any point of view, he further notes. However, Rooke argues that it is impossible to stand outside society to observe it, in the same way the behaviour of physical bodies can be observed. Furthermore, contends Rooke, descriptions of the social world are composed of the same stuff from which the social world itself is constructed; that is to say, words, concepts, or meanings.

Unique adequacy insists that the methods used to produce a description of a situation, should be those which originate from the situation they describe (Rooke and Seymour, 2005). The neutral stance which objectivity is intended to guarantee, observes Rooke (1997), is established in ethnomethodology (EM), in the policy of ethnomethodological indifference:

> *"to refuse serious consideration to the prevailing proposal that efficiency, efficacy, effectiveness [...] i.e. that the rational properties of practical activities—be assessed, recognised, categorised, described by using a rule or a standard obtained outside actual settings within which such properties are recognised, used, produced, and talked about by settings' members." (Garfinkel 1984 p.33)*

What follows is an explanation of the two sets of criteria prescribed by unique adequacy: the weak and the strong requirements.

2.4.1.1The weak requirement

The weak requirement is that 'the analyst must be *vulgarly* competent in the local production and reflexively natural accountability of the phenomenon' (Garfinkel and Wieder 1992: 182). This is to say, to analyse a setting adequately, the researcher must know what any member to that setting would ordinarily know about that setting. This knowledge, expressed as competence, is the kind referred to by Ryle (1963) as 'knowing how'. It consists in being able to perform relevant activities within that setting without censure from other members (Rooke et al, 2010a). The question of whether such an understanding has been achieved is a matter for the judgement of any other competent participant.

In this form the requirement is proposed as a criterion for adequate ethnography (Wieder, 1974), the most certain method for acquiring such knowledge being participant observation. However, it is possible to usefully apply it to other forms of enquiry, such as interviews and questionnaires. Thus, for instance, a questionnaire designed by someone who had no direct knowledge of the activity under study is likely to contain irrelevant, misleading or meaningless questions. Meeting the weak requirement is a researcher's problem. Any member of the setting (that is anyone having sufficient competence to operate in the setting without censure) is capable of delivering an account of that setting which meets the weak requirement. For a researcher encountering that setting for the first time, it is a matter of achieving this basic level of competence.

2.4.1.2 The strong requirement

By contrast, the strong requirement concerns the reporting of research (Rooke and Kagioglou, 2007). It demands that the methods of analysis used to report on a setting should be derived from that setting. In effect, it stipulates the application of a policy of 'ethnomethodological indifference': a refusal to evaluate, describe or explain the activities that constitute the setting using criteria, concepts or theories that are not a part of that setting. This criterion is founded on the discovery that a phenomenon, ‘ already possesses whatever as methods methods could be of [observing], of [recognizing], of [counting], of [collecting], of [topicalizing], of [describing] it, and so on" (Garfinkel and Wieder 1992:182)

Put in a different way, this means methods which members to a situation use to make their meanings clear to other members to that situation are sufficient to the purpose of describing that situation (Rooke 1997). Thus, the use of any other methods must involve some distortion of the phenomenon. The task of EM, rather than to produce an alternative description of the situation, is to describe those methods, as they are used by members, as a means of producing, managing, maintaining the orderliness of, acting in, manipulating, directing, or whatever, that setting, to each other (Rooke 1997, Rooke and Kagioglou, 2007).

Lynch (1999) points out that the achievement of unique adequacy is a skillful practice which researchers must learn. Francis and Hester (2004: 25) suggest three methodological steps

which can be followed in order to achieve an acceptable degree of the strong requirement of unique adequacy:

- ✓ Notice something that is observably-the-case about some talk, activity or setting.
- ✓ Pose the question 'How it is that this observable feature has been produced such that it is recognizable for what it is?'
- ✓ Consider, analyse and describe the methods used in the production and recognition of the observable feature.

Research informed by the unique adequacy criteria is not new, it is well known in Computer Supported Cooperative Work (e.g. Button and Sharrock 1995; Button and Dourish 1996; Dourish and Button 1998, Crabtree 2004). This research has mainly been concerned with reporting to designers on the activities of customers, or prospective customers and with developing uniquely adequate approaches which make a more active contribution to the design process. Crabtree's (2004:207)) work, for example, proposes a procedure for integrating ethnomethodology and design as follows:

- Let designers build whatever they want with whomever they want, subject to their own constraints.
- Deploy the objects of design in real world settings.
- Treat deployment as a breaching experiment.
- Explicate the accountable structures of practical action made visible in the breach.
- Explore the topics identified in the breach through the study of perspicuous settings.
- Use the studies of perspicuous settings to flesh out abstract design concepts
- Deploy the new design solution in real world settings and study its use.
- Repeat the process until the research agenda has been satisfied for all practical purposes

Crabtree suggests that initially design should be accomplished in a conventional manner, subject to normal constraints. When design objects are deployed in the real world, this deployment can be treated as a breaching procedure, that is to say, an opportunity to observe the disruption that the designed object creates in the established activities that constitute the setting. This well worn ethnomethodological procedure allows for the explication of

accountable structures of practical action that constitute the setting, he asserts. The topics thus identified can then be explored through the study of perspicuous settings. These are settings that provide access to members who routinely solve a problem of interest.

Work has also been done to encourage reflection in design and management processes (Rooke and Seymour 2005). These studies have contributed to the design of collaborative systems by reporting to engineers on the activities of work groups. Such reports constitute a detailed analysis that can inform effective design, supplying unnoticed but vital features that might be overlooked in less empirically grounded approaches (Rooke, 2007). Button and Dourish (1996) note that this informing process has occurred in two ways: either through designers learning from ethnomethodological accounts of a work setting; or through direct interaction between the designers and ethnomethodologists who are experienced in the setting of interest. They suggest that ethnomethodology should develop a more active role in the design process, in which it provides concepts as well as observations to the design process.

The practice of combining ethnomethodology and design in ways which are respectful of both bodies of knowledge and practice is called technomethodology (Button and Dourish 1996, Crabtree 2002). This methodological move seeks to approach design from a new position by forging more foundational relationships where ethnomethodology must become an active participant in design (Button and Dourish 1996, Rooke and Seymour 2005). According to Rooke and Seymour (2005) technomethodology represents what they call a "hybrid discipline". Arguably, this is precisely the focus of van Atken's (2004) efforts where he argues for a calculated and appropriate mixture of descriptions and prescriptions. In the case of technomethodology, this is achieved by maintaining observance of the unique adequacy requirement of methods, together with an interest in the aims of the discipline with which ethnomethodology is to be hybridised (Rooke and Seymour 2005).

The section that follows considers the application of the design science research approach to wayfinding paying particular attention to the descriptions obtained by maintaining observance of the unique adequacy criteria.

2.5 DESIGN SCIENCE, UNIQUE ADEQUACY AND WAYFINDING

A close consideration of the main concepts of both design science and those of unique adequacy makes it is possible to identify precisely where the two approaches complement

each other. Arguably this is done in a manner suggested by both van Aken (2004) and the proponents of technomethodology (e.g. Button and Dourish 1996, Crabtree 2004, Rooke and Seymour 2005). Figure 3 is of a diagram representing what a Wayfinding Conceptual Framework (WCF) showing the relationship between Peffers et al's (2008) DSRP model and the weak and strong criteria of unique adequacy would look like.

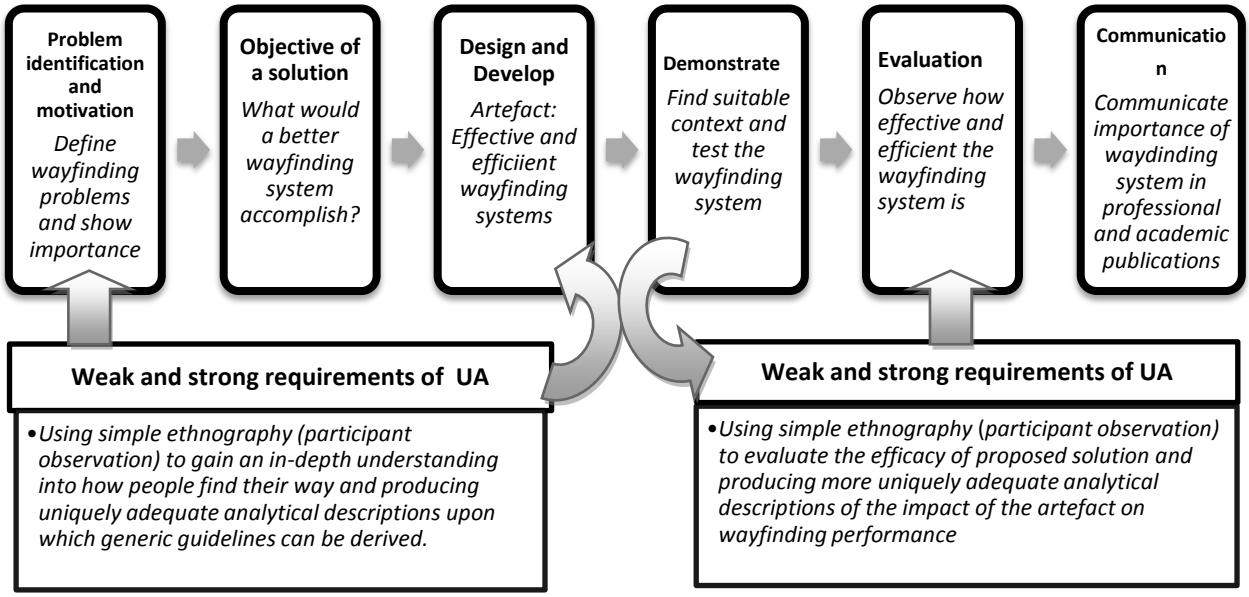


Figure 3 A Wayfinding Conceptual Framework (WCF) showing the complementary nature of design science and unique adequacy.

In the top half of the WCF the six steps of Peffers et al's (2008) DSRP model can be seen. Under each DSR activity is an abstract description of the wayfinding activity commensurate with each step. The bottom half of the framework articulates where both the weak and strong criteria of UA can be applied.

Effective problem identification can be achieved by observing the weak criteria and uniquely adequate description of the behaviour of the wayfinders can be achieved by observing the strong criteria. A uniquely adequate understanding of the problems of wayfinding and consequent production of uniquely adequate descriptions responds should lead to the design and development of guidelines for improving wayfinding. Once the design is complete a suitable context for testing and evaluating it must be found.

Again evaluation of the effectiveness of the design can be achieved through adhering to both

the weak and strong requirements of unique adequacy as articulated in the second box (see Figure 2.4). Adhering to the demands of the unique adequacy criteria is precisely the focus demanded by Arthur and Passini (1992) where they assert that:

> *'...the only way to approach wayfinding issues intelligibly is for architects and designers to pay attention to how people perceive and understand the environment, how they situate themselves in space and how they use information in the decision-making and decision-executing processes' (p.5)*

A similar emphasis on this level of focus is made by Wayfinder UK Ltd (2009) who go as far as asserting that their own insight into human behaviour has led to the organisation's success and recognition by Royal Institute of British Architects (RIBA) as a leading authority in Wayfinding. Wayfinder UK ltd (2009) captures the value of adopting a human centred approach where they write:

> *'To achieve success at wayfinding and avoid disorientation and confusion, it is important we understand the characteristics of fundamental human behaviour. This explains the complexities by which the many elements of today's human environments interact with each other and helps us to deliver the best solution for all.*
>
> *In creating a solution, our consultative approach means we examine the ways people perceive space and how they navigate through complex environments, asking many questions to arrive at the correct solution.*
>
> *Understanding the information people can store and what they reject, what they see clearly and what they miss is paramount in determining the best solution. It is important to know when there is enough information and when* [SIC] *there is too much*.'

The organisation's idea of human centred methodologies amounts to an approach which involves the following:

- the use of specialist techniques and disciplines,
- an understanding of human behaviour' taking 'into account the in-built mechanisms by which humans collect and process information in order to navigate, as well as considering their reactions to the complex structure and unique characteristics
- their 'own pioneering wayfinding philosophy' and working closely with their clients 'to understand their needs'

Unfortunately efforts to include this organisation as part of the research with the hope of learning from their good practice were constrained largely due to timing. However, it was possible to pay a visit the two NHS hospitals sites of Springfield in London, UK and Addenbroke in Cambridge, UK cited as flagships for the organisation's good work. The outcome of the visits is discussed under section 4.4.1.

Worthy of highlight is the fact that the UA criteria is not without its critics. Some, for example, Wakefield (2000) concede that the view of EM and UA has methodological limitations when it comes to achieving the strong requirement as an insider. Others as Cuff et al (1992) observe, argue that ethnomethodological techniques, like other forms of qualitative research, are not generalisable to a wider population. As such techniques of this kind are viewed as being of little value, they further argue. Both criticisms fail to demonstrate a thorough understanding of EM and UA partly of the preoccupation with the positivist burden of *objectivity* and *generalisability*. EM makes it clear that its job is to explicate the mundane activities of everyday life which are often taken for granted but key to understanding a phenomenon under study. Garfinkel notes that this policy "has been constantly misunderstood" and that from the beginning it was regarded as "naughty advice" (2002:170) because its demands are fundamentally at odds with the activities of sociologists. This has resulted in much tension between EM and perspectives such as Actor Network Theory (ANT).

ANT, an approach born out of the fields of social studies of science and technology, addresses the important role played by artefacts (Law and Hassard 1999, Anderson 1994, Bloomfield and Vurdubakis 1994). It describes the progressive constitution of a network in which both human and non-human actors assume identities and interact with each other (Callon and Law 1995). For this reason it could be argued that ANT would have been appropriate for researching the problems of wayfinding. However, the fact that it views non-human actors as autonomous, thus deserving of the same status as humans (Akrich and Latour 1992) put it at odds with EM informed approach of UA. Whether the artefacts encountered during a wayfinding task could assume equal identities and play the same role as human actors thus provide the researcher behavioural cues is questionable. Whilst it is true that these artefacts play an important role in aiding wayfinding it is difficult to see how they can be seen to be as autonomous as humans. The wayfinder, for example, is able to control his/her actions fine tuning them to meet the demands of the task at hand in a manner that the non-human agents within the built environment cannot.

What follows is a detailed discussion of the actual process followed in researching the problems of wayfinding in old and complex built environments.

2.5.1 The problem of wayfinding in old and complex settings

Using Salford Royal hospital as the main case study, a retrospective self reflection of the author's wayfinding experience and brief comparative studies conducted in settings other than hospitals a discussion of attempts to follow the DSRP process model as given by Peffers et al (2008) is offered. Figure 2.3 below shows a simple graphical representation of how attempts to apply the DSRP model resulted in an interactive process revealing the complex nature of the research.

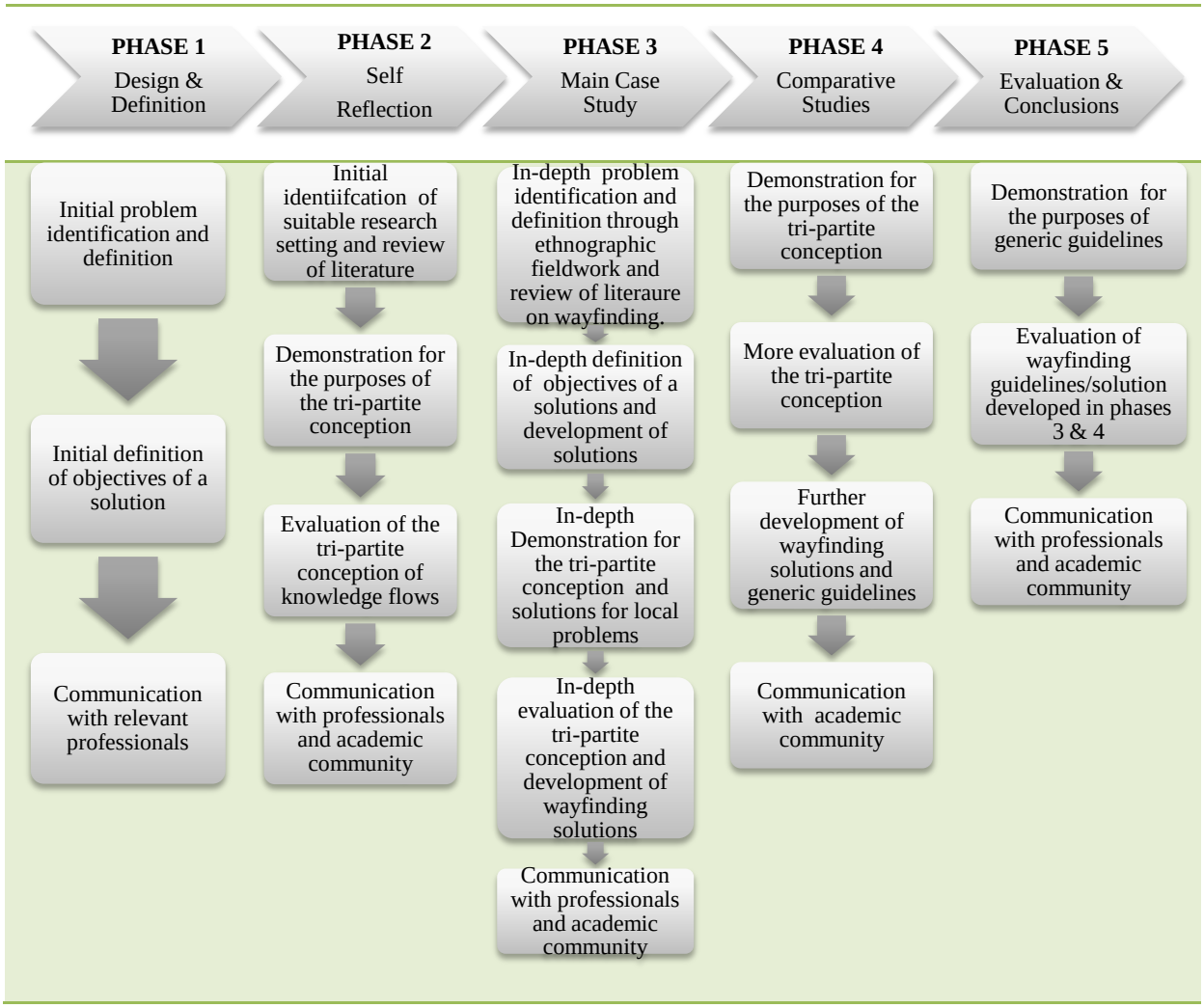


Figure 4 Research process showing the complex and interactive nature of the research process

The diagram above reveals a process not as linear as that of Peffers et al's (2008) model (see p: 21). Here overlaps in the activities of design science research can be seen. Communication, for example, starts from the outset and continues throughout all the phases of the research instead of being the last activity. Similarly demonstration and evaluation take place throughout the study depending on what is being evaluated. The three subsections that follow give a detailed account of the design science research activities highlighting in particular where the unique adequacy criteria was adhered to. The first two stages of Peffers et al's model are discussed under one heading: problem identification and definition as are the demonstration and evaluation stages. Communication is not treated as a stage in its own right as it happens throughout the research.

2.5.1.1 Problem Identification and definition

Initial problem identification was an industry led activity which took place during a meeting that marked the end of a project in which the University of Salford and Salford Royal NHS Foundation Trust had collaborated for over a year. Here the problems challenging the hospital were described in a way that made it apparent that the organisation was having difficulty in communicating wayfinding information to its visitors. Researchers from the university took the opportunity to communicate the perceived appropriateness of the tri-partite conception of knowledge flows as an evaluative and sensitisation tool with regards to managing the problems of wayfinding.

The benefits of a more efficient wayfinding system were briefly highlighted and discussed. Those representing the hospital's Redevelopment Team indicated their keenness to engage with any efforts that would lead to an improvement in the hospital's existing wayfinding system from the outset. This timely occurrence made two things possible: 1) an immediate and convenient opportunity to do an in-depth study in order to establish whether more suitable way of communicating wayfinding information could be suggested whilst gaining an understanding into the behaviour of wayfinders, and 2) smooth and continuous access to the setting for the purpose of demonstrating and evaluating proposed design solutions.

The initial description of the nature of wayfinding problems at Salford Royal hospital supported by the author's pre-existing knowledge of the persistent nature of wayfinding

problems in NHS hospitals, gained from her experience as a nurse, patient and visitor, prompted the author to turn her own experiences into topics of inquiry. Thus, in the interim period, the author took the opportunity to engage in the retrospective exercise of self reflecting on her own wayfinding experience prior to commencing this research. By turning her own experiences into topics of inquiry, she aimed to gain a better understanding of the nature of wayfinding problems in general.

The technique of 'armchair research' (Francis and Hester 2004) using the method of self-reflection was adopted for this purpose. According to Francis and Hester (2004)

> *'...all of us, as members of society, possess knowledge and competences that we bring to bear to understand the situations, events, objects and persons that we encounter in and as comprising our daily lives. This knowledge and these competencies are normally taken for granted- we rely upon them but do not typically reflect upon them. Yet these phenomena are fundamental to social life; without them we would not be able to understand other, nor they us. Self-reflection then, is a method of bringing into focus this taken for granted domain. By reflecting on upon our own understanding, we can begin to examine and appreciate the accomplished nature of social phenomena, and analyse the methods in and through which ordinary life is done' (p.52)*

Guided by the fundamental thinking highlighted above, the author reflected on specific incidences where as: a nurse she had to stop her usual nursing duties in order to give instructions to lost visitors; and as patient and visitor she had needed the help of others in finding the way around complex NHS settings. In addition, the author spent approximately five hours at the hospital which is the subject of her self-reflection in order to gain a firsthand account of how other visitors found their way around this complex setting. The opportunity was also used to assess how wayfinding information is communicated. This time other techniques including ethnographic interviews, participant observation, direct observation and the analysis of documents and photographs of hospital artefacts were used. A detailed report of these experiences is offered in Chapter four under section 4.2. In this phase a paper presented at a postgraduate conference marked the initial efforts at communicating the importance of the research to an academic audience.

The third phase of the study was the busiest of all. In the months that followed the initial meeting between Salford Royal hospital and Salford University two more meetings were held prior to in-depth ethnographic fieldwork. The purpose of the first meeting was to supply the researchers with more details on the internal and external layout of the site and problematic

areas to focus on. Literature and other wayfinding aids used to support the existing wayfinding system (e.g. leaflets with maps representing internal routes, official guidelines on how to realise effective wayfinding in NHS estates etc) were also supplied. One of these was Miller and Lewis' (2005) document which is criticised for its lack of transparency in the literature review Chapter. The project manager was amused by the claims that the guidelines were designed for busy people like her. Whilst she acknowledged the value of the advice contained in this document, she made it clear that she found it most difficult to follow due to layout and small print.

In the second meeting, the researcher was introduced to several stakeholders (e.g. other members of the Redevelopment team at Salford Royal hospital, Balfour Beatty (the builders) and Ryders HKS (the architects). Here the role of the researcher was explained as was the expected outcome from the involvement of the university: a report detailing the good and bad aspects of the existing wayfinding system containing suggestions for improvement (see Appendix 3) and, depending on the impact of the report, possible continuous involvement.

The intensive ethnographic fieldwork that followed spread over a period of eleven weeks from 13 October 2008 to 31 December 2008. The fieldwork was conducted to conform to demands of the unique adequacy criteria (see Chapter four). Adhering to the demands of the unique adequacy approach during data collection made the job of capturing the problem's complexity less problematic. This, backed by a simultaneous review of literature on wayfinding (see Chapter three), led to a more refined and deeper understanding of the breadth of the problems of wayfinding not only at Salford Royal hospital but elsewhere in the UK and around the world. Data was collected in ten separate visits the objective of each visit being to find a specific department e.g. dermatology, radiology, maternity, outpatients department etc. chosen at random and previously unknown to the researcher. In undertaking these journeys, the researcher was a visitor to the hospital who was unfamiliar with the hospital lay-out. As such, she was in an analogous position to any other visitor to the setting, whether patient, visitor, or new staff member.

In addition, the researcher observed how people made sense of the hospital environment and was also able to reflect on her own experience of navigating the environment as this was her first time through. These direct observation methods were supplemented by conversations with other visitors to the hospital and with members of staff and hospital voluntary workers.

The eye witness experience of how other visitors to the setting made sense of the environment in finding their way proved a rich source of data which surveys, interviews or other methods would have missed. Photographs were also taken. Following the data collection phase it was possible to identify and classify both helpful and unhelpful aspects of the wayfinding system at Salford Royal hospital as seen by the wayfinders (see report in Appendix 3).

Attempts at answering the question of what a better artefact would accomplish, posed by Peffers et al (2006) led to a clear identification of the need to develop design solutions that would ensure effective and efficient wayfinding in old and complex environments such as that of Salford Royal hospital. The benefits of an effective and efficient wayfinding system or strategy were first discussed during the initial meetings held between the researchers and their hospital partners. However, following the review of wayfinding literature and in-depth fieldwork at Salford Royal hospital the benefits were confirmed and re-emphasised. It became clear that a good design solution would accomplish improved physical health of the wayfinder and the fiscal health of the organisation in question. Evidence from the review of literature indicate that improving the operating costs of an organisation while adding value for patients and members of the public can be achieved through:

1. Reducing the amount of time wasted by highly trained and expensive medical operatives, in giving directions to members of the public (e.g. Arthur and Passini 1992)
2. Facilitating better time-keeping by patients visiting hospital departments, contributing to greater efficiency in the use of resources and consequent cost-savings (e.g. Huelat 2007)
3. Reducing the levels of stress and anxiety, accompanied by frustration, anger, elevated blood pressure and feelings of inadequacy, which in turn have a negative effect on health outcomes (Arthur and Passini 1992).
4. Encouraging better attendance by patients at repeat appointments with medical professional, contributing to better health outcomes (e.g. Carpman and Grant 2002)
5. Encouraging more frequent visits to the hospital by those coming to see their hospitalized relatives, contributing to speedy recovery (e.g. Huelat 2007)
6. Improving the overall patient flows and patient experience (e.g. Huelat 2007).

This section has shown that effective problem identification and definition was made possible

through the review of literature on wayfinding and intensive-ethnographic work. These activities led to an in-depth knowledge of the state of the problem and the importance of its solution (Peffers et al. 2008). The next section focuses on the design and development stage which according to Peffers et al. (2008: 55) needs resources such as knowledge of 'theory that can be brought to bear in a solution'

2.5.1.3 Design and development

This stage of the research process saw the development of solutions to local problems at Salford Royal hospital and that of generic wayfinding guidelines designed to meet the qualities of heuristic prescriptions articulated by van Aken (2004) in section 2.3.3 above. In order to achieve a confident level of prescribing such guidelines the study drew from two sources: 1) the body of knowledge from wayfinding, design, and production and operations management literature (see Chapter three) and 2) the in-depth uniquely adequate descriptions and analyses of how wayfinders find their way in and around old and complex environments (see Chapter five). Chapter six is devoted to establishing that it is possible to derive generic wayfinding guidelines from uniquely adequate descriptions of the behaviour wayfinders in old and complex environments.

2.5.1.4 Demonstration and evaluation

The importance of finding an organisation that is interested in solving the problem in question so that there is a '...win-win situation for both parities' is emphasised by van Aken (2004: p:233). In the case of Salford Royal hospital, engaging with an organisation keen to solve their wayfinding problem from the outset eased the burden of finding a suitable environment for the purposes of demonstration. In all the other environments considered the task was burden free because most of these environments if not all are public places. These include hospitals in Europe, the USA and other parts of the UK; international airports, railway stations including the London underground tube network and hotels. Detailed descriptions of the research settings are offered in Chapter four.

As indicated in Figure 4 different forms of demonstration and evaluation occurred at various stages of the research. Figure 5 below gives a brief summary of the various forms of evaluation achieved for this research. A detailed discussion of each form of evaluation is offered in Chapter seven.

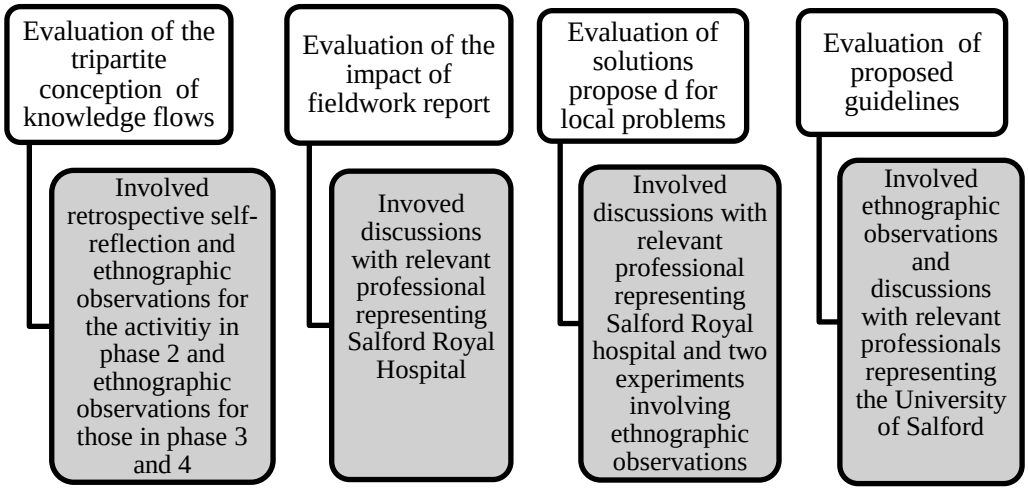


Figure 5 A graphical summary of the various forms of evaluation conducted for this research.

2.6 DISCUSSION

This Chapter starts by highlighting that methodology continues to be in a state of crisis. The work of Vygotsky (1931/1991) and Wittgenstein (1958) are cited as early attempts at encouraging a radical move away from the blind application of formal methods. The inappropriate application of formal methods continues to be criticized by those who see the practice as largely responsible for the production of research outputs that lack relevance. Dainty's (2008) proposed approach of *methodological pluralism is* yet another attempt aimed at addressing this problem within the construction management research community. The study recognizes Dainty's arguments as valid and as needing serious consideration as they appear to resonate with those of the proponents of mixing description-driven and prescription-driven research. Perhaps an in-depth future consideration of this work could generate insights into how the radical approach adopted for this study addresses Dainty's concerns.

In the meantime, it is apparent that the design science community continues to work hard at distancing itself from the traditional practice of applying ideas borrowed from the natural and social science. Indeed what good is description-driven research outputs if they are not going to advance the aims and objectives of a project. Surely in applied disciplines such as IS and the built environment, where the focus is largely on solving human and environmental problems, to use Buckminster Fuller's words, the Design Science Research approach could not have a better home. The community's position regarding the value/utility of research outputs and the need to work closely with organisations for whom the outputs are designed

for is the clearest it can ever be. Also made clear is the need to ensure solutions developed from paying attention to local problems can be applied to other similar contexts.

However, the community fails to emphasise with a similar amount of enthusiasm and passion the need to ensure that the research methods used to gain an in-depth understanding into what a group of people want are appropriate ones. It is proposed that the unique adequacy approach provides the means by which this can be achieved. The proposition is based on the success of Computer Supported Cooperative Work where the merits of combining design with the ethnomethodologically informed unique adequacy approach have been emphasised. This resonates with van Aken's (2004) cogent thinking around the merits of combining description -driven and prescription-driven research in order to mitigate the rigour-relevance dilemma.

From what has been discussed in this section two things can be said. First, that it is not sufficient for research criteria in the Built Environment, where the dominant disciplines are design and management disciplines, to address the needs of descriptive research. The needs of an applied discipline must be met. In the WCF both types of research highlighted above are apparent: the development of wayfinding guidelines (i.e. **prescriptions**) from uniquely adequate **descriptions** of the behaviour of the wayfinders. Second, it can be said that the Computer Supported Cooperative Work often dubbed 'technomethodology' (Crabtree, 2004) fits in quite neatly with van Aken's (2004) ideas developed round about the same period.

In addition it can also be argued that in the first step of Crabtree's model the first three steps of Peffers et al.'s (2008) DRSP model are contained and that deployment and breaching are similar to the demonstration and evaluation steps respectively. This exercise reveals that although the study clearly benefits from following Peffers et al's (2008) model it actually has more in common with Crabtree's (2004) model due to the emphasis on the unique adequacy approach. It would appear therefore; that there is mileage in the proposition that ethnomethodology should develop a more active role in the design process, in which it provides concepts as well as observations to the design process.

The empirical findings reported in Chapters four and five, for instance, explicate the decision making practices of wayfinders in order to explore the role of physical properties in communication. These can then be used to flesh out abstract design concepts. The research/design process then enters an iterative cycle in which the new design solution is

deployed and subjected to further study. This procedure adopts some key aspects of Crabtree's approach, notably the treatment of wayfinding settings as perspicuous and the use of them to develop generic design concepts.

2.7 SUMMARY

This Chapter has discussed the research methodology for this study highlighting the general consensus that the inappropriate application of formal methods is doing more harm than good and that there remains a need to find a radical solution for the construction management research community. The design science/constructive research approach has been suggested and it has been shown how the approach can be successfully complemented by the ethnomethodologically informed approach of unique adequacy. Here ways in which ethnographic fieldwork can contribute both to the development of design principles and directly to the design of wayfinding systems in complex built facilities has been demonstrated. Finally, following the mapping of three design processes, the Chapter concludes with the endorsement of the assertion that design science needs ethnomethodology and that the latter should develop a more active role in the design process, in which it provides concepts as well as observations.

3 LITERATURE REVIEW

3.1 INTRODUCTION

The invaluable role of literature review is emphasised by many. For example, Eisenhardt and Graebner (2007) see it as the basis for sound empirical research, Taylor (2007) sees it as summary and evaluation of the current state of knowledge or state of the art in a particular field. According to Kulatunga (2008) it ensures that the researchers' knowledge in a selected subject area is up to date and that they are not reinventing the wheel whilst Randolph (2009) observes that it helps in delimiting the research problem and with gaining methodological insights.

The primary aim of the review of literature for this study was to evaluate the extent to which the review of relevant literature only could address the aim and objectives of the study and whether this would then lead to an effective identification or development of solutions to the identified problems of wayfinding. This is achieved through: establishing the state of the art in the field of wayfinding paying particular attention the historical developments, the importance of good wayfinding design and solutions (e.g. theories, methodologies, guidelines and principles) that have been developed over the years and a review of the views from other supporting bodies of literature such as knowledge management, production and operations management and design.

Worthy of note is that the study departs from the traditional practice of indentifying the gap in knowledge prior to empirical research. From the outset it became clear that a critical review of literature was going to serve the purpose of establishing a basis for sound empirical research (Eisenhardt and Graebner 2007). The research starts with ethnographic fieldwork and the review of relevant literature, data collection and analysis are simultaneous. The findings from fieldwork are constantly compared with those from the review of literature right from the start.

The Chapter is split into five parts. The first part presents a summary of the key developments in wayfinding since the concept was first introduced by Lynch (1960) in the early 1960s. This historical account, which is biased towards the influential work of Passini (1984), follows the development of wayfinding from the concept spatial orientation (Lynch 1960) to that of spatial problem solving (Passini 1977, 1984). Here it is argued that the development of all wayfinding solutions be they theories, principles or guidelines is firmly underpinned by the

original thinking of Lynch and Passini. This is followed by a close look at what the experts say about good wayfinding design. Here the merits and demerits of good/bad wayfinding are examined including the value/utility of existing solutions. Particular attention is paid to the Department of Health guidelines on wayfinding as the bulk of the in-depth ethnographic fieldwork was conducted in hospitals targeted by these guidelines.

The second part discusses other the concepts from knowledge management (the tri-partite conception of knowledge flows), product design (affordances) and production and operations management (transparency and production flows) with a view to showing how they can be usefully applied to the wayfinding design. The third part concentrates on evaluating the extent to which the overall review provides answers to three questions of the research:

1. How can knowledge be best managed for the purposes of realising good wayfinding?
2. How do wayfinders make sense of wayfinding information embedded in the physical properties of the built environments in finding their way?, and
3. Can the behaviour of wayfinders be used to improve the design of wayfinding systems for more complex and older environments?

Here the necessary gaps in knowledge are highlighted. The Chapter concludes with a summary and discussion the key findings and a brief proposal of how the study intends to address the gaps identified

3.2 WAYFINDING

There is a large body of literature on wayfinding dating back to the first time the word was used by Lynch (1960). A simple Google search using the word ***Wayfinding***, for example, returns millions of both scholarly and non-scholarly articles (4,950,000). The same search using the words ***wayfinding theories***, ***principles*** or ***guidelines*** returns 658 000, 1 030 000 and 641 000 results respectively. What is clear from these articles is that the subject continues to capture the interest of people from all walks of life (e.g. architects, designers, planners, academic researchers, estate and project managers, patient representatives in the case of healthcare etc.) Another picture that emerges is that of a booming wayfinding business with consultants/specialists eager to market their expertise in wayfinding. Although it has long been the concern of cognitive and environmental psychologists, wayfinding is becoming more

and more prominent in the field of design. One thing that appears to unify the interest in wayfinding is the need to find solutions that go beyond the long standing traditional practice of using signs and the need to have in-depth understanding of how wayfinders perform the job of finding their way. The sub-section that follows offers a comprehensive review of wayfinding literature starting with the history of its development.

3.2.1 The history of developments in wayfinding

The developments in wayfinding appear to fall into three overlapping eras: the Pre-Passini Era (PrePE) from 1960 to the 1970s, the Passini Era (PE) from the late 1970s to 1990s and the Post-Passini Era (PoPE) from the mid 1990s to date. The first era sees the inception and conceptualisation of wayfinding. It is dominated by thinkers keen to study cognitive structures responsible for information processing and wayfinding is understood and explained in terms of spatial orientation and cognitive maps (e.g. Lynch 1960, Downs and Stea 1973, 1977, Kaplan 1976, Siegel and White 1975). In the second era, wayfinding is conceptualised further by extending the concept of spatial orientation. The era is dominated by thinkers keen to study the dynamism of humans in space (e.g. Passini 1977, 1984, 1996, Wiseman 1981, Arthur and Passini 1992). Wayfinding is understood and explained in terms of spatial problem solving. The third era sees an extensive operationalisation of existing concepts, nothing new is offered in terms of conceptualization. The era is polarised into two camps: ***pro-Passinis*** (e.g. Carpman and Grant 2001, Huelat 2004, Brandon 2008, Rooke et al. 2010b) and ***pro-cognitivists*** *(e.g.* Golledge 1999, Raubal 2001, Haq and Zimring 2003, Holscher et al 2005). Implicit in the categorization are practices underpinned by environmental and cognitive psychology respectively. The developments in each era are discussed in detail below:

The term wayfinding was first used by Lynch (1960) where he referred to maps, street numbers, and directional signs etc. as "way-finding" devices. Lynch asked residents of four cities in the United States to draw sketch maps of different cities from memory. By comparing the sketch maps to the actual layout of each city, he found that respondents organized their city images using a set of common images and features such as paths, landmarks, regions, edges and nodes. His work, which is seen by many as being pivotal in how we understand environments, was based on the concept of ***spatial orientation*** and its prerequisite the ***cognitive map (***Arthur and Passini, 1992). Lynch reasoned that the five key features (paths, landmarks, regions and nodes are the main components of cognitive maps (Appleyard, 1969.,

Francescato and Mebane, 1973).

Cognitive maps are defined as mental representations or overall mental images of the spaces and layout of a setting (Arthur and Passini 1992). They are also known as mental maps, mind maps cognitive models or mental models (Brandon 2008). Spatial orientation is defined as the natural ability to formulate an adequate cognitive map of a setting in relation to the surrounding environment (physical space) (Passini, 1977., 1984).

As a concept, wayfinding did not become prominent until the 1970s when it essentially replaced the phrase ***spatial orientation*** (Arthur and Passini, 1992). Cognitive researchers such as Downs and Stea (1973, 1977) and Kaplan (1976) represented a group of thinkers who subscribed to the theory that people form 'cognitive maps' of their surroundings, acquiring, storing, and refining information in a schematized and structured form. They saw wayfinding as an exercise in which people build mental models of spatial environments and use information presented to them to aid navigation. Thus, a clear understanding of the underlying cognitive processes that influence people's ability to find their way was emphasised. Hunter (2010) notes that this era saw the popularisation of human cognition and cognitive mapping research and that the researchers of the time sought patterns in architecture related to human behavior and the formation of cognitive patterns and maps.

According to Arthur and Passini (1992 p.24) the

> *'... conceptualisation of spatial orientation has not only generated a great deal of research on cognitive maps, their nature, their composition, their evolution when exploring a new setting or their evolution through a life span, but it has also proven useful exploring some of the spatial characteristics that facilitate cognitive mapping'*

They credit the work of Lynch (1960) for making it possible to make 'that all –important link between spatial orientation and planning' (p.24)

In the late 70s the thinking of the cognitive scientists was challenged by Romedi Passini (1977), an architect and environmental psychologist, who argued that the concept of ***spatial orientation*** did not take into account the dynamic aspects of the movement of humans. He argued that wayfinding involves more than just a generation of a static mental map of a spatial situation as suggested by Lynch (1960). He introduced the idea of wayfinding as a ***spatial problem-solving*** exercise in which people must solve a wide variety of problems as they move through architectural and urban spaces. He found that humans depend on information

and cues within environmental spaces to aid decision making, decision execution and information processing (Passini 1977, 1984).

In 1992, Passini collaborated with Paul Arthur, the late Toronto designer, on a seminal work (*Wayfinding: People, Signs, and Architecture*) that codified architectural and cognitive research on wayfinding (Hunter, 2010). Their work, which clearly extends Passini's (1984) earlier work, introduces the term ***environmental communication,*** arguing that the built environment and its parts should communicate with its users. According to Hunter (2010) the work of Arthur and Passini was the first to distinguish architectural and information components of wayfinding, compile relevant evidence, and translate it into design guidance.

It is worth noting that whilst it may appear as if the concept of the cognitive map is lost in Passini's (1984) reformulation of the meaning of wayfinding, it is in fact subsumed in it. Arthur and Passini (1992 p.25) assert that it is, '...part of the environmental and perception and cognition...is a source of information to make and execute decisions' and has been merely situated '...within the much larger process of spatial problem solving'. However, they caution against overreliance on the theory of the mental map highlighting the major methodological and conceptual problems associated with it. They note that in the past researchers working in the field of cognitive mapping found it

> *'...extremely difficult to have people describe and externalize their spatial knowledge and to measure it reliably. Furthermore, it was argued that that the term 'map' had to be taken in a metaphorical sense: a cognitive map was not really a 'map' as we know it from geography or planning. It was maplike only in the sense that it contained the same information as an actual map' (1992 p .24).*

Current research shows that wayfinding issues continue to be emphasized at all levels of scale in planning be it regional, city, neighbourhood, street systems, public transportation, parking, building complexes, infrastructure and amenities, and individual building layout (Hunter 2010). Peponis and Wiseman (2002) note that both outdoor and indoor wayfinding continues to receive the attention of architects, planners, designers, wayfinding consultants and academic researchers. A close examination of current wayfinding research reveals the continuous production of solutions (principles and guidelines) firmly rooted in the thinking defined by the disciplines of cognitive and/or environmental psychology. The solutions are mostly based on the theoretical concepts of: spatial orientation as originally defined by Lynch

(1960); spatial problem solving as presented by Passini (1977, 1984, Arthur and Passini 1992); cognitive mapping as given by Golledge (1999); and to a lesser degree that of space syntax as argued by Peponis et al (1990).

The impact of the work of Passini (1977, 1984) and that of Arthur and Passini (1992) is articulated in an extremely complimentary way by Brandon (2008). He asserts that it has provided a structure for describing and explaining many of the issues which graphic designers have been grappling with for many years. In some cases, he continues, it has ratified the intuition of designers about good wayfinding design and in others it has corrected faulty notions. At its best, he contends, it has seen the development of a common language by which designers and clients can discuss wayfinding needs and solutions. In the Department Of Health (DOH) document (DOH, 1999, 2005) offering guidance for improving wayfinding in NHS healthcare settings, Miller and Lewis fully acknowledge the work of Arthur and Passini (1992) where they refer to information processing, decision making and decision execution as the 'three key processes in the wayfinding process' (p.14).

Hunter (2010) on the other hand highlights the impact of the work on cognitive mapping and wayfinding by Golledge (1999) and that of space syntax and wayfinding (e.g. Peponis et al 1990, Haq and Girotto 2003). Central to Golledge's (1999) work remains the thinking that humans rely on mental maps more than any other information in finding their way. However, he acknowledges that the challenges associated with attributing any specific cognitive psychological process to wayfinding generally as wayfinding is a purpose-dependent exercise. Cognitive mapping continues to be widely used in research on wayfinding in virtual environments (e.g Darken and Banker 1998, Chen and Stanney 1999). This research heavily references the work of Lynch (1960) and it appears to be driven by the desire to find out if simulated environments can provide solutions that can be applied in real life. However, this work hardly acknowledges the value of Passini's contributions.

The concept of space syntax and wayfinding is based on the analytical techniques developed by Bill Hillier in the late 1970s to identify and collect topological information and compare settings (Peponis et al. 1990, Haq and Girotto 2003). Peponis et al (1990: 556) argued that there was 'a scarcity of theories and analytic techniques to deal with the architectural environment as a knowable morphology' and that the concept of space syntax was the solution. Prior research on the relationship between humans and their built environments, they noted, tended to focus on how people acquire knowledge rather than on actual variations in

their environment. In the statement below, Holscher and Brosamle (2007: 043-11) make the community's long term research goal clear:

> *'Wayfinding research concentrates on data from individual users with known goals and in highly controlled settings. We see a great opportunity to further investigate the feasibility of connecting the two fields. It is very important for research into spatio-cognitive processes to achieve a sound description and understanding of environmental variables'*

This research community is convinced that a greater integration of environmental psychology, space cognition, and space syntax research into design programs would allow an incorporation of findings into more experimental phases of design (Holscher and Brosamle 2007).

This section has followed the three overlapping phases through which wayfinding has developed since its inception. It has been shown that wayfinding continues to be largely underpinned by the concepts of spatial orientation, cognitive mapping and spatial problem solving. It has been argued that the three concepts continue to influence the production of wayfinding principles and guidelines. The potential contribution to be made by the theory of space syntax has also been highlighted. The growing interest in wayfinding, especially in the field of design issue is clearly an indication that wayfinding problems persist to this day and that there remains a need to find an ideal solution. But this raises the question of the value/utility of existing guidelines and principles. The next follows the evidence supporting the value of good wayfinding and examines a handful of wayfinding principles with a view to establishing their value/utility.

3.2.2 The Importance of good wayfinding

Most studies on wayfinding, when highlighting the costs of poor wayfinding, appear to focus on the impact on the wayfinder on the one hand and the organization on the other. Zimring (1990), Arthur and Passini (1992), Carpman and Grant (2001) and Huelat 2004), for example, unanimously agree that stress related problems such as: raised blood pressure, headaches, increased physical exertion, and fatigue are linked to wayfinding in complex environments. They identify additional costs such as: lost staff time; reduced staff concentration caused by the need to provide directions or other interventions; lost business and dissatisfaction due to frustration and ill-will of users; costly missed appointments or delayed meetings; additional

security staff and traffic management costs; compensatory environmental communications systems; potential law suits surrounding lack of safety and accessibility; danger to users wandering into limited access areas of buildings; and injury and death during emergency.

Zimring's (1990) study, for example, found that the hidden costs of direction-giving by people other than information staff equalled the cost of employing two full time professional (US$220 000 per year). Needless to point out that the lost hours could be better spent delivering a better healthcare service to the patients in the case of hospitals. Zimring argues that whilst direction-giving by staff and other occupants of the building are an essential part of wayfinding they are to be relied upon less when developing an effective and comprehensive wayfinding strategy.

Quite often people feel inadequate for lacking the acumen to navigate complex buildings (Arthur and Passini 1992, Rooke et al. 2009, 2010). However, many who have and continue to study wayfinding assert that getting lost is an indication of either a poorly designed environment or wayfinding system and not inadequacy on the part of the wayfinder (Arthur and Passini 1992, Butler et al. 1993, Haq and Zimring 2003, Baskaya et al. 2004, Huelat 2004). The challenges associated with good wayfinding design are well documented. In addition to those already identified in the introductory Chapter Arthur and Passini (1992) and Van der Klipp (2006) highlight limitations such as language difficulties, reduced visual ability, memory loss, reduced endurance, strength, and balance, gender differences and cultural differences. As Coleman et al (2003) rightly note people with hearing losses and communications impairments may find it difficult to make sense of verbal instructions whilst those with visual impairments cannot rely on visual information.

Other research findings (e.g. Lawton et al 1996 and 2001, Lawton and Kallai 2002, Frank 2002) reveal that women tend to have less spatial confidence than men and rely on localized landmarks for wayfinding. Men on the other hand tend to use globalized configuration strategies to find their way or give directions (Bever 1992). Lawson (1999) asserts that spaces that belong to us or come under our control should communicate with us through their physical properties. He contends that this 'human language of space' should be a basic a tool of the trade for architects. A similar point is made by Lynch (1960) who emphasises that design ought to be used to reinforce already existing social meaning, not to negate it. From what is said here, it is clear that the importance of reducing capability demands needs no further emphasis. Research evidence examined below is a summary of the view of the experts

regarding ways in which the design of both the built environment and wayfinding systems can be improved in order to avoid the costs identified above.

According to Arthur and Passini (1992) applying good design and nonverbal cues uniformly makes wayfinding intuitive. This in turn reduces the fear and anxiety associated with hospital visits so patients feel more relaxed, comfortable, and ultimately, healthier, they assert. The importance of legible physical settings (e.g. architectural clues and other forms of visual and tactile cues) is emphasised by Passini (1984), Arthur and Passini (1992), Carpman and Grant (2001), Huelat (2007) and Rooke et al (2010b) amongst many others. Arthur and Passini, for example, point out that wayfinding in buildings and groups of buildings is most affected by the logic of the architectural arrangement and design. The apparent logic of how a group of buildings or spaces is arranged affects the user's ability to understand and remember where he is in the environment, they assert. Their observation that visual dominance of entrances, definition of public space from private space, the ability to visually separate one functional zone from another, are critical to successful navigation is reiterated by Carpman and Grant (2001) and Huelat (2007).

Huelat (2007) asserts that easy to identify entrances, clear pathways, easy to see visitors elevators and landmarks contribute to good wayfinding and the formation of cognitive maps of a space. A good design of building features, she observes, can foster easy comprehension and use of built environment thus assisting users to find their way and maintain their sense of orientation. This should in turn contribute substantially to user satisfaction and frequency of use of a built environment (Hunter 2010). Some other studies (e.g. Haq and Zimring 2003, Huelat 2007) highlight specific characteristics of the spatial layout of the environment that affect the paths people take. According to Huelat, interior finish materials can be used to delineate visitors' pathways from staff pathways, varying colour palettes can separate departments or floors and lighting can provide direction on circulation pathways.

Haq and Zimring (2003) pay attention to the overall structure of the system of rooms and corridors stating that the naming, numbering and general organization of the parts of a building is a critical organizational aspect of a wayfinding plan. Floor numbering, dedicatory names vs. common names, departmental names, stall numbering, and room numbering must be given carefully consideration at an early stage, they find. The use of distinctive views of plantings, water views, and views of shocking or unexpected sites such as large changes in

scale or colour variation, can also assist users to construct wider mental maps, as can strong contrasts of spatial configuration, materials (Lynch 1960, Hunter 2010).

Werner and Schindler (2004) and Ruddle and Peruch (2004) highlight properties of building layout that facilitate or impede movement. Environments with perpendicular intersecting hallways, for example, give better wayfinding performance than those with angled intersections (Werner and Schindler 2004). Ruddle and Peruch assert that well-designed signs are likely to be quite ineffective in a building that is highly complicated and does not provide simple cues that enable natural movement. They observe that signs can be confusing or unsuccessful when layered on poorly designed site or architectural features. The merits of providing users with clear sightlines on entering a building are emphasised by Hunter (2010). She notes that this can afford the user an overview of their surroundings so they can see a large number of elements and their relationships at the same time thus giving them a sense of orientation. The panoramic experience, she further notes, not only "delights", but helps the user obtain a view of the larger spatial configuration that enhances memorability. Holscher and Brosamle (2007) also assert that if large parts of the environment are immediately visible, people rely less on stored spatial knowledge and more on information directly available in their field of vision.

According to Ware (2004:351), human attention is a very limited resource which 'should not be taken up by irrelevant visual noise' He observes that processing of simple visual objects is at a rate of 40-50 milliseconds and that each fixation will last for about 100-300 milliseconds. This is endorsed by Arthur and Passini (1992:165) who observe that 'looking at signs and trying to get information from them has more in common with glancing at our watches than it has with reading a book. They assert that information that is not directly applicable or relevant information that is buried within a complex body of information may not be perceived at all or be screened out and not remembered and that putting '…information at the wrong place is as good as no information at all' (1992:34).

Passini (1984) and Ware (2004) observe that if the rate at which visual information is presented poorly matches the rate at which it is processed information overload occurs. The former refers to it as a mental condition. A model that has been used successfully used to eliminate information overload at airports and could greatly benefit complex setting such as hospitals is *The Airport Model: Progressive Disclosure* (Huelat (2007:4). The model guides

the provision of only enough information necessary to get the wayfinder to the next decision-making point. Huelat makes a valid point that most hospital settings, especially the very old are ‘complex mazes of long and confusing corridor systems with bends, turns, and foreign-sounding signs’ (p: 4). Her call for hospitals to adopt this model deserves serious consideration.

Some of the evidence examined above also points to the need to reduce reliance on signage as a means of aiding wayfinding. Miller and Lewis (1998) observe that many people associate wayfinding with signage. They point out, as many others do, that signs alone cannot overcome the problems of wayfinding caused by ‘a complex, illogical site layout, or inconsistent, conflicting wayfinding information’ (p: 3). Muhlhausen (2006) contends that the misunderstanding that wayfinding is essentially the same as signage can be attributed to Lynch's referral to maps, street numbers, directional signs etc. as "way-finding" devices. Whilst acknowledging the important role played by signage in wayfinding, he points out that wayfinding used to navigate unfamiliar environments, doesn't rely exclusively on signs.

Huelat (2007:11) asserts that signage should support ‘the good bones’ of the physical environment. She calls for a clear organized set of sign elements which should provide four types of information: informational, directional, identifying and regulatory. These, she adds should be integrated into design in a logical, consistent and user friendly way. This call reiterates Carpman et al.’s (1984) observation that directional signs are more effective when placed at or before every major intersection, at major destinations, and where a single environmental cue or a series of such cues (e.g., changes in flooring material) convey the message that the individual is moving from one area into another. Carpman and Grant (1993) point out that any good wayfinding system should go beyond mere signage and the use of colour codes to differentiate various areas. They call for an integration of coordinated elements, such as visible and easy-to-understand signs and numbers; graphic symbols; clear and consistent verbal directions; consistent and clear paper, mail-out, and electronic information.

The importance of informational handouts, information desks, visitor information centres, you-are-here maps, paper maps, directories, is stressed by Carpman et al. (1983), Levine M (1982), Levine et al. (1984), Nelson-Shulman (1983-84), Wright et al (1993) and Huelat (2007). According to Nelson-Shulman (1983-84), wayfinders who have the benefit of an information system are more self-reliant and make fewer demands on staff. Wright et al.

(1993) assert that a combination of hand held maps and wall signs help users reach their destination quicker than those who use only wall signs. Huelat (2007) observes that there is nothing more basic to good wayfinding than a map. She stresses the importance of strategic positioning of maps (e.g. at key entrances and transitions between buildings).

Graphic symbols or devices such as wall and floor graphics, strategic placement of sculpture, art programs, and computerized information kiosks have the potential to contribute towards successful wayfinding design, asserts Huelat (2007). When symbols and wayfinding graphics are used properly (i.e. repeating the message on signs), it should help those who cannot read or feel too embarrassed to ask in finding their way' (Huelat 2007). 'The adage that a picture is worth a thousand words is especially true in wayfinding (Huelat 2007:12). The invaluable role played by staff and other users of the setting in aiding wayfinding is neatly captured by Huelat (2007:12) who asserts that people or staff who care about visitors' ability to find their destination are 'The best wayfinding amenity...' However, as already pointed out by Zimring (1990) a wayfinding system that is over reliant on this resource can be costly.

Some studies emphasise the importance of research methodology stating that the wrong approach could result in a production of solutions that do not solve wayfinding problems (e.g. Arthur and Passini 1992). Over the years various approaches have been suggested and used. The most popular appear to be the use of questionnaire surveys and interviews (e.g. DOH 2005) and or sketch maps that should help externalize the cognitive understanding of an environment (e.g. Lynch 1960, Rovine and Weisman 1989). The proponents of the latter base their approach on the pioneering work of Lynch (1960) and that of Golledge (1999). In section 3.1.1 the pitfalls of relying on this methodological approach have been briefly highlighted.

As an alternative, Passini (1984) and Arthur and Passini (1992) suggests that users of a setting should be observed directly while in action. Arthur and Passini (1992:5) as already indicated in Chapter two are convinced that this is the '...only way to approach wayfinding issues intelligibly' They argue that in addition to comprehensive and collaborative planning between architects and graphic designers early in the design process, designers need to acquire the specialized tools of good wayfinding design, including participant research, user involvement in design, and evaluative research and design assessment tools. A similar call is made by Carpman and Grant (2002) who encourage broader research into: how people use

simultaneous wayfinding cues; how humans give and take directions; how organizations make wayfinding design decisions. They also call for real-world observation of common wayfinding strategies and correction of wayfinding mistakes and for research into behavioural response to architectural features beyond Arthur and Passini's (1992) work.

However, a point must be made that to this day the question of which of the many approaches should be taken as a role model remains unanswered. What remains undeniable is the need for an approach that will allow an in-depth understanding of how wayfinders make sense of the wayfinding information presented to them in any setting. This knowledge should no doubt guide the building of more effective and intuitive wayfinding systems.

The vast body of research evidence examined here shows that wayfinding is more than just individual perception, cognition, and behaviour. It is 'a macro issue involving the physical and operational environments in which it occurs (Carpman and Grant 2002: 427). It is also clear that there is a wealth of advice regarding the design of ideal wayfinding systems and strategies that should aid effective communication with wayfinders from all walks of life. In addition to the challenges already highlighted it ought to be highlighted the sheer large volumes of the evidence-base for good wayfinding can be daunting for anyone aiming for the ideal wayfinding design. According to Arthur and Passini (1992), the solution is to develop wayfinding design principles that will provide a structure to organize the environment into a spatial hierarchy capable of supporting wayfinding tasks. The next section examines a handful of wayfinding principles/guidelines with a view to establishing their value/utility.

3.2.3 Wayfinding design principles/guidelines: value/utility

Carpman and Grant (2002) contend that evidence-based principles of wayfinding must be translated into built and graphic form through spatial planning and environmental communication. However, Peponis and Weiseman (2002) warn that designers should not assume that wayfinding principles are the same at all scales. They assert that these should reflect the: differences in interior and exterior wayfinding, wayfinding differences between first time and regular users, and differences in strategies used by significant population groups. Below are four sets of design principles/guidelines chosen at random from the large volumes produced over the years. In general, it can be said that the chosen sets are underpinned by the influential work of Lynch (1960) and that they reflect the general thinking

within the field of wayfinding. Some of these guidelines and principles are evaluated against DOH guidelines which are critiqued further in section 6.2 and subsections 6.3.3.1 and 6.4.1.

The first set is of principles developed by Foltz (1998) who acknowledges relying on his findings from 'both the study of museum exhibits and the research of environmental psychologists, cognitive scientists, and others who study how humans represent and navigate in the physical environment' (see Table 4).

Create an identity at each location, different from all others (Arthur and Passini 1992).
Use landmarks to provide orientation cues and memorable locations (Lynch 1960).
Create well-structured paths (Lynch 1960, Carpman and Grant 2002).
Create regions of differing visual character (Lynch 1960).
Don't give the user too many choices in navigation (Carpman and Grant 2002).
Use survey views (give navigators a vista or map) (Huelat 2007)
Provide signs at decision points to help wayfinding decisions (Passini 1984, Arthur and Passini 1992, Carpman and Grant 2002)
Use sight lines to show what ahead (McLean 1993, Hunter 2010**)**

Table 4 Design Principles for wayfinding by Foltz (1998)

The second set of principles are referred to by their developers, The Centre for Universal Design (1997: 4), as *basic wayfinding designs principles* despite the fact that they are quite substantial in content and in comparison with the first set (see Table 5). As is the case with the first set of principles, the authors acknowledge the influence of the cognitive scientists and environmental psychologists.

Analyse the building or site for access points, taking into account the physical and aesthetic characteristics of the building or site. How will the site be accessed? Divide the large-scale site into distinctive smaller parts, or zones of functional use, while preserving a sense of place and connectivity between spaces. Organise the smaller parts under a simple organisational principle, such as use. Devise a zonation plan with a logical and rational structure. Provide frequent directional cues throughout the space, particularly at decision points along journeys in both directions.	-Any naming protocol must be flexible enough to be adapted to changing functions in a building or throughout a landscape or public space. Use a sequential, logical, rational and consistent naming protocol for places such as hospitals or educational institutions where buildings have been master planned and organised into a logical arrangement. When considering a naming protocol of an alpha-numeric coding system provide consistency within the coding system. For example: Room B3.7 reads Building B, Level 3 Room

The design of decision points must be logical, rational and obvious to a sighted user, ensuring the directional cues relate directly to a building or landscape space. Ensure sequencing and that the priority and grouping of message signs is unambiguous. Design and implement a naming protocol by choosing a theme for segregating places and spaces. Use names and symbols that can be easily remembered by users from diverse cultural backgrounds.	7. Room C4.6 reads Building C, Level 4 Room 6. Block BS1 reads Building B, South, Entry 1. Block MN2 reads Building M, North, Entry 2. Consider incorporating information in multiple languages or incorporating pictograms when devising a naming protocol. Ensure the physical placement, installation and illumination of signs is suitable for all users.

Table 5 Wayfinding design principles developed by The Centre for Universal Design (1997)

The developer of the third set, Huelat (2007), presents her principles in graphical form showing building blocks (Facility Amenities, Graphics, Signage, Architecture, Interior Architecture, Interior Design, Landscape and Master Plan) which she asserts rely on each other to form a solid wayfinding system (see Figure 6).

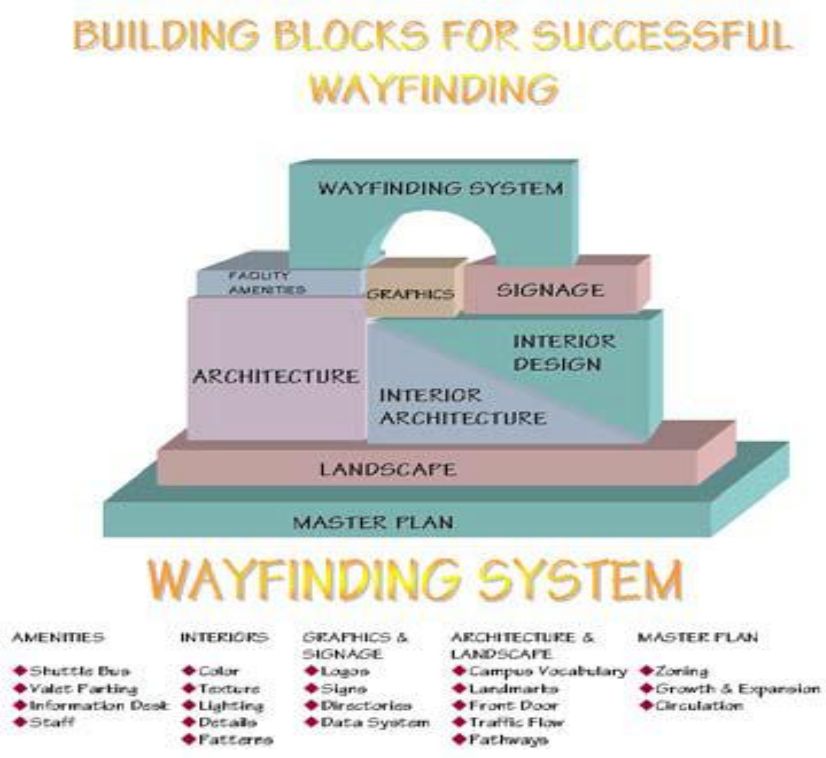


Figure 6 Huelat's (2007:9) Building Block Model for successful wayfinding.

According to this model a **Master Plan** includes the following; Zoning, Growth and Expansion and Circulation. Huelat argues that the Master Plan can provide a solid foundation for a good

wayfinding system. The **Landscape** and **Architecture** blocks include things such as; trees, plantings, flagpoles, water features, outdoor furnishings, campus vocabulary, front door, landmarks, traffic flow and pathways. The **Architecture** block includes; windows in corridors to aid in visitor orientation, entrances that are easy to identify, clear pathways, easy-to-see visitor elevators, and landmarks that create visual cues at decision points. The **Interior Architecture** and **Interior Design** blocks include; colour, texture, lighting, details and palettes. The **Facility Amenities** block includes; shuttle bus; valet parking, information desk and staff and the **Graphics** and **Signage** include; directories, logos, signs, you-are-hear maps and data systems.

The graphical model presented above is supported by a checklist (see Table 6) and again acknowledges the underpinning concepts.

Apply the progressive-disclosure model of wayfinding Identify all parking, buildings, and entrances. Use consistent graphics, colour, and logos. Create a user-friendly handheld map, and repeat that map in lobby directories. Develop an appropriate wayfinding system that is specific to your facility. Incorporate environmental cues such as landscapes. Include windows in corridors for outdoor orientation. Design main entrance drop-off areas. Offer valet parking. Provide easy and well-identified parking. Clearly delineate handicap parking and access routes. Establish clear routes to primary destinations.	Train all staff in giving directions—the same way to the same place. Have a highly visible visitor-information centre. Develop a sensible room-numbering system. Identify all destinations in the same vocabulary. Use symbols and icons to bridge language barriers. Provide clear, concise, and consistent signs that have strong contrast and visibility. Clearly light all signs and use lighting to feature landmarks. Provide easy access to patient education. Offer learning centres with extended hours, high visibility, and a friendly staff. Differentiate public elevators from staff and clinical elevators. Display clocks in primary waiting areas. Provide telephones in emergency areas, waiting areas, entrances, and dining areas

Table 6 Huelat's (2007) check list for developing good wayfinding system

The fourth set is somewhat different in that it contains more generic principles: The Principles of Universal Design. They were developed by The Centre for Universal Design (1997) in collaboration with a consortium of universal design researchers and practitioners from across

the United States (see Table 7).

Principle 1: Equitable use	The design is useful and marketable to people with diverse abilities.
Principle 2: Flexibility in use	The design accommodates a wide range of individual preferences and abilities.
Principle 3: Simple and intuitive use	Use of the design is easy to understand, regardless of the users experience, knowledge, language skills or current concentration level.
Principle 4: Perceptible information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the users sensory abilities.
Principle 5: Tolerance for error	The design minimises hazards and the adverse consequences of accidental or unintended actions.
Principle 6: Low physical effort	The design can be used efficiently and comfortably and with a minimum of fatigue.
Principle 7: Size and space for approach and use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of users body size, posture or mobility.

Table 7 Principles of Universal Design by The Centre for Universal Design (1997)

A closer examination of these principles reveals that the authors have gone to great lengths to represent what is viewed as good practice within the field of wayfinding. Inherent in all sets is an awareness of the issues raised by Peponis and Weiseman (2002) regarding the need for principles that should reflect the differences in the environment; the people visiting such environments and the strategies that they employ. Thus it can be argued that anyone one setting out to design for better wayfinding or better still for use of environments in general should find these principles a sufficient and valuable guide to a degree. In fact the authors of the seven generic principles presented in Table 7 are confident that theirs ‘may be applied to evaluate existing designs, guide the design process and educate designers and consumers about the characteristics of more usable products and environments’ (The Centre for Universal Design, 1997: 3). They are convinced that following their principles should lead to a non-discriminatory design approach.

However, Huelat’s (2007) *Building Block Model* for successful wayfinding is outstanding in that it provides a useful visual framework for categorizing and understanding what influences the good wayfinding design. Here we are presented with a graphical representation of the specific areas to focus on (e.g. master plan, architecture and landscape, graphics and signage,

interiors and amenities) supported by a fairly comprehensive checklist for developing a good wayfinding system. The other attraction of this model is that it has been developed with hospital wayfinding problems in mind. In that sense, it is an improvement on the work Miller and Lewis (1999) whose document [Wayfinding: Effective wayfinding and signing systems (DOH 1999, 2005] is aimed at those wishing to design, implement or improve wayfinding systems for National Health Service (NHS) healthcare sites.

Miller and Lewis (1998:10), who clearly rely on the work of Passini (1984) and that of Arthur and Passini (1992) offer rich and invaluable guidance on evaluating existing wayfinding systems on a more practical level. Their work, they assert, is designed for '… busy people, with very practical concerns...' (p.10). They contend that rather than set out a series of rules that everyone must follow the focus should be on providing information that will enable the development of local solutions as '...each trust, and each site, has its own problems and priorities' (p.10). It can be argued that this work is an extension or rather a simplification of Arthur and Passini (1992) who write for an academic audience. Unfortunately this work, which is written for people who work with wayfinding systems on a day-to-day basis such as estates and facilities managers and patient services managers, is presented in 141 pages of small print and a style that is not the easiest to follow. Thus it fails to live up to its claimed quality of being designed in such a way that its users should find it less cumbersome.

Besides, it remains a mystery that such context specific guidance appears to have made so little impact more than a decade since its publication. This raises interesting questions around issues of decision making relating to the design and management of wayfinding systems as highlighted by Carpman and Grant (2002) earlier. Also one wonders whether the guidance document, which continues to be the point of reference, certainly in the United Kingdom, is in need of evaluation and upgrading itself. The picture painted here is rather disappointing especially in view of the amount of good research demonstrating the importance of wayfinding to building use, costs, and safety.

Hunter (2010) observes that despite the impressive research evidence, wayfinding continues to receive less than its due in planning, research and building evaluation. She further observes that often the investment in wayfinding systems is less than that devoted to amenities like art and furnishings and wayfinding systems are often not evaluated until a serious problem occurs. Arthur and Passini (1992) make an interesting observation that could partly explain this. They point out that when comparing getting lost to other inconveniences placed before us

in modern everyday life it is unlikely that people will actually die from the stress of getting lost.

To this point, the historical developments in wayfinding have been charted. It has been argued that beyond the initial work of Lynch (1960), that of cognitive scientists (e.g. Dows and Stea, 1973, Golledge 1999) and environmental psychologists (e.g. Romedi Passini) there is little in the way of new wayfinding concepts or theories apart from the work on space syntax and wayfinding by Peponis et al (1990). The review shows that wayfinding continues to be a subject of interest and that this is an indication of the need for more research. Section 3.1.2 has reviewed some of the wayfinding research highlighting the benefits of good wayfinding. The review also emphasises the importance of designing built environments and wayfinding systems that should promote the fiscal health of an organisation and the physical well being of the wayfinder. The value and utility of wayfinding design principles has been argued in section 3.1.3 and a point has been made about the need for principles that can easily translate into built and graphic form through spatial planning and environmental communication.

Carpman and Grant (2002) assert that architects and designers, being relatively new to wayfinding, should be taking advantage of the more specialised in-depth knowledge that has been accumulated in other related fields. The next section will now consider views from other related disciplines.

3.3 VIEWS FROM KNOWLEDGE MANAGEMENT, DESIGN AND PRODUCTION AND OPERATIONS MANAGEMENT

This section discusses four concepts: the tri-partite conception of knowledge flows; affordances taken from product design, and transparency and production flows taken from production and operations management. As will become apparent, the concepts of affordances and transparency pay particular attention to the readability of physical properties of objects.

3.3.1 Knowledge Management

This research sits within the framework provided for by the Immortal Information and Through Life Knowledge Management project commonly referred to as Knowledge and

Information Management (KIM). KIM, an EPSRC funded Grand Challenge project challenged academics, from several universities across the United Kingdom, and a number of industrial partners, from across the defence, aerospace, construction and healthcare sectors, to 'find robust ways of handling information and knowledge over the lifetime of product-services such as PFI hospitals, schools and military equipment' (KIM 2006). KIM's focus on developing more effective ways of managing the flow of knowledge between designers, manufacturers and customers/end users was partly driven by the recognition that a shift from a traditional product delivery paradigm (making and selling products with little emphasis on after-sales support) to a product-service paradigm (a product that is sold as a service) has occurred and is increasing in popularity (Oliva and Kallenberg 2003). Oliva and Kallenberg note that organisations across all sectors are increasingly being asked not only to provide products in the first instance but also to support them throughout their service life. The KIM project attempted to develop such an approach, based on a dichotomy of knowledge and information. A critique of this approach led to the formulation of the tri-partite conception of knowledge flow, an approach seen as appropriate for the effective communication of wayfinding information in complex environments.

Currently, the Knowledge Management (KM) literature tends to take a dichotomous approach, making a distinction between knowledge and information which relies heavily on a further distinction between tacit and explicit (Davenport and Prusak 1998, Quintas 2005). Nonaka and Takeuchi's (1995) argument that a key KM process is the “conversion of tacit knowledge to explicit knowledge” (p.11) has been widely influential, though generally misunderstood (Snowden 2002). To all intents and purposes, explicit knowledge is taken to be synonymous with information, the function of KM thus being to convert the hidden tacit knowledge held by individuals into communicable information (Snowden 2002, Keane and Mason 2006).

Knowledge also tends to be discussed in terms of communities of practice (e.g. Wenger 1999, Davenport and Prusak 1998, Quintas 2005). This conception is useful in that it simultaneously stresses both the social and the practical aspects of knowledge. The conception of knowledge as social practice is particularly useful as the test for knowledge in a human being is always performative. For instance, it is our ability to give answer to questions, or perform tasks (i.e. our practice) constitutes the evidence of our knowledge. Empirically speaking, our knowledge is constituted in nothing other than instances of practice. However, the conception of community of practice is a narrow conception, tied to the particular phenomenon of informal

organization. In fact, knowledge as social practice is ubiquitous; it is as much a feature of formal organization as it is of informal organization.

In tying our conception of knowledge as practice to a particular organizational form, we risk committing what Ryle (1963) would call a category error; confusing informal organization (a type of organization) with the natural reflexivity of action, which is a feature of all human organization (Garfinkel 2002). Bittner (1973) provides a more accurate rendering of the relationship between action and formal organization. Along with Wittgenstein (1958), all these writers explicitly recognise that knowledge is inevitably associated with social practice. This is true equally of information. It might be objected that these two conceptions of knowledge constitute mutually exclusive categories. Recorded information (knowledge that) whether embedded in text books or computer code, is clearly distinguishable from human activity. To understand the relationship between the two there is need to look more closely at the nature of meaning. As Garfinkel (1984) stresses, the meaning of information depends upon the context in which it is produced and used. That context is always a social process.

Thus, the existence of two clearly distinguishable, though intimately related, categories of knowledge of information, on the one hand; social practice on the other can be seen. Furthermore, a third, overlapping category of the physical qualities of objects in which knowledge can be embedded can be identified. Rooke et al (2010a) refer to this formulation as the tri-partite conception of knowledge flows and highlight that the physical properties of artefacts have a vital role to play in the process of knowledge management. The tri-partite conception identifies informational and practical aspects of knowledge, as well as a conception of physical objects and environments as information carrying entities which are constituted, recognised and used in the course of social practice. Thus, the formulation includes: [1] information; [2] social practice; [3] the physical properties of objects in which knowledge can be embedded. The value of the physical (including among others visual and tactile) properties of artefacts in the preservation of knowledge through subsequent stages of the life-cycle of a building and its transfer from artefact to user is emphasised.

As indicated in the introductory Chapter, one of the preoccupations of this research was to find an efficient way for managing wayfinding information embedded in the physical properties of the built environment. The request to help with wayfinding problems at Salford Royal hospital came in the early stages of this research and at a time when the researchers at

Salford University were also looking for an ideal opportunity to operationalise the tri-partite conception of knowledge flows. From the outset it was clear that the study of wayfinding would provide a prominent example of how knowledge can be effectively communicated and managed through adopting an approach based on the tri-partite conception of knowledge flows. It also became apparent that this would create an opportunity to establish and demonstrate the important role played by the physical properties of the BE in aiding a more effective transfer of the knowledge between designers and end users. This made the idea of learning from the behaviour of the users of the setting in particular how they make sense of knowledge embedded in the physical properties of the built environment an attractive one.

One of the arguments in this thesis is that the problems of wayfinding can be effectively solved by adopting a knowledge management (KM) approach based on the tri-partite conception of knowledge flows (Rooke et al, 2010a). It is assumed that any wayfinding system/strategy should integrate all three knowledge flows suggested in the tri-partite conception. Doing so should facilitate the design of effective wayfinding systems and will ensure that the *right information* in the *right form* is in the *right place* so that it can be accessed by the *right people* at the *right time*. This in turn should ensure that wayfinding information remains immortal throughout the various stages of the long life cycles complex buildings remain in use.

Notwithstanding the relative neglect in KM studies of the active role played by artefacts in the transfer of knowledge (Rooke et al, 2010a), communication rendered via physical properties has received attention from a range of other disciplines, for example: kanban and poke yoke (Shingo 1988) in production and operations management and affordances (Norman 2002) in design.

3.3.2 Design: Affordances

The work of Norman (1999, 2002) on affordances is suggested as a good starting point for general design guidelines to make any product or environment more user-friendly (Ruabal 2008). The word ***affordance*** was coined by psychologist J. J. Gibson (1977, 1979) to refer to the actionable properties between the world and an actor (a person or animal). Gibson viewed affordances as part of nature arguing that they do not have to be visible, known, or desirable. This implies that some affordances are yet to be discovered and that none of us know all the affordances of even everyday objects (Norman 1999). Norman (2002) introduced the term

affordance to design as ‘perceived affordance’ in response to the fact that in design what matters to designers is whether the user perceives that some action is possible. Norman (1999) acknowledges the existence of both real and perceived affordances in product design where designers deal with real, physical objects.

He pays particular close attention to the interaction between artefact and user. He points out that the physical properties of a device can provide critical clues as to its proper operation and argues that the art of the designer is to ensure that the actions relevant to an artefact are readily perceivable. According to Norman (2002), well designed objects should be easy to interpret and understand, containing visible clues as to how they should be operated without the need for words or symbols. Thus, the design of a door should provide not only for the visibility of functional parts such as handles, but also communicate their correct use, informing the user as to whether the door opens inwards or outwards for instance. A door with a vertical plate on one side (see Figure 7) and a handle on the other (see Figure 8) immediately communicates this, providing a good example of how knowledge can be embedded in artefacts at design stage.

Other concepts provided by Norman (1999) include physical, logical and cultural constraints. Physical constraints are closely related to real affordances (e.g. the impossibility of moving the cursor outside the screen). Logical constraints use reasoning to determine the alternatives (e.g. where one is asked to click on 5 locations and only 4 are immediately visible; the person knows, logically, that there is still a location left). Cultural constraints, he observes, are learned conventions that are shared by a cultural group (e.g. knowing that the graphic icon on the right hand side of a display is a "scroll bar" and that moving the cursor to it, holding down a mouse button, and dragging it downward should expose the objects located below. Norman recognizes that cultural constraints can only be effectively incorporated into design through direct observation of user activity. However, he also warns that there is considerable confusion in the use of these terms (Norman 1999).

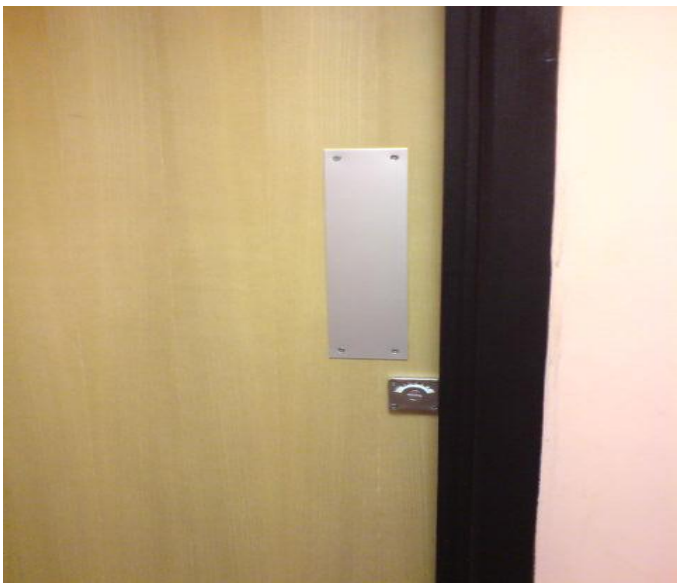


Figure 7 Door with a vertical metal plate

Figure 8 Same door with metal handle on the other side

3.3.3 Production and Operations Management

In production and operations management, attention has been given to the rendering of information in visual form and providing 'transparency' to the work situation (Galsworth 1997, Formoso et al. 2002, Hines et al. 2005), especially stimulated by the example of the Toyota Production System. In a theoretical sense, visual management means a separation of the network of information and the hierarchical structure of order giving (Greif 1991). Generally, it can be assumed that lack of transparency increases the propensity to err, reduces the visibility of errors, and diminishes motivation for improvement. The value of visual management in helping organisations influence, direct, limit or guarantee the behaviour of people is emphasised by Galsworth (1997). She points out that it is constituted of visual elements consciously designed to structure human behaviour and identifies four elements: the visual indicator, the visual signal, the visual control and the visual guarantee.

The visual indicator gives information and influences behaviour by telling. An example would be of a sign telling the visitor that to get the galleries they must go up the stairs. The visual signal is designed to catch one's attention with visual stimuli and works by directing behaviour, for example flashing lights at traffic lights tells the motorists when to stop and when to go. The visual control works by controlling and limiting human response in terms of size, weight, length, weight etc. Bordering, colour-coding, outlining and marking are good examples of visual control. The visual guarantee works by guaranteeing and allowing the

correct response only. There are no intentional or unintentional errors and all the information one needs is embodied mechanically or electronically into the physical properties of the artefact. Poka-yokes are a good example of visual guarantees. Poka yoke is a Japanese term that means mistake-proofing and involves the physical embodiment of assembly and operation knowledge in components and products (Shingo 1988). Generally this technique is used in manufacturing process but has much wider uses, such as; offices - order and invoice processing, hospitals - drug dispensing, aircraft maintenance - particularly with processes having the potential of inducing catastrophic in-service failures.

The visual elements discussed here serve to show how knowledge can be transferred or integrated into the environment and physical objects. As with the concepts of perceived affordances, physical, logical and cultural constraints proposed by Norman (1999) for user-centred design, it can be said that the focus as in production and operations management is also on the information bearing qualities of artefacts. That both the concepts of affordances and of transparency underpin successful wayfinding needs no further emphasis. The review of the body of wayfinding literature has shown that a good wayfinding design should aim at delivering environments and wayfinding systems that are transparent and that afford the easiest movement, circulation and promote memorability.

Koskela (1992, 2000) has theorised aspects of production management, highlighting the realisation that production involves the flow of materials and products through a series of work stations and stages of production. The Transformation Flow Value (TFV) theory focuses on the management and improvement of processes by considering customer needs, eliminating waste and maximizing value (Koskela 1992, 2000). Applying this thinking to knowledge management focuses attention on the communication of knowledge. Thus, the management of knowledge would imply minimising the waste that occurs through loss of knowledge and the most efficient use of knowledge to increase customer value.

In the case of wayfinding, the aim should be, therefore, to design wayfinding systems which maximise the flow of wayfinding information. Thus the focus on flows would emphasise the importance of the media through which wayfinding information is communicated (e.g. practices, coded information and the physical properties of built environment) throughout the successive stages of the built environment life-cycle. Simultaneously thinkers in knowledge management, such as Gupta and Govindarajan (1991) and Nissen and Levitt (2002) have also

treated knowledge as a flow. The thinking presented here appears to link in well with that of Huelat (2007) where she proposes the *Progressive Disclosure* model used in designing effective wayfinding systems for airports.

The overall aim of this literature review as stated earlier was to establish whether it would have been possible to progress the aims of the study without recourse to empirical research. In order to do this, literature on wayfinding and the supporting disciplines of knowledge management, production and operations management and design was reviewed. The next section focuses on assessing how well the review provides suitable answers to the three questions stated in section 3.1.

3.4 EVALUATING THE REVIEW OF RELEVANT LITERATURE

The historical account of the key developments in wayfinding provides insights into the theoretical concepts that have continued to underpin wayfinding research to this day: spatial orientation, cognitive mapping and spatial problem solving. The review also provides insights into what good wayfinding design entails highlighting the merits and demerits of poor wayfinding. The value/utility of wayfinding design principles is emphasised as are the benefits of learning from other disciplines. However, despite the impressive developments in wayfinding there remains a need to fully address the persistent problems of wayfinding. There is a longstanding call for broader research into: how humans navigate, wayfind and make sense of wayfinding information embedded in the built environment; how wayfinding decisions are made at organisational level and post-occupancy evaluation amongst other things. Figure 10 below presents a summary of how well the review of literature provides answers to the three questions posed in section 3.1.

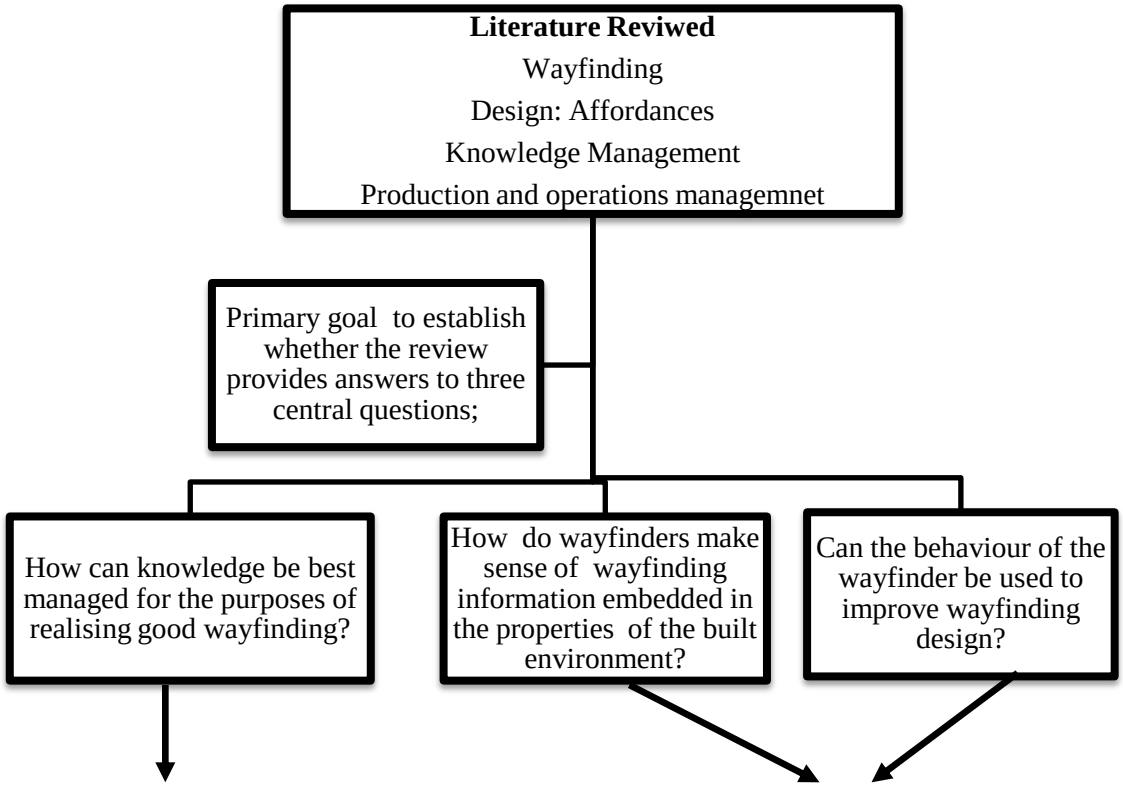


Figure 9 Summary of key findings from the review of literature

Having established the value of the physical (including among others visual and tactile) properties of artefacts in the preservation and transfer of knowledge an assumption is made

that any wayfinding strategy should utilise all three aspects of knowledge: coded information; social practice; and the physical properties of artefacts. Whilst the standard practice is to rely on signage and graphics supplemented by verbal direction giving by staff at information desks, visitor's centres or other members of the setting, the importance of the need to communicate with users through the physical properties of the built environment and other objects in it is strongly emphasised. The call for legible physical settings (e.g. Carpman and Grant's 2001) architectural wayfinding communication or environmental communication (e.g. Arthur and Passini 1992) and the human language of space (e.g. Lawson 1999) is proof of an acute awareness of the knowledge bearing capacity of physical properties of the built environment and other physical objects.

Here it has been argued that the idea of affordances and transparency form the core of wayfinding design. As with the applicability of production flows, it can be argued from a lean perspective that the tri-partite conception can be used by designers to identify where and how loss of value resulting from getting lost can be eliminated or reduced. Reducing waste ensures that value is protected and that efficiency is improved (Fillingham 2008, Shingo 1988, Koskela 2000).

Whether the review provides any insights into the how wayfinders make sense of wayfinding information embedded in the physical properties of the built environment the answer is not so straight forward. The review provides little insight into how real life observations of the behaviour of wayfinders can be used to produce meaningful wayfinding solutions for old and complex environments. However, there is clear emphasis on the need for an in-depth understanding of how wayfinders make sense of wayfinding information embedded in both the physical properties of the built environment and wayfinding systems themselves. Evidence also suggests that the question of which approach to adopt as a role model out of the many that have been suggested remains unanswered. The call for broader research into: how people use simultaneous wayfinding cues; how they give and take directions; real-world observation of common wayfinding strategies and correction of wayfinding mistakes; behavioural response to architectural features and how organizations make wayfinding design decisions by Carpman and Grant (2002) earlier spells out precisely where the focus ought to be.

3.5 DISCUSSION OF KEY FINDINGS

In section 3.4 it is argued that there is sufficient evidence from literature to support the assertion that the tri-partite conception is relevant to the problems of managing wayfinding information. If suggestions for improving wayfinding at Salford Royal Hospital were to be made at this stage of the research then a very general prescriptive framework based on the tri-partite conception of knowledge flows (see Figure 10) would have been possible. However, suggesting this framework as a solution to the problems of wayfinding at Salford Royal hospital at this stage of the research would have been failure to heed the live call for broader research into real-world observation into the behaviour of wayfinders and decision making by organizations faced with the job of providing effective wayfinding systems. As it happens, the decision to review relevant literature simultaneous to ethnographic empirical research made it possible to avoid this pitfall.

Figure 10 shows a very simplistic graphical representation of the framework in the shape of an inverted pyramid.

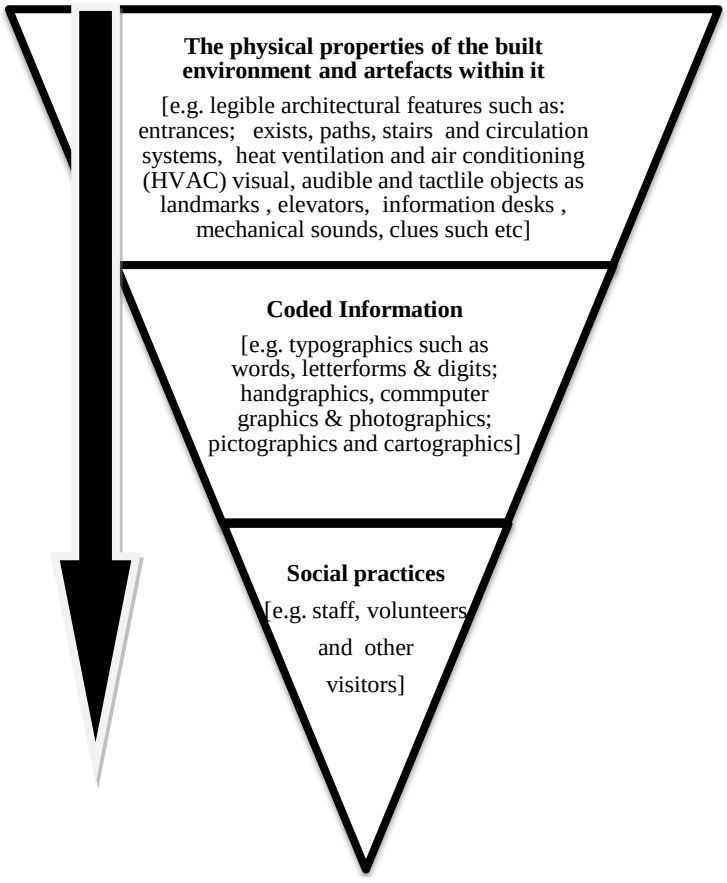


Figure 10 A prescriptive framework for addressing wayfinding problems adapted from Rooke et al. (2010a)

The framework prioritises communicating through the physical properties of the built environment over coded information and social practice. It communicates that signs are not the most important means of communicating wayfinding information and that there should be less reliance on the practice of giving verbal instruction by staff, volunteers and/or other visitors. To the left of the pyramid is an arrow indicating the order of priority. The size of each segment communicates the importance of each knowledge flow in comparison. In this context, the function of the tri-partite conception can be seen. Each element of the concept – practice, information, physical artefact – represents a mode of communication.

The concept thus acts as a high level guide to the management of knowledge for the purposes of wayfinding; each element of the concept pointing towards a different disciplinary approach to the management of knowledge: organizational practice; information storage and retrieval; design of physical artefacts. As will be shown in the empirical research Chapters, the tri-partite framework served as an extremely useful and robust tool for evaluating and categorising existing wayfinding problems both during the first phase of the fieldwork at Salford Royal hospital, when doing a retrospective self reflective analysis of wayfinding experience and further on into the research when conducting comparative studies in other hospitals.

3.6 SUMMARY

This Chapter has discussed the relevant literature for this study. Section 3.2.1 has presented a historical account of the key developments in wayfinding since the concept was first introduced in the early 1960s. Here it has been argued that the pioneering work of pioneering work of (Lynch 1960), that of cognitive scientists on *spatial orientation* and *cognitive mapping* and that of environmental psychologists on *spatial problem solving* has continued to underpin wayfinding research to this day. It has also been asserted that all wayfinding design principles or guidelines are firmly rooted in either the thinking of cognitive scientist or that of environmental psychologists and the relevance and value of both outlooks have been emphasised.

Section 3.2.2 has reviewed what the experts say about the importance of good wayfinding and how it can be achieved through paying close attention to the design of both the built environment and wayfinding systems. The impact of poor wayfinding on both the health of

the organisation and that of the wayfinder has also been emphasised. Section 3.2.3 has discussed the need for wayfinding design principles highlighting their value and utility and the need for principles that can easily translate into built and graphic form through spatial planning and environmental communication. Section 3.3 has reviewed knowledge management, production and operations management and design literature. The review has highlighted the concepts of: the tri-partite conception of knowledge flows, affordances and transparency and production flows in production and operations management as highly relevant to wayfinding design.

Section 3.4 has evaluated the value of the literature review itself and has shown that wayfinding matters cannot be successfully resolved in an abstract way. Here it has been argued that although it is possible to develop a prescriptive conceptual framework from the review of literature alone the framework would be too general. Thus, measured against a contextual framework developed from an in-depth understanding of situated problems, its value would be questionable. This is to imply that the utility of such a prescriptive framework would have to be tested in the real field.

Having established the extent to the review of literature addresses the central questions of the study and the urgent need for solutions to the problems of wayfinding at Salford Royal hospital, the conclusion is that a simple examination of methodological descriptions found in academic publications is insufficient. The review shows that the need for wayfinding solutions that are underpinned by an in-depth understanding of the situated behaviour of wayfinders remains outstanding.

The next four Chapters present the empirical research conducted with the aim of answering the three central questions identified in section 3.1. The Chapters are structured according to the stages of the design science research process as follows: problem identification and definition (Chapters 4 and 5); design and development (Chapter 6) and evaluation (Chapter 7). Chapter 4 focuses on problem identification through participant observations whilst Chapter 5 is about producing analytic descriptions. The central argument here is that observing the unique adequacy criteria allows an in-depth identification and definition of wayfinding problems and the evaluation of solutions developed from uniquely adequate descriptions of the methods by which wayfinders find their way in complex hospital environments.

4 PROBLEM IDENTIFICATION AND DEFINITION: OBSERVATIONS

4.1 INTRODUCTION

This Chapter reports on the ethnographic work conducted for this study. The reports are presented under three main parts: retrospective case study; main case study and comparative case studies. Each part starts by offering a description of the organisation studied followed by overview of the work carried out. A discussion of the key findings is offered last. Figure 11 below is graphical summary of the various built environments considered for the study.

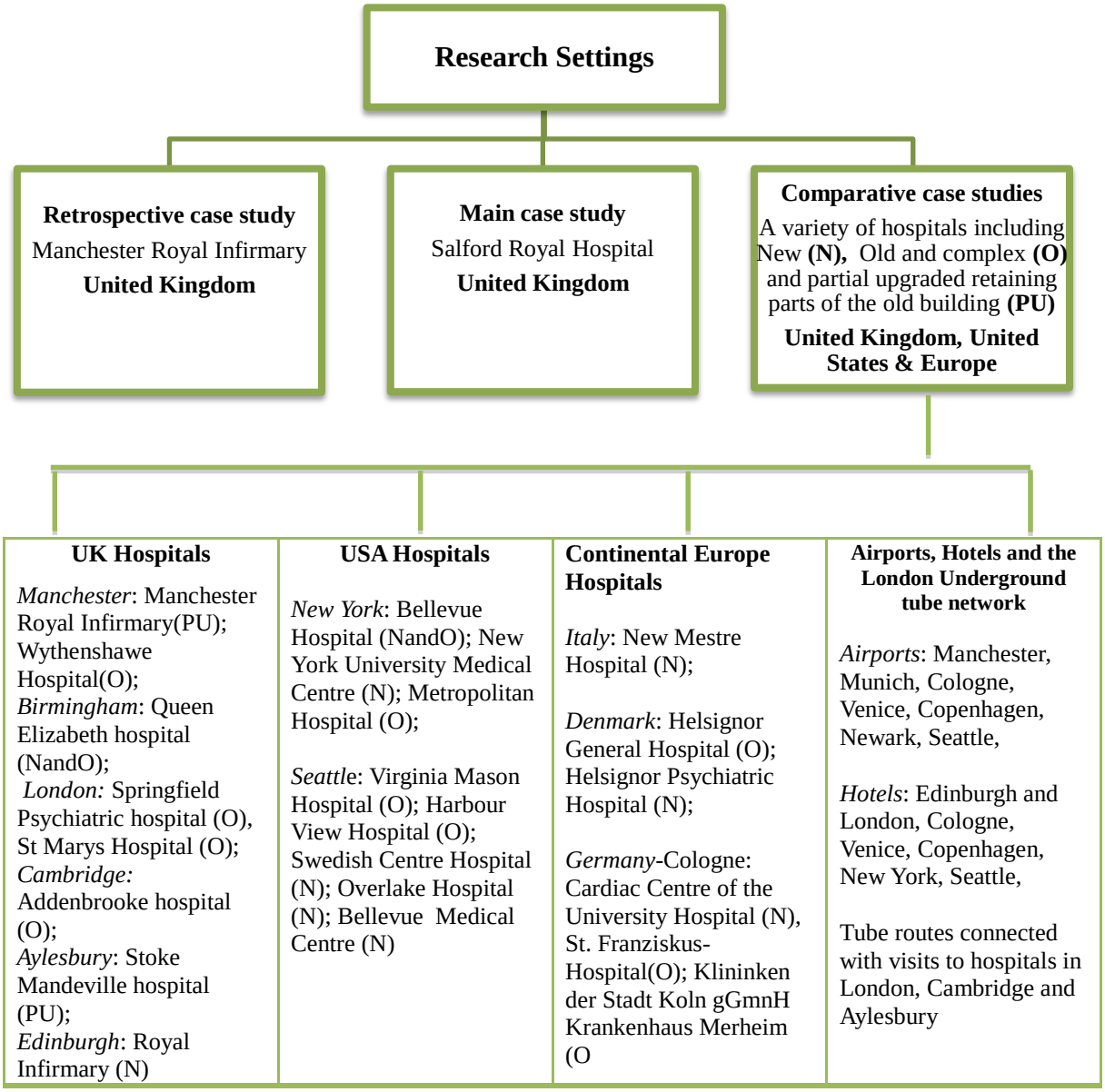


Figure 11 A graphical summary of all the settings where ethnographic field work was conducted.

First and foremost it ought to be said that conducting in-depth ethnographic fieldwork in a variety of settings described in this put the researcher in a unique position that allowed the degree of focus demanded by Arthur and Passini (1992) if wayfinding issues are to be approached intelligibly (see Chapter 2, Sec 2.3.2). Following the Design Science Research Approach whilst observing both the weak and strong requirements of the unique adequacy approach yielded positive results. In addition to allowing real-world observation of common wayfinding strategies the methodological approach also allowed an in-depth post-occupancy evaluation of the wayfinding system at Salford Royal hospital and part correction of wayfinding mistakes.

Addressing ethical issues around gaining access into research settings was largely guided by the University of Salford's policy and procedures on 'Integrity and Self-Regulation in Research conduct. Here the need to comply with research ethics frameworks or codes of practice belonging to other organizations (e.g. the NHS) or any other sites in which research is to be conducted is made clear. Appendix 1 contains documentary evidence of the process of gaining ethical approval from various bodies. They include letters of clarification and approval and a permit.

In conducting research at Salford Royal Hospital and other NHS hospitals in the UK the research fully complied with National Research Ethics Service (NRES) regulations and requirements. Additional permission to walk around, talk to visitors and staff was granted by Salford Royal in the form of a permit. Gaining access into hospitals in other parts of the United Kingdom and around the world did not require approval in advance. Permission to enter a setting, walk around and where appropriate take photographs was negotiated on site. In all cases considered, but for one (Bellevue Hospital, New York) where hospital police had to be consulted, such permission was granted by the executive managers.

Information on how to get to and around various hospitals is in the form of maps and directions for most hospitals. This can be found under the '*Plan your visit'* or '*Find us'* etc sections on respective hospital's website. A representative example is that of the map and directions for the Manchester Royal Infirmary found by following the appropriate link on their website (CMFT 2012). Here the prospective visitor is presented with maps that 'reveal your best route to the hospital' from home to the hospital. A map of the site showing drop-off

areas, parking and entrances can also be downloaded from the website (see Appendix 2). Additional information on how to get there by various modes of transport such as bus, car, train, tram, walking, cycling etc. is also included. Some organisations, for example Salford Royal Hospital, provide more detailed information such as:

> *Salford Royal is colour coded to make it easier for you to find your way around. There are maps located inside the hospital to help you get to where you are going. If you have an appointment letter please bring this with you on your visit and a member of staff will be able to direct you (Salford Royal NHS Foundation Trust 2012)*

4.2 RETROSPECTIVE CASE STUDY

This section presents a retrospective reflective account of the author's (She will be referred to as Mrs R) own attempts at finding the way to the to the x-ray department to attend a scheduled appointment. The visit took place in the year 2007 four years after the author had stopped working at the hospital as a nurse. Unbeknown to her the hospital was undergoing major reconstruction which resulted in partial or complete demolition of buildings and architectural layouts the author was familiar with.

Manchester Royal Infirmary (MRI) is part of the five large and complex hospitals owned by Central Manchester University Hospitals NHS Foundation Trust. The hospitals care for more than one million patients a year from the local community and further afield. Visitors come with a wide range of medical needs (psychiatric and physical) and from diverse ethnic and cultural backgrounds. The MRI is a large teaching hospital for the University of Manchester University with specialities such as kidney and pancreas transplants and haematology and sickle cell disease. It is a major provider of cardiac services and cardiothoracic surgery and cardiology in the region.

The letter offering Mrs R an appointment had the following instruction as far as wayfinding directions go:

> *'...The x-ray department is in the purple zone... Please report to the main x-ray reception on arrival...'*

Mrs R's vast knowledge of the hospital layout gained as an operative (nurse) allowed her to picture in her mind's eye the various routes and entrances possible to her including how to get there in the first place. On the day of the appointment she commuted from home to the

hospital by bus in the same manner she used to four years prior to the current visit. She alighted at a stop closest to the entrance that leads to the to the x-ray department and before long she found herself presented with a sign clearly announcing that her chosen route was no longer available. At this point she could see that the entire hospital site was undergoing major upgrading involving complete or partial demolition of a large percentage of the old buildings. Unfortunately, there was no further information to help Mrs R gain access to the main hospital from this point. On exploring beyond the sign and relying purely on her memory of the site's layout she found herself negotiating her way through a temporary construction site. This lead her to a familiar entrance that would take her to the purple zone (see Figure 12 below).

Figure 12 Sign found at one of the entrances to MRI

From here, in addition to her previous knowledge of the internal layout of the hospital, Mrs R made use of signs; hanging from the ceiling, stuck flat on the walls, protruding from walls into corridors or placed above doors/entrances in order to reach the x-ray department. However, despite Mrs R' previous knowledge of the hospital setting she found herself lost and confused at a junction where the sign for the x-ray department was placed above a door with an arrow pointing upwards. Beyond the door and immediately to the right a lift could be seen. The route bears to the left following the alcove between the lift and the wall directly opposite the door. Mrs R was left wondering whether she should follow the route by turning left and

going straight ahead or go up a level via the lifts. Three other people appeared shortly afterwards and exhibited behaviour similar to that of Mrs R. On approaching the door, just like Mrs R, they stopped to read the instruction above the door, walked through, stopped by the lift and looked left and back to the lift. A hospital porter appeared and spontaneously offered to help stating; '***Its double Dutch here'.*** This is a phrase commonly used to refer to something extremely confusing. It so happens that the sign is designed to instruct the wayfinder to turn left and then go straight ahead. Directions for the x-ray department are straight forward from this point on.

4.3 MAIN CASE STUDY

In the main case study, the author's task was to find her way to various departments previously unknown to her in order to establish how it is that people visiting the hospital or departments find their way and why they get lost. It was hoped that the exercise would lead to proposing strategies for improving wayfinding across the hospital and the development of generic wayfinding guidelines.

Salford Royal hospital is owned by the large teaching trust: Salford Royal NHS Foundation Trust with a team of over 6,000 staff. The trust provides hospital and community care to the people of Salford and beyond. It also offers specialist care to people from all over the UK who need expert help with brain, bone, intestine, skin or kidney conditions. At the time of conducting the in-depth fieldwork the hospital was in the middle of a £200million scheme to redevelop the hospital site. This entailed the demolition of several older buildings to provide space for a new patient and visitor car park.

As already indicated in the quote in the introductory section of this Chapter Salford Royal hospital is made up of colour coded areas (Red, Green, Yellow, Orange Blue and Purple) designed to help visitors with their internal wayfinding needs. These can be accessed via several (1-9) entry points across the site. The main entrance (4) is located in the Red area and through here all other areas, apart from the Accident and Emergency (A&E) department and the Blue area can be reached via a connecting corridor found on the first floor (see Appendix 5 for a simple floor plan for both the ground and first floor). The initial work carried out is reported in detail in the document entitled: *A review of the existing wayfinding strategy for Salford Royal NHS Foundation Trust* (see Appendix 3). This exercise identified that the major

challenges faced by visitors using entrance 4 (see floor plan in Appendix 5) was to successfully navigate through the maze between the main reception, the connecting corridor and the route leading to A&E. The wayfinder is presented with four possible routes accessible via the stairs or lifts. The routes are described in detail in the document detailing the proposed wayfinding experiment presented to the hospital's Redevelopment team for consideration (see Appendix 4). Two of these routes are analysed closely in Chapter 5.

4.4 COMPARATIVE CASE STUDIES

As briefly indicated in the research methodology Chapter, the move to conduct brief ethnographic fieldwork in other settings was motivated by the desire to learn from 'best practice' as it was by the desire to establish the generic nature of wayfinding problems. The sections that follow give brief descriptions of the various settings visited including the precise reasons for selecting specific hospitals.

It has to be made clear from the outset that by referring to these case studies as comparative the study does not claim to engage in ***Comparative research*** a research methodology which aims to make comparisons across different countries, cultures or settings (Przeworski and Henry, 1970). As will become apparent in Chapters 5, 6 and 7 the collection and consequent analysis of data during this stage of the research makes the job of applying the DSR approach to wayfinding a straight forward one. For example, in the design and development stage these provide a rich source of information which serves to validate the findings recorded in both the retrospective and main case studies. In the evaluation stage of the research it also becomes possible to demonstrate the generic nature of the problems of wayfinding through successfully testing suggested solutions in settings other than hospitals.

4.4.1 UK hospitals

The visit to **Springfield Psychiatric hospital** in South London and **Addenbrooke hospital** in Cambridge as already indicated in section 1.3 was motivated by the fact that direct dealings with the organisation who carried out the flagship work at theses hospitals were constrained largely due time. However, the fact that hospitals are public places where one can enter and walk around without the need for prior permission made it possible for the researcher to do a quick review of the wayfinding systems in both hospitals.

Springfield Psychiatric hospital is owned by the South West London and St George's Mental Health NHS Trust which also operates from nearly 100 other locations, providing community and hospital psychiatric services to Kingston, Merton, Richmond, Sutton and Wandsworth. It also offers more specialist services to people throughout the United Kingdom. The trust employs about 2,700 staff and provides treatment to about 20,000 people at any one given time with a total of 39,500 people receiving services each year. Addenbrooke's Hospital is run by the Cambridge University Hospitals NHS Foundation Trust (CUH). It provides emergency, surgical and medical services for people living in the Cambridge area but also offers regional specialist services like organ transplantation, cancer, neurosciences, paediatrics and genetics. In the year 2009/10 the trust employed around 7 000 staff, had 90 353 A&E attendances, 66 613 inpatient admissions, 446540 visits to outpatients and 5 711 birth (CUH 2010)

In each case more than five hours was spent walking in and around the hospital site. Due to the sensitive nature of psychiatric services offered at Springfield hospital assessment of all internal systems was not possible. Access was only allowed into one of the modern buildings said to be the state-of-the-art. Thus most of the work conducted here was the assessment of how the external wayfinding system is constituted. However, at Addenbrooke it was possible to assess both the external and internal wayfinding systems as the researcher was able to move around freely both in and outside the hospital. Here the way in which wayfinding information is displayed and how visitors made sense of it at the time of the visit was studied.

Queen Elizabeth hospital is one of the hospitals owned by University Hospitals Birmingham NHS Foundation Trust (UHB) a leading university teaching hospital in the West Midlands. The Trust employs around 6,900 staff and every year it provides a wide range of services, both inpatient and outpatient, to more than half a million patients. It is a regional centre for cancer, trauma, burns and plastics, and has the largest solid organ transplantation programme in Europe. On 16 June 2010 UHB's new £545 million Queen Elizabeth Hospital Birmingham opened resulting in the transfer of the A&E and inpatients from the old to the new setting but retaining some services remaining at the old Queen Elizabeth, adjacent to the new hospital.

The desire to briefly study the new hospital was motivated by the experience a friend of the author who had recently been lost in the new setting. He remarked:

> *'... the vast new Queen Elizabeth hospital has a clear policy on signing - minimalist and inadequate. This much was admitted by the nurse I talked to. 'You'll never find your way out' she said, opening an unmarked door*

after a trudge through yards of anonymous corridors'.

The work conducted here amounted to finding the new hospital in the first instance. Directions on how to get to the hospital by bus were in the form of verbal instructions obtained from the information centre situated outside the train station. At the hospital, two hours were spent walking in and around both the new and old hospital which are connected by a suspended corridor (canopy) approximately quarter of a mile long. During this time the researcher was able to study the way in which wayfinders make sense of the wayfinding information made available to them both in the old and new settings.

Wythenshawe Hospital is owned by the University Hospital of South Manchester (UHSM) a major acute teaching hospital trust which employs approximately 5,500 staff. It provides district general hospital services and specialist tertiary services to the local community. Its specialist expertise includes cardiology and cardiothoracic surgery, heart and lung transplantation, respiratory conditions, burns and plastics, cancer and breast care services. In 2010/11 549 302 people were treated in A&E, as outpatients, as inpatients and day cases (UHSM 2010).

The work conducted here was a simple walk through assessing the level of information overload caused by the large volume of signs across the site and detail on individual signs. This brief survey was conducted at night whilst the author was on an hour's break from a nursing shift on one of the wards. The author has knowledge of the hospital layout and various departments gained as a previous fulltime employee of the Trust.

Stoke Mandeville hospital is run by the Buckinghamshire Healthcare NHS Trust. It is located on the edge of the market town of Aylesbury. It is best known for its internationally acclaimed spinal injuries unit and provides a wide range of services (e.g. A&E, maternity, cancer care, outpatients, and psychiatric services) to Buckinghamshire and beyond. The hospital is also a regional centre for specialist services for burns and plastics and eye care. It treats over 48 000 inpatients and 219 000 outpatients a year. The author has knowledge of the hospital gained as a trainee nurse in from October 1998 to August 2001. Recently (2009) Stoke Mandeville has undergone an extensive multi-million pound renovation as part of the drive to meet the patients' expectations from good quality, comfortable environments.

The visit to the hospital was largely motivated by the hospital's attitude towards wayfinding expressed in the extract taken from the minutes of the meeting held on 18 October 2007 under

section 44/07 (a) p: 3 **New Items awaiting Approval**

> *'The committee considered a proposal to improve the signage and wayfinding on the Stoke Mandeville Hospital site. A request had been made to fund this from the SMH General Amenities fund at an estimated cost of £58750 and it was stressed that this proposal was for signage / wayfinding over and above that which had already been provided to comply with NHS standards and, as such, was not a high priority for exchequer funds. The proposal would however be of significant benefit to both staff and patients. After some considerable debate, the proposal was agreed. The committee also indicated that any changes or updating to the signage / wayfinding would need to be addressed by normal exchequer sources and suggested that the Trust acquired a "soft copy" of the signage as part of the deal. The committee also wanted to make it clear that the approval decision was made on the basis of the particular characteristics of the SMH site and should not be seen as a precedent for other requests of this nature'*

First is the common mistake, as identified in the literature review, that signage is the same as wayfinding. Second, is the low prioritisation of wayfinding issues despite the acknowledged significant benefit to both staff and patients. In addition to these the author was keen to test the extent to which she could rely on her cognitive map of the hospital developed during her three years nurse training.

Approximately five hours was spent inside the hospital with the researcher trying to get to various departments previously known to her. The researcher confidently entered the hospital via a familiar A&E entrance but she soon found herself completely disoriented to the point of having to ask for directions on how to get out of the hospital in order to re-orient herself. Despite the fact that some parts of the old hospital have been retained, the entire hospital was as good as a new setting for the researcher. In a spontaneous conversation with the manager of the Patient and Liaison Services (PALS) it was revealed that the problem of disorientation was widespread. PALS continue to receive countless complaints about problems occurring when trying to navigate between the old and new parts of the hospitals.

A similar challenge is currently faced by those visiting the new **Manchester Royal Infirmary hospital** which is now up and running following a major four year upgrade worth £500 million. The author found herself in a situation not different to that described above when she visited the new setting out of curiosity. The new parts of the hospital are not synchronised with old parts where is comes to guiding the visitor to their desired destinations. No effort has been made to upgrade the old wayfinding system to match the new one.

St Marys Hospital is a general acute hospital that diagnoses and treats a range of adult and paediatric conditions. In addition it is internationally renowned for excellence in the diagnosis, treatment and care of people with sexual health problems, including sexually transmitted diseases such as HIV and AIDS. The hospital has also pioneered the use of robotic surgery, including the UK's first da Vinci robot for keyhole surgery.

Work conducted here was not previously planned. The researcher took advantage of the fact that the hospital happens to be approximately 20 minutes walk away from the in which hotel she was staying whilst researching the hospitals in the South of England. As with Wythenshawe hospital above, a simple walkthrough paying attention to how wayfinding information is displayed in relation to the spatial configuration of the hospital constituted the research. No more than two hours was spent moving in and around the hospital.

Edinburgh Royal Infirmary is part of NHS Lothian's University Hospitals Division which n provides services for the second largest residential population in Scotland - circa 800,000 people. NHS Lothian employs 28 000 staff, including approximately 15 000 nurses (registered and unregistered) and midwives and around 2 700 medical staff. The Royal Infirmary is a £190 million major acute teaching hospital opened in 2003 as a modern, purpose-built replacement for the old and out-dated Victorian building at Lauriston Place. It has 900 plus inpatient beds and provides a full range of acute medical and surgical services for patients from across Lothian and specialist services for people from across the south east of Scotland and beyond. The services include: accident and emergency, acute medicine, cardiology and cardiothoracic surgery, gastroenterology, general surgery, maternity-gynaecology and neonatal units, orthopaedic surgery, renal (kidney) medicine and dialysis, respiratory medicine, sleep medicine, transplant surgery (kidney and liver transplant) and vascular surgery.

The desire to study the hospital was inspired during an arranged visit connected to a healthcare conference to which the author was a delegate. It was revealed during this visit that the hospital had received several awards for excellence in healthcare provision. This encouraged a separate visit with a view to establishing how the visitors managed their wayfinding tasks in this well performing hospital. A month later the researcher visited the Royal Infirmary and spent seven hours from 0900hrs-1600hrs paying attention to the way the internal wayfinding system is constituted and to how visitors made sense of the wayfinding

cues presented to them at the time of the visit.

4.4.2 USA hospitals

The trips to the USA were motivated by the need to learn from the good practices of the award winning new Ambulatory Care Facility of Bellevue Hospital Centre, New York and the Bellevue Medical Centre of Seattle, Washington. The design of the latter is said to be so good that it is almost impossible for visitors to be lost. Whilst in New York, the researcher took advantage of the opportunities that arose out of proximity to study New York University Medical Centre and the Metropolitan Hospital. In Seattle Virginia Mason Hospital, Harbour View Hospital, Swedish Centre Hospital and Overlake Hospital were also studied. In each case the researcher spent up to five hours paying close attention to the way visitors made sense of the wayfinding cues presented to them and to how it is put together in a wayfinding system. Next is a brief overview of each hospital.

Bellevue Hospital Centre is a 912 bed acute-care general hospital, said to be the flagship hospital of New York City's Health and Hospitals Corporation (HHC) and the nation's largest municipal health care-system (HHC 2010). The new Ambulatory Care Facility, together with renovated medical spaces within the existing Bellevue Hospital complex, is said to have radically transformed the environment. The new building serves as the main entrance for the entire hospital complex through which 10 000 visitors pass daily. The Ambulatory Care Building provides a full range of clinical functions.

The positive impact of the physical design of this part of the hospital on wayfinding is discussed in section 4.5.3. However, as is the case with UK hospitals where existing and new buildings are brought together, the greatest challenge here is to effectively synchronise the wayfinding cues presented to the visitor

The **New York University Medical Centre NYU** is situated next to the Bellevue Hospital. It is described as a world-class patient-centred integrated academic medical establishment providing excellent healthcare, biomedical research, and medical education. The NYU comprises three hospitals—Tisch Hospital, a 705-bed acute-care tertiary facility; Rusk Institute of Rehabilitation Medicine, the first rehabilitation hospital in the world, with 174 beds and extensive outpatient rehabilitation programs; and the 190-bed hospital for joint

diseases. The latter is one of only five hospitals in the world dedicated to orthopaedics and rheumatology. In 2010 the centre is reported to have had 37 408 inpatient and 656 250 outpatient admissions (HHC 2010).

The hour spent walking around this hospital was enough to establish that the modern physical layout of the building means less reliance on signage and the practice of giving verbal directions. Visitors to the setting appeared to conduct their wayfinding tasks with little need for help from signs or verbal instructions.

The **Metropolitan Hospital** is an hour's walk away and on the same avenue (First Avenue) as the two hospitals described above. Affiliated with New York Medical College it represents the oldest American partnership between a hospital and a private medical school in the United States. It is described as a full-service, acute care hospital emphasizing primary care and prides itself on delivering culturally-sensitive medical care to the diverse neighbourhoods of northern Manhattan. It was the first hospital in East Harlem to be designated by the New York State Department of Health (NYSDOH) as an official Stroke Centre. In 2009 it had 341 beds, 351 160 clinic visits, 61 393 emergency visits and 1 698 births (HHC 2009)

Although many areas within the Metropolitan have been recently renovated most of the hospital retains its old external and internal architectural features. Unlike the two hospitals described earlier here the researcher witnessed a frequent occurrence of visitors asking for directions and an overreliance on the use of signs. One of the visitors could be heard telling the direction giver (a nurse) that she knew she would still get lost despite her instructions.

Bellevue Medical Centre is said to be an innovative, state-of-the-art comprehensive medical centre for Group Health members in East King County (Group Health Cooperative 2010) It serves as Group Health's primary facility on Seattle's east side providing space for the outpatient practice of Group Health physicians in more than 20 specialty areas. The centre t is equipped to provide outpatient care to more than 1000 patients a day. Overnight patients stay at Overlake Hospital Medical Centre situated next door. The four-story facility provides services which include surgery, radiology, a women's health care centre, a cancer treatment centre and an outpatient acute and urgent care centre (Group Health Cooperative 2010)

Regarding the hospital's wayfinding this is what one of the designers has to say:

> *I've always said if we have to use the word "wayfinding," our buildings are too complicated. We went as far as we could to design this building as simply to use as humanly possible given its size.....It's almost impossible to get lost in the building...One of the tenets that we follow is to let people orient themselves naturally, not necessarily by signs. You simply can't make people read signs. You can do this in really big buildings; there's nothing particularly magical about it. You come out of the elevators and you're in exactly the same orientation in that building as when you went into the elevators. You can pinpoint yourself—"Yep, I know where I am"—and then you can walk off and go where you need to go.(*Hultlock 2008)

The claim that it is almost impossible to get lost in this hospital was validated in part during the brief period spent studying the hospital. Here is a hospital that relies more on the physical make up of the built environment than signs and verbal directions to guide its visitors. As one enters the hospital they are presented with a long public corridor designed in such a way that all the check-in stations are visible from the point of entry. The elevator and stairs are situated at the end of the public corridor and are in full view. This pattern is repeated on each floor and patients are able to check in any place in the building, go up to the specialty area, and then be escorted into their space—the patient exam room (Hutlock 2008). There are two interconnecting corridors besides the medical assistant stations, a corridor in the front that allows one to circulate to either side of the corridor and a corridor in the back, which is the offstage corridor for the staff (Hutlock 2008).

Overlake Hospital Medical Centre is a 349-bed, non-profit regional medical centre connected to Bellevue Medical Centre. It is a regional healthcare centre providing advanced medical services in the areas of cardiac care, general and specialty surgery, women's services, cancer treatment and services for seniors. The latest Figures stand at: over 2 500 employees plus more than 1000 physicians, 197 157 patients (including newborns), 14 585 Surgical procedures 53 572 Emergency Room (ER) patients 1 008 436 Lab tests and 49 440 radiology patients seen (Overlake hospital Medical Centre 2012).

The research carried out here amounted to a brief walkthrough of not more than 30 minutes. During this time it was possible to establish the hospital's dependency on signage and the practice of giving verbal instructions. However, its less complex layout in comparison with older settings means that less signs are used.

Virginia Mason Medical Centre (VM) is a non-profit organization with an acute care hospital licensed for 336 beds and emergency departments. It offers integrated health services, which include a multispecialty group practice of more than 440 physicians offering both primary and specialized care (Virginia Mason Medical Centre 2011). VM prides itself in its Virginia Mason Production System (VMPS) management method which is believed to have contributed towards providing the best outcomes and patient experiences (Virginia Mason Medical Centre 2011). The method which adopts the basic tenets of the Toyota Production System (TPS) (Shingo 1988) embraces the concepts of quality, safety, customer satisfaction, staff satisfaction and cost effectiveness. This focus is precisely what motivated the need to establish the extent to which wayfinding matters were taken seriously at VM.

The two hours spent walking around VM was sufficient to establish that signage and the practice of giving verbal instructions made up the wayfinding system. The hospital is old and complex in layout and appears to suffer problems similar to those identified in other old settings. The researcher found herself lost on a number of occasions when trying to find her way out of the hospital. Each time she was either offered help spontaneously by staff or asked for directions from other visitors.

Swedish Medical Center is the largest nonprofit health-care provider in the Greater Seattle area. It is situated approximately a mile away from VM. The hospital is said to be a regional referral center, providing an extensive range of specialized treatment: oncology, cardiovascular care, neurological care, orthopedic care, obstetrics, surgery pediatrics and primary care (Swedish Medical Centre 2012). In 2009 it employed 6 838 staff; delivered 7 334 babies; treated 107 492 in emergence; had 40 734 inpatient admissions; performed 32 225 surgeries and had 43 080 visits to the medical-oncology and treatment-center (Swedish Medical Centre 2012). Similar to Overlake hospital, this hospital relies on signage and the practice of giving verbal instructions and its less complex physical layout means less signs.

Harborview Medical Centre is situated less than half a mile from the Swedish Medical Centre. It serves as the trauma-receiving centre for all of Western Washington, as well as portions of British Columbia and southern Alaska and is said to be one of the nation's leading adult and paediatric trauma and burn centre (University of Washington, 2011) It also offers services in neurosurgery, eye care, vascular, rehabilitation, sleep medicine and spine care.
The latest Figures are as follows: Licensed beds- 413; Employees- 4 619; Physicians- 1 243; Admissions-19 578; Emergency Department visits - 62 172; Clinic visits- 246 420; Surgery

cases- 14 872 (University of Washington 2011).

With regards to wayfinding, the problems encountered here are similar to those found in old hospitals considered above. The hospital's wayfinding system heavily relies on signs and the practice of giving directions by word of mouth.

4.4.3 Continental Europe hospitals

The trips to Europe where motivated by the same reason stated earlier. Three award winning hospitals selected for study were: Helsingør Psychiatric Hospital, Denmark; Cardiac Centre of the University Hospital, Germany and New Mestre hospital, Italy. Again due to proximity it was possible to study St. Franziskus-Hospital and Klininken der Stadt Koln gGmnH Krankenhaus Merheim in Germany and Helsingør General Hospital in Denmark. Up to five hours was spent at each of these hospitals paying attention to the way the wayfinding system is designed and how visitors made sense of the wayfinding cues. Worthy of mention are the challenges faced in obtaining basic information direct from hospital websites and onsite due to the language barrier. The problem was more pronounced in German and Italian hospitals where all literature obtained from information stalls was not in English. Verbal communication was also problematic in these two countries. The description of each hospital follows.

According to World Architecture News.com (2009) **Helsingør Psychiatric Hospital** is housed in a custom-made modern building presenting itself as anything but a hospital. It is said to be a safe and calm environment offering residential and public psychiatric treatment programs to the residents of Helsingør and beyond. Architonic (2006) observes that it is utilized as a best practices example for modern hospital design. Success of the project both in terms of design and operation, they further observe, has led to JDS Architects collaborating with some of the leading researchers and lecturers in hospital care.

Due to the sensitive nature of psychiatric services provided here the researcher was allowed only up to an hour to walk around the hospital taking photographs of the physical layout of the hospital where appropriate. An extra hour was spent with the Deputy Chief Executive (DCE) of the hospital who was keen to validate the claims that the modern design was having a positive impact on both the patients and staff's morale. However, she was unable to

comment on its impact on wayfinding performance stating that this subject was for designers. In addition the DCE spent an extra 30 minutes showing the researcher around **Helsingør General Hospital** which is connected to the psychiatric hospital by a suspended corridor. In the brief period spent walking around in both the psychiatric hospital it was possible to study how the physical properties of the layout contributes to efficient wayfinding. A brief description is given under section 4.5.3. In the general hospital the researcher found that the wayfinding system is heavily reliant on signage and verbal directions.

The Cardiac Centre of the University Hospital, Cologne is equipped with state of the art medical technology and welcomes its patients and visitors with a 20-metre high glassed entrance (Nickle-.Weller 2009, World Architecture News.com 2009). The structure-high reception hall is said to be more reminiscent of a hotel than of a clinic (World Architecture News.com 2009). The centre caters for specialities such as heart-thorax surgery, cardiology, paediatric cardiology and vascular surgery.

Despite the language barrier mentioned earlier, the researcher was able to find the way from her hotel to the hospital which is situated outside the city centre of Cologne and reachable by train. Directions to the hospital were obtained from the hotel's information kiosk where the English translation was available. The trip requires three train changes, all signs on platforms are in German and stop announcements are made in the local language only. At the hospital more language challenges were faced at the reception. Through the use of inarticulate and elaborate sign language the receptionist appeared to understand the expression of the wish to look around the hospital. Permission was granted by nodding of the head followed by the German version of 'please feel free to walk around' The two hours spent walking in and around the hospital was sufficient to reach the conclusion that the physical spatial layout of the H-shaped building made it possible for the wayfinding system to rely less on signage and on verbal directions.

Klininken der Stadt Koln gGmnH Krankenhaus is an old non-profit hospital in Merheim It is part of the three hospitals of the city of Cologne gGmbH: Holweide, Merheim and Children's Hospital Amsterdam street (Riehl). The hospitals are said to be the largest providers of inpatient health services with more than 1500 beds and 3500 employees (Klininken der Stadt Koln gGmnH 2011). Like the Cardiac Centre it is also on the outskirts of

the city centre of Cologne but in the opposite direction. A single 30 minute train journey is needed from the city centre.

Directions to the hospital were obtained from the hotel's information kiosk and additional information in the form of street maps and verbal instructions were given at the tourist centre and at the underground train station. The verbal instructions were emphasised with gestures: lifting both hands to shoulder level and stretching them outward to indicate the need to get off the train at the correct destination (Merheim). Finding the hospital, which is 10 minutes walk away from the Merheim train stop, was possible without recourse to further verbal instructions. In the hour that was spent walking in and around the hospital it was possible to conclude that like most old and complex hospital settings the wayfinding system here heavily relies on signage and the practice of giving verbal instructions. Also due to the complex physical layout the placement of some signs confuses the visitors.

The St. Franziskus-Hospital is a traditional Catholic hospital in Cologne-Ehrenfeld. It offers different clinics including amongst others internal medicine, general and visceral surgery, trauma surgery, special orthopaedic surgery and joint replacement, spine surgery, arthroscopic surgery, radiology and accidents and emergency services. The St. Franziskus-Hospital is an academic teaching hospital with 300 beds and 600 employees. It treats an average of 11 000 inpatient and 25 000 outpatients per year (St Fraziskus-Hospital ND).

This hospital was discovered during the orientation walk the researcher decided to take on the first night of arriving in Cologne. After missing a crucial turn on the way back to the hotel the researcher found herself completely lost and disoriented. The hospital was the only place she felt was safe to ask for directions. During this brief encounter, it was possible to tell that this hospital too relies on signage and the practice of giving verbal directions supported by street maps. The receptionist, who strongly advised against walking back to the hotel in the dark, sent the researcher off with a set of verbal instructions given in understandable English plus a street map. Two train changes were needed despite the fact that the hotel was only 30 minutes' walk away. The hotel was found after an anxious one and half hours of trying to follow the verbal instructions given in German by random people met on the streets.

New Mestre hospital is a Venice-Mestre Hospital general care hospital with 680 patient care beds, an emergency care centre and advanced surgical facilities. According to

Archinnovations (AI) its more conventional design is the product of understanding that a hospital should be conceived as part of the healing. Visitors arriving by car or train enter the hospital on a gently sloping green ramp and enter directly into a Lobby, which is also a reception hall for day patients. Various public facilities such as shops and cafes are contained within the hospital (AI 2010).

Finding the way to the hospital from the hotel involved a 30-minute trip on the waterbus from Venice Island to Roma Square and an additional 60 minutes on an ordinary bus from the square to New-Mestre. As is the case in Germany all signs here are in Italian and stop announcements are made in the local language only. This is the case too at the hospital. Efforts to engage in conversation with the receptionist at the hospital were not as successful as those at the Cardiac Centre in Cologne. The lady behind the desk shook her head sideways and said 'No English please' to communicate she did not speak English. Nonetheless, as is the case with most public places such as hospitals, it was possible to walk around taking appropriate photographs of the layout. Five hours was spent studying the impact of the physical spatial layout on visitors' ability to find their way and the way in which the hospital's wayfinding system has been designed. Here is a hospital design that appears to have incorporated wayfinding right from the beginning. Section 4.5.1 offers a brief description of the wayfinding system.

4.4.4 Settings other than hospitals

During the trips described above spontaneous opportunities to briefly study wayfinding performance in airports (Manchester, Munich, Cologne, Venice, Copenhagen, Newark and Seattle) arose. The respective hotels where the researcher stayed in these cities and the cities of London and Edinburgh were also studied as were the London underground tube network and railway stations connected with visits to hospitals in London, Cambridge, Edinburgh and Aylesbury. These settings provided a useful source of data upon which a comparison with hospitals could be made.

In all cases considered, the researcher was able to study the way in which the wayfinding systems in the various places are designed and how visitors to such setting make sense of the wayfinding information made available to them. In almost all the settings it became apparent that the wayfinding systems heavily rely on signs and the practice of giving verbal

instructions. However, most modern airports and the London tube network appear to use less signs. In both cases the effect appears to have been achieved by observing the principles of progressive disclosure and visual management highlighted in the literature review Chapter. Here visitors can be observed performing their wayfinding tasks almost effortlessly. The challenges encountered in most hotels are similar to those of hospital in that the complex layout of the built environment gives rise to the poor placement of signs. Some of the examples given in the next section are of photographs taken from these settings

4.5 KEY FINDINGS

In general it can be said that in all the wayfinding systems studied varying degrees of adherence to the basic wayfinding principles presented in the literature review Chapter were evident. Efforts to create an identity at each location, well-structured paths and regions of differing visual character and the use of landmarks to provide orientation cues and memorable locations can be seen. Also evident is the abundant use of survey views (give navigators a vista or map) and provision of signs at decision points to aid wayfinding decisions. In newer buildings effort is made not to give the user too many choices in navigation and to use sight lines to show what's ahead.

There is evidence that wayfinding systems/strategies and visitors rely on coded information, physical properties, and the practice of giving verbal instructions. Some hospital settings, especially the old and complex ones, rely heavily on signs which can be seen along the walls, above doors and hanging from the ceiling. The layout of old environments is far too complex to explain with signs and this, in some cases, has resulted in yet another overreliance on the practice of using volunteers and staff. The role played by the physical properties of the built environment and the objects within it in communicating wayfinding information is generally overlooked. However, newer environments tend to promote better wayfinding largely due to the less complex architectural design of such buildings. In such environments wayfinding systems rely less on the use of coded information and the practices of giving verbal directions.

The next three subsections offer detailed accounts of the prevalence of coded information, the practice of giving verbal instructions and communication through the physical properties of the built environment. Examples of breakdowns caused by: too much information (information overload) or lack of it; inconsistent use of colour and ill positioning of directional signs are the main focus.

4.5.1 Coded Information: signage and graphics

Coded information is represented by all forms graphical information for both external and internal wayfinding purposes. According to Arthur and Passini (1992) typographics such as words, letterforms and digits; handgraphics, computer graphics and photographics; pictographics and cartographics fall under this category. In Figure 13 below are examples of some of the widely accepted symbols. These and many others were found in most of the settings studied.

Figure 13 Examples of some of the widely accepted symbols (see DOH 2005: 84)

In all wayfinding systems considered three types of coded information identified by Arthur and Passini (1992) could be seen: 1) orientation and general information about the setting; 2) directional information to destinations; 3) identification of destinations. Their description of information type is as follows. Orientation information is that which gives the wayfinder an overview of what shape the building has (T, H, L etc.), where they are and where the destination lies. This information is used in the decision making stage. Directional information is used in the decision execution stage. It guides the wayfinder along a designated or preselected route to a destination. The last type of information aids decision execution. It is provided at the destination. What follows are photographs of examples of each information as found in various wayfinding settings.

Building directory

Safety information: dos and don't

Floor plan

Map

Figure 14 Examples of orientation and general information

The hospital directory in the top left corner is found in the foyer of Bellevue Medical Centre in Seattle where it is claimed that it is almost impossible to get lost. The safety information in the top left is of the traffic lights found outside Bellevue Medical Centre in Seattle Washington. The floor plan is found inside the main entrance to Salford Royal hospital and the map is that which is outside St Mary's hospital near Imperial College in London.

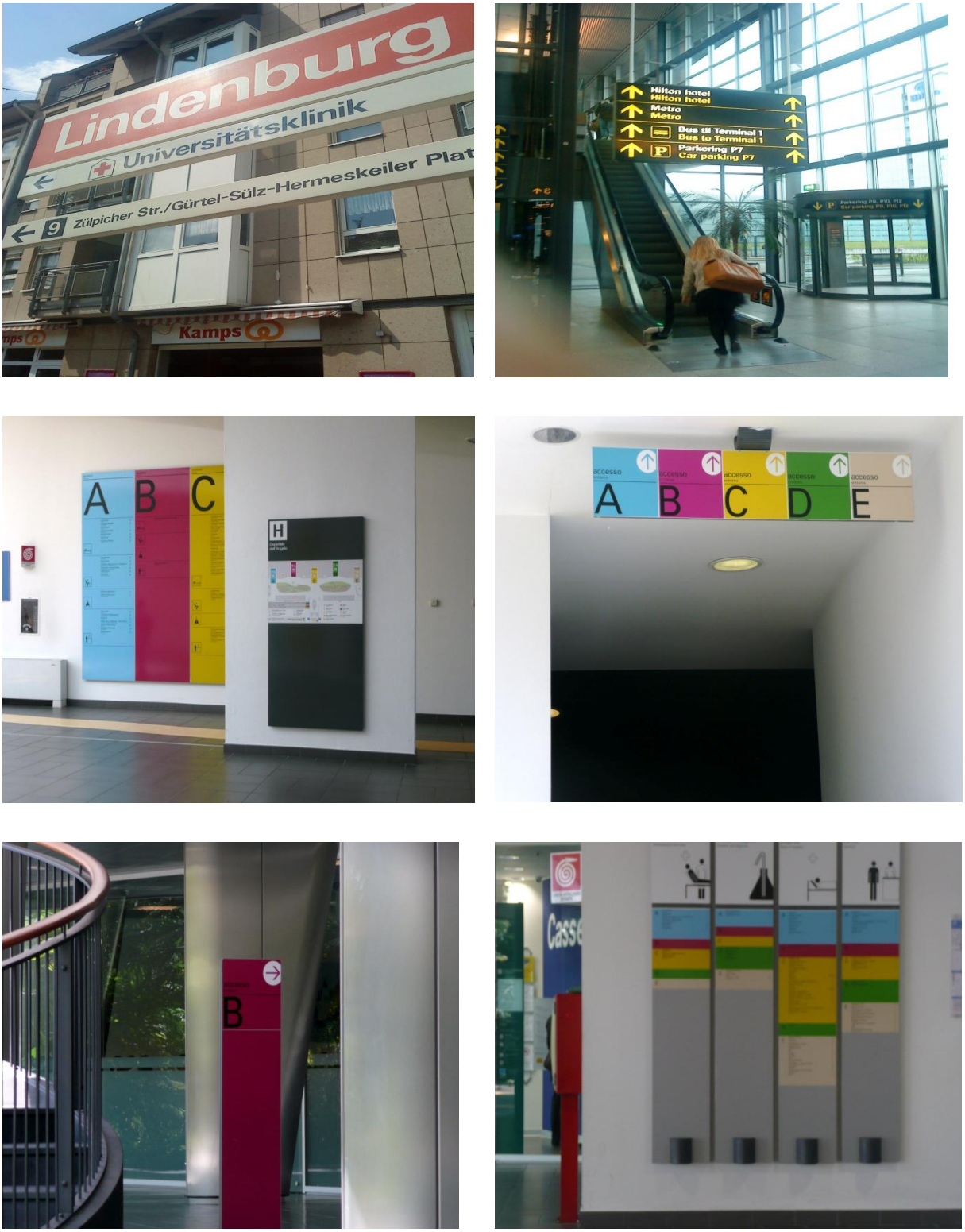


Figure 15 Six examples of directional information: signs with arrows and use of colour codes

The first photograph is of directions to the Cardiac Centre visited in Cologne, Germany and the second in the top right is of directions inside the Copenhagen airport in Denmark. The rest

of the photographs show how colour coding has been used at New Mestre hospital in Venice, Italy to guide the wayfinder from the time they enter the lobby. The fist picture is of the hospital directory showing all the colour coded areas from A to E, the second shows directions positioned above the escalator which leads to main reception. In the third picture the wayfinder is guided to the purple area and in the last there is a mixture of colour, text and pictographs to communicate the kind of services offered in each department.

Figure 16 Examples of identification of destinations.

The first photograph is of the main entrance to the old Metropolitan hospital found in Manhattan New York. The second is yet another entrance announcing arrival with warmness (WELCOME). In addition to the provision of useful and clear information seen on either side of WVRS information desk the smell of coffee coming from the WVRS shop not too far to the right adds to warmness of the welcome.

In almost all old and complex hospital settings the heavy volume of signs intended to explicate the complex layouts creates more confusion in the wayfinder. The layouts are far too complex to explain with signs. Such layouts have clearly evolved over time with extensions and buildings being added in a piecemeal way thus resulting in the creation of illogical circulation routes. In the hospital setting of Salford royal this problem has been mitigated by adopting the practice of leaving the doors open. This, as will be seen later, allows the quick

identification of signs, routes and decision-making points. In Chapters 5 and 6 examples of the confusion caused by ill positioned directional signs are considered in detail.

Two other observable problems relate to the way in which information designed to aid decision making is constituted and displayed and the way in which colour-coding systems are used. For example some directories (see Figure 17) clearly create what Passini (1984) describes as information overload.

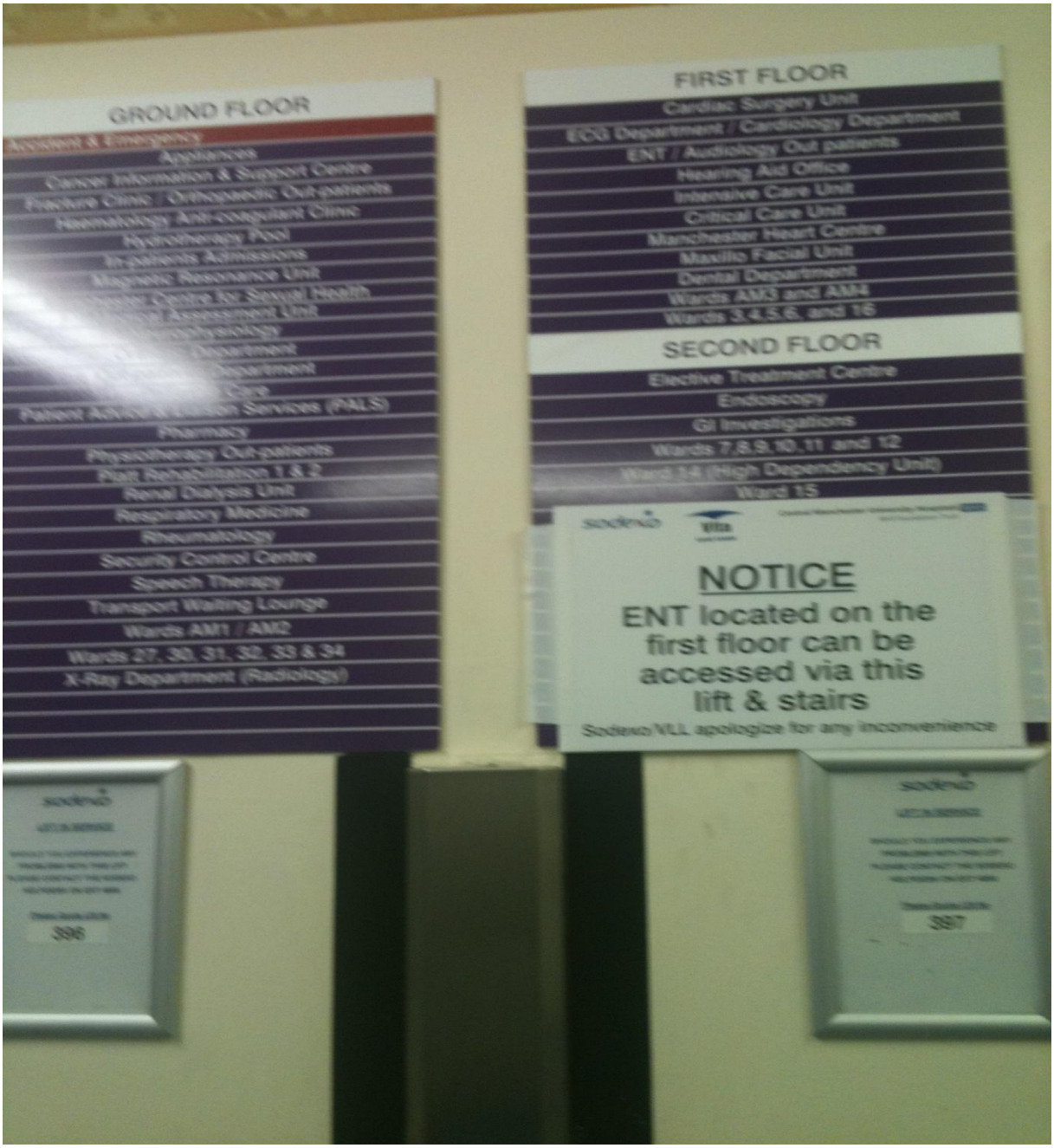


Figure 17 An extremely busy hospital directory typical of most if not all old hospitals.

This decision making point is made up of the most used form of communication; typographics. This mode of communication assumes that everyone can read and understand the message. Arthur and Passini (1992) could not be more right in their assertion that this is too big an assumption to make. The behaviour of wayfinders at decision making point endorses points made by Ware (2004) and Arthur and Passini (1992) about the short time span in which humans access and process information.

The widespread use of colour coding is apparent in most settings. This can be seen on several features of the built environment such as skirting boards; strips on the wall and also on borders around signs etc (see Figures 18 and 19 below)

Figure 18 The lift area contained in the space between the Red and Blue areas of Salford Royal hospital.

Noticeable here is the dual use of the colour blue: for decorative purposes on the wall and for wayfinding purposes on the directional sign hanging from the ceiling.

Figure 19 A section of a corridor joining the Red and Blue areas to other colour-coded areas of Salford Royal hospital.

The deliberate use of blue and purple colours seen here is for decorative purposes and yet both colours happen to be colours used to aid wayfinding. In Chapter 5 detailed descriptions of the confusion caused by this inconsistent use of colour are offered.

4.5.2 The practice of giving verbal directions

The second knowledge flow is characterized by audible forms of communication which are either verbal or aural. These are provided via information desks by trained staff, an army of volunteers or fellow wayfinders and audible systems such as telephones, audible maps and public address systems. The social practice of giving directions verbally is prevalent in every setting be it hotel, hospital, or airport. An information desk or customer services desk in any setting tells the wayfinder that help is available should they need it. Figure 20 below is a photograph of and a reception area found at Edinburgh Royal infirmary and manned 24hours a day. It is visible from the time the visitor enters the hospital building. In addition to booking patients in for their outpatient clinics and admissions reception staff also give verbal directions. Here the receptionist can be seen giving the visitor directions shortly after they have been booked in.

Figure 20 Reception-cum-Information desk situated in the receiving area of Edinburgh Royal Infirmary hospital.

In all NHS hospitals in the United Kingdom it is hospital policy that its staff must stop and offer help to anyone lost or appearing to be lost. In extreme cases, the staff must take those lost all the way to their destination. This practice can be observed in the behaviour of both the instruction giver and the wayfinder. Anyone who stops long enough soon becomes aware that volunteers and members of staff are constantly giving directions. Some staff admit to finding themselves dividing their working day between direction giving and their normal duties. At Salford Royal hospital evidence that the system heavily relies on it staff and volunteers is reflected in the chaos that occurs during the days and times when volunteers and personnel are off duty. A good example is that of the disruption of a Saturday outpatient clinic where nurses running the clinics battle to meet the demands of their paid job and those of giving directions to visitors.

It is also common to find other more experienced users of the setting offering spontaneous help to those lost or appearing to be lost. Even those lost stop to help each other, finding comfort in complaining about how confusing the place is. Some can be heard saying '*It is the blind leading the blind':* a remark said with a great deal of humour.

However, in extremely complex settings people continue to be lost no matter how good the verbal directions are. During the extensive fieldwork at Salford Royal the researcher witnessed an exchange of conversation between visitor and volunteer. After trying and failing to make sense of the sign seen in Figure 29 when looking for directions to the Green area the visitor accepts the offer of help from the volunteer who gives a series of instructions. He says '*Thank you but I know I will still be lost'* '*No you won't'* the volunteer challenges. *'Oh yes I will'* the visitor replies in a light-hearted way as he walks away. Both of them laugh and the volunteer attends to the next visitor (the researcher). In section 5.2.1 the route taken by this gentleman and later by the researcher is described.

4.5.3 The physical properties of the built environments and objects within it

The third flow is about knowledge embedded in physical objects and environments. Legible architectural features (e.g. entrances; exists, paths, stairs and circulation systems), visual, audible and tactile objects as landmarks, elevators, information desks and mechanical sounds can be classified under this category. Below are some examples taken from the old and complex environment of Salford Royal hospital and the new settings of Helsingør Psychiatric hospital and Bellevue Ambulatory Centre.

Figure 21 Entrance /Exit at Salford Royal Hospital.

Figure 22 is of a photograph showing a recognisable entrance/exit which requires no labelling with coded information to say what it is. The physical properties of the entrance are readable and serve as valuable information for even those who cannot read. The frontal approach gives it its legibility qualities as it allows the greatest visual access to an entrance. According to Arthur and Passini (1992) this approach is considered more effective in comparison with the oblique and indirect approaches to entrances. They observe that visual access diminishes as the approach becomes more oblique and finally disappears when the approach is indirect. Although exits are the same as entrances from an architectural point of view for the user it is not the same, note Arthur and Passini (1992) who further observe that people's perception of exists is limited to actual doors which are most of the time seen at short range.

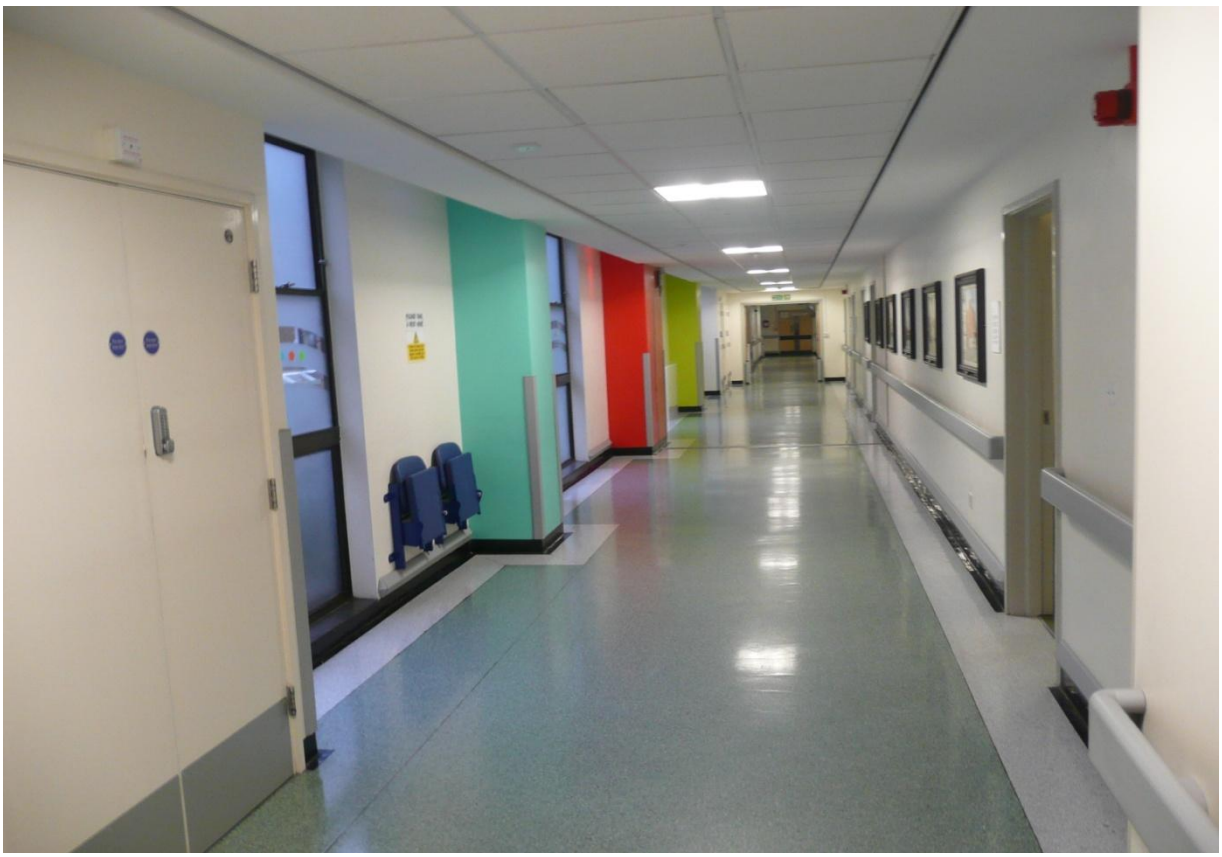


Figure 22 Path found at Salford Royal hospital

Figure 22 is of a photograph of a well lit path clearly communicating that it leads somewhere and that people are allowed on it. A number of things along this path serve as evidence to this assertion. On either side of the walls can be seen deliberate decorations intended to give the path a social element. Also notice the fold-up chairs immediately after the entrance seen to the right. The markings on floor differentiated by two shades of grey plus the lighting from the ceiling also adds to path‘s prominence.

Figure 23 The receiving area of Helsignor Psychiatric hospital, Denmark

In Figure 23 the linear circulation system is apparent. All parts of the building are fused at one single point. The visitor to the setting arrives at a central point from which single ordered paths lead them to various hospital departments. Here there is no need for directional signs. The name of the destination to which the path leads appears to be sufficient

Figure 24 Bellevue Ambulatory Centre Manhattan New York

In Figure 24 the concentric circulatory system can be seen. Visitors enter beneath a sheltering overhang and, passing through transparent glass entrances. The the visitor is in full view of all the floors in the building from a focal square which is used as the main reception to the centre. The conjunction of the sweeping, curved balconies of the new building and historic brickwork are enhanced by natural light. Public waiting areas are arrayed along curved gallerias on upper floors. Strategically placed reception units facilitate public interface with the different clinical modules. The division of the floor plate in three distinct zones — public, service and clinical/examination — optimizes programmatic flexibility and promotes efficiency.

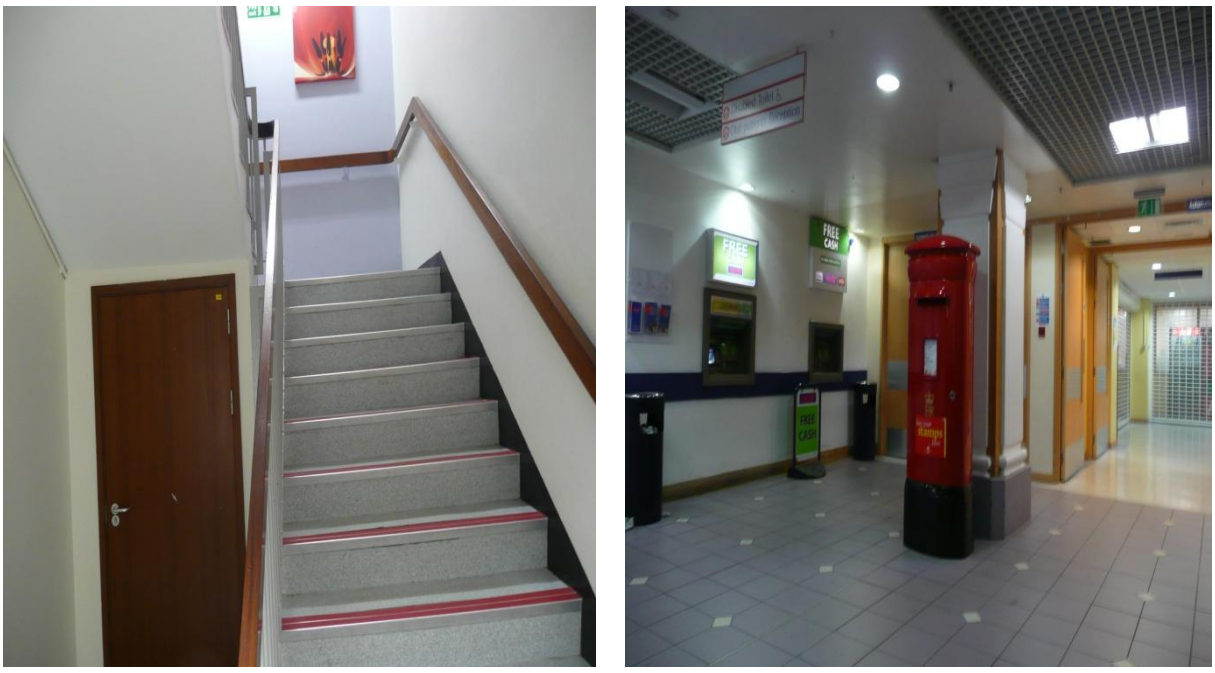


Figure 25 The stairs and objects used as landmarks at Salford Royal hospital

The photograph to the left is of the stairs which clearly do not need a sign to communicate what they are, what they should be used for or how they should be used. The last photograph contains a number of objects which are effectively incorporated into the practice of giving verbal directions as landmarks: the red post box and the cash machine. Several other objects within the hospital environment in general are used as landmarks in the same way (e.g. the body shop and the vending machine seen in wayfinding settings described in Chapter 5.

In this sub-section, examples showing how basic information about entrances, exists, paths and circulatory systems can provide the wayfinder with a variety of wayfinding cues with little need for signs have been considered. Thus it has been demonstrated that the physical properties of the built environment and objects within it play a vital role in communicating with the wayfinder. However, in old and more complex hospital settings the impact of the physical properties of built environment on wayfinding is generally overlooked. This is evident in the confusion caused by signs which are displayed without paying much attention to the architectural layout of the environment. Detailed analytical accounts describing wayfinding experience relating to the impact of the physical properties of the built environment on wayfinding behaviour are presented in the next Chapter. The accounts, as will become apparent, endorse Arthur and Passini's (1992:139) points that architectural and coded information systems go hand in hand and that although coded information '...may well reinforce and describe the circulatory system in more detail' rarely can it '...effectively replace

missing or misplaced architectural information'

4.6 SUMMARY

This is Chapter has presented the data collected for the study including a brief description of the various research settings considered for the study. Particular attention is paid to how the exercise aided a more in-depth identification and definition of the problems of wayfinding. The Chapter emphasises the prevalence of the three aspects of the tri-partite conception as it does the fact that an understanding of how wayfinders make sense of wayfinding information embedded in the physical properties of complex environments is possible through uniquely adequate observations.

The next Chapter presents an in-depth analysis of the behaviour of the wayfinders with a view to producing detailed uniquely adequate descriptions upon which wayfinding guidelines can be derived.

5 PROBLEM IDENTIFICATION AND DEFINITION: ANALYSIS

5.1 INTRODUCTION

This Chapter is presented in two parts. The first part offers detailed uniquely adequate analytical accounts of how wayfinders find their way with a view to establishing that from such accounts guidelines for improving wayfinding can be developed. This represents what Crabtree (2004) refers to as explicating the accountable structures of practical action made visible in the breach with a view to fleshing out abstract design concepts. The second part discusses the findings of this stage paying attention to the extent to which the central questions of the research have been answered.

5.2 UNIQUELY ADEQUATE ACCOUNTS OF THE BEHAVIOUR OF WAYFINDERS

Crabtree (2000) points out that spaces and places are made up of intelligible or meaningful material arrangements which are tied to the performance of particular activities and that without such arrangements social activities could not be accomplished. He identifies four interrelated and generic features that constitute this intelligible character of spatial arrangements. They are: manifestly visible and observable arrangements; constructed for their visibility; public and widely or commonly known; and paired up with interactional competencies for their use. What follows are several examples of uniquely adequate analytical descriptions which reveal these generic characteristics of spatial arrangements.

The descriptions articulate the confusion caused by misleading and/or ambiguous signs, inconsistent use of colour or too much use of it and information overload or lack of it at selected physical settings of Salford Royal hospital. The researcher's own experience, the observed behaviour of other wayfinders and spontaneous conversations occurring in various wayfinding settings make it possible to gain a clear and in-depth understanding of how various signs and physical settings are interpreted by wayfinders. To ensure that the methods used by wayfinders in the social production of the wayfinding settings described here are presented with minimal distortion due to personal or theoretical leanings or speculations (Rooke and Kagioglou, 2009), Francis and Hester's (2004) three methodological steps listed in section 2.3 of the research methodology Chapter are followed. They are:

- ✓ Notice something that is observably-the-case about some talk, activity or

setting.

- ✓ Pose the question 'How it is that this observable feature has been produced such that it is recognizable for what it is?'
- ✓ Consider, analyse and describe the methods used in the production and recognition of the observable feature.

Once the wayfinder enters the Red area via main entrance (see Figure 26), the information desk situated directly opposite the revolving glass door and the key decision making point (DMP) situated right next to it are in full view (see Figures 28 and 29). They are positioned right at the end of the wide corridor that leads from the glass doors (see Figure 27) Some visitors can be observed heading straight for the information desk to ask for directions but others choose to make sense of the instructions on the key DMP and/or the many signs seen hanging from the ceiling or on the walls. The information desk is manned by a team of volunteers and the key DMP, which is also situated next to the entry to the Plaza Shopping Mall, stretches all the way from the floor to the ceiling and contains nineteen destinations most of which are indicated by way of an arrow followed by text (see Figure 29).

Figure 26 Main entrance

Figure 27 Information desk and key Decision Making Point in full view

Figure 28 Close-up of desk and key Decision Making Point

Figure 29 Close up of the key Decision Making point

Two journeys have been selected for a detailed description: 1) finding the way to the Green area: the same route travelled by the gentleman mentioned in section 4.5.2; and 2) finding the way to the A&E department (see appendices 4 and 5). According to the key DMP both areas are on the first floor. However, there is no indication from this sign where the lifts or stairs to get one to the first floor in the first place can be found. During the day time when the information desk is manned by a team of volunteers, one receives spontaneous verbal instructions on the four possible routes accessible via the stairs or lifts (see Appendix 4). Between 1700hrs and 0900hrs the following day when the volunteers are off duty, the wayfinders are left to their own devices. In this case the wayfinder finds the lifts or stairs by exploring the possible options two of which are not difficult to identify. To the left of the information desk the entry to two routes (lifts and stairs) are apparent. The other two routes (also stairs and lifts) are hidden behind the Plaza Shopping Mall. The entry to the Plaza is located to the right of the key decision making point.

The two journeys analysed here take the wayfinder via the lifts which are located beyond the Plaza (see settings 1-5 and the floor map in Appendix 5). The descriptions of the wayfinders' behaviour along the two journeys reveal that the successful performance of wayfinding tasks is heavily reliant on the spatial arrangements of the built environment, coded information

available to them and the verbal instructions given by volunteers or more experienced visitors. In general it can be said that the observable confusion and frustration of the users of the environment at certain decision making points is evident in their behaviour: looking lost, turning this way and that; muttering to themselves or expressing their frustration openly to whoever stops to show interest. When staff stop to offer help there is an immediate sense of relief which is sometimes quickly replaced by more frustration and/or anxiety when one realises that they now have another task of recalling the verbal directions. However, quite often, the users politely give the impression that they have understood the instructions although it is clear that they haven't. This is evident in their behaviour both verbally and non-verbally once the helper is out of hearing range or sight. Remarks such as *'I can't make sense of all that'* or *'that helps!*' followed by rolling of the eyes and a tilting back of the head can be heard and observed. Specific descriptions are offered next.

5.2.1 Finding the way to the Green area via the lifts.

This journey is made up of more than ten DMPs. The settings depicted in these photographs are what the wayfinders are presented with during the weekends and between 1700hrs and 0900hrs when information desk is unattended. To get to the lifts the wayfinder must go through the Plaza Shopping Mall and a short corridor beyond the Mall (see Settings 1-5). A description of each setting is offered below followed by a uniquely adequate description of the wayfinders' behaviour in response to what they are presented with during the course of the journey.

Figure 30 Setting 1: Entry to the Plaza

The wayfinder who chooses to walk through the set of doors seen in setting 1 is either exploring or has been given verbal instruction at the desk by volunteers or by another more experienced visitor. The instructions would sound something like this:

> *'Go through the Plaza and follow the corridor until you get to the lifts and go up a level to get to the first floor. You will find directions for the Green area when you get out of the lifts'*

This verbal instruction is always emphasised with body gestures showing a -straight ahead- motion (lifting of lower arm to head level and stretching it away from the body in the direction of the Plaza) and a consequent –upward- motion with the inner part of the hand pointing up to indicate the movement of the lift. Getting out of the lifts is emphasised with a smooth outward movement of the last gesture from shoulder level.

The wayfinder is immediately presented with the Plaza: a miniature version of what one would find in town. It has a cash point, a card and jewellery shop, a restaurant, several shops (e.g. Body shop, clothes shop, convenience shop, a pharmacy, a hair salon, and a posting box. The sitting area of the restaurant is also the path that wayfinders use in order to get to the corridor found beyond the Plaza (see Figure 30). The shopping mall is open from Monday to Friday but is closed at weekends and between 1700hrs and 0900hrs each working day of the week. The wayfinder with the benefit of instructions can be observed performing their wayfinding task with much ease up to the point where they reach the short corridor leading to the stairs and lifts (see Figure 33).

However, the case is different for those without the benefit of verbal instructions. In such cases the wayfinder must depend purely on information on signs. The first set of direction giving signs given to the wayfinder can be seen above **The Body Shop** (see Setting 2 below) which is situated where the sitting area the restaurant ends. Noticeable is that on this DMP there is no mention of where the lifts are. Some visitors, depending on the state of their minds do not appear to bother with the signs in the first place. The signs also appear insignificant during the times when the Plaza is fully functional. However, despite the large amount of stimulation the wayfinder is able to work their way round to the second DMP which can be seen just above the clothes shop (see Setting 3 below).

Figure 31 Setting 2: First Decision Making Point inside the Plaza

Again despite the lack of information as to where the lifts or stairs are on the second DMP the independent wayfinder is able to explore beyond the signs to find the short corridor seen in setting 4 below.

Figure 32 Setting 3-Third Decision Making Point in the Plaza

Figure 33 Setting 4- Short corridor at the end of the Plaza, entry to the stairs and lifts

In this corridor the wayfinder is presented with a possible route. A sign announcing the presence of the stairs protrudes from the wall to the left as the wayfinder leaves the Plaza. A door leading to the staircase is situated less than a meter inside the break seen in the wall just before the sign. Here the wayfinder stops for a few moments clearly contemplating whether they should follow this route. Some can be seen taking a left turn and disappearing but others return immediately after having decided that the route via the stairs is not for them. They continue in search for further clues. Looking straight ahead from the position of the sign signs hanging above the vending machine can be seen. The signs give directions to other departments within the Red area which can be accessed by taking a right turn. At this point the wayfinder is left with one option: to follow the corridor as it curves sharply to the left at the vending machine seen here (see floor plan in Appendix 5). This action takes them into the wayfinding setting seen in Figure 34 below.

Figure 34 Setting 5- Fourth Decision Making Point located to the left of vending machine seen in Fig 33 above

In this wayfinding setting the wayfinder is presented with the much needed information on how to get to the first floor where, according to the information on the key DMP at the information desk, the Green area is located. Three relevant signs are identifiable: 1) directional informing the wayfinder that the lifts are located in the area to the left of where they are standing and, 2) informational telling the wayfinder where to find four other colour coded areas one of which is the Green area. The lifts are in full view and easily identifiable even by those who cannot read. A glass wall separates the lift area from the receiving area and one must walk through a door which is left open throughout the day (see setting 6). From the behaviour of the wayfinders in this setting it is clear that the open door is an invitation to enter the area housing the lifts. Important to note is the fact that this time the coded message is slightly different from that received at the information desk. The impression given here is that the Green area is not on the first floor but reachable ***via 1st floor*** (see the words inserted in the brackets after the first two direction signs to the left).

Figure 35 Setting 6-Glass wall and open door leading into the lift area.

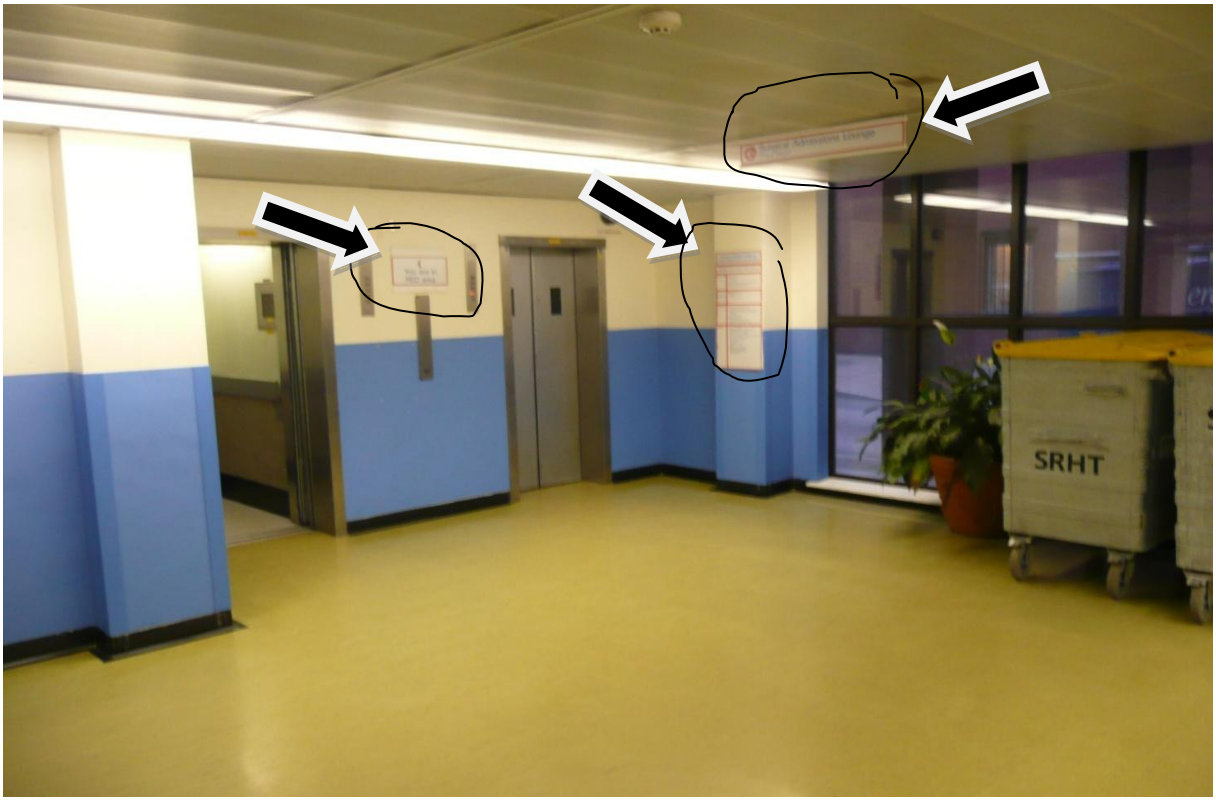


Figure 36 Setting 7- Inside the lift area on the ground with three pieces of information.

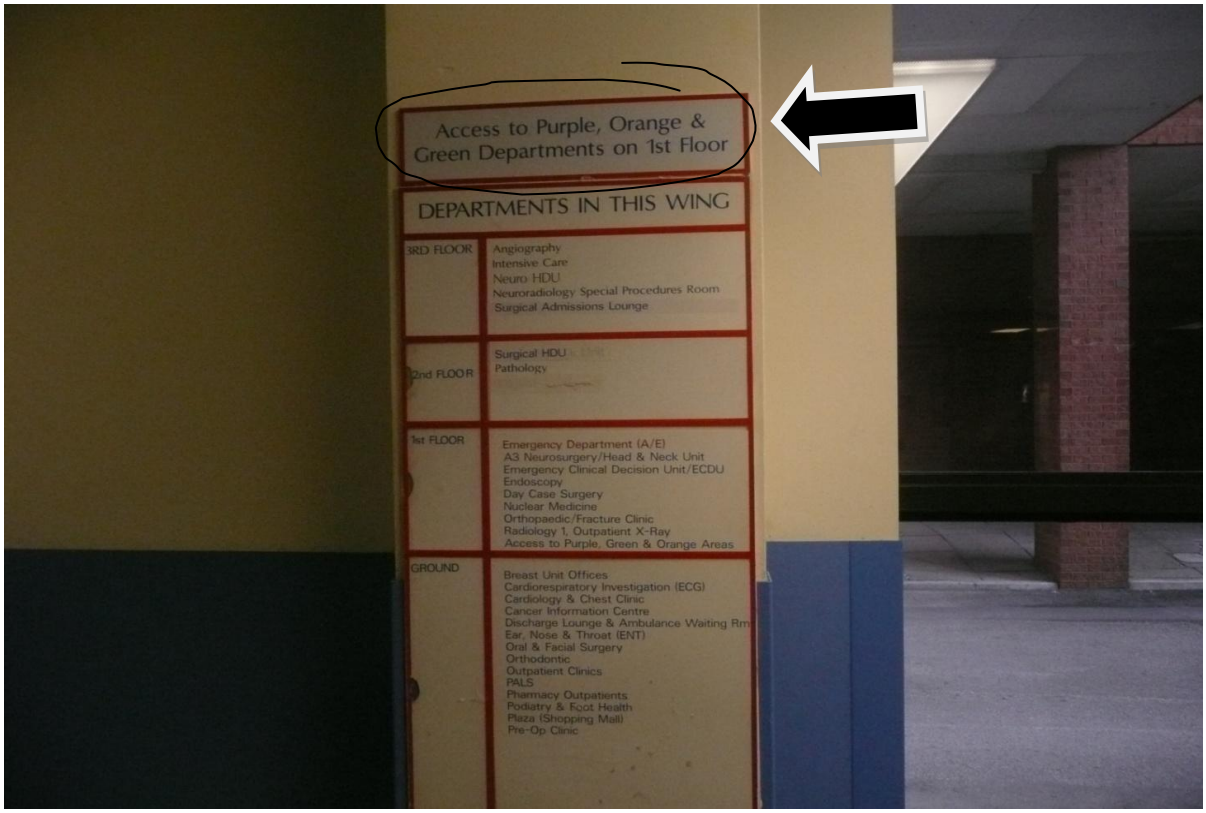


Figure 37 The Decision Making Point with information for the Green Area.

Inside the lift area one is presented with three pieces of information: a directory containing information on various departments within the Red Area; a sign in the space between the lifts confirming to the wayfinder that they are in the Red area and a sign hanging from the ceiling with directions for the Surgical Admission Lounge to be found on the third floor (see setting). Of interest to the wayfinder is the information directory where the clues for the Green area can be found (see Figures 36 and 37). This information can be seen at the top of the directory and it is noticeable here that the words ***via 1st floor*** seen in setting 5 have been replaced by ***Access to*** and that the Yellow area has been omitted.

Noticeable too is the use of the colour blue, which also happens to be a colour code for one of the areas, to decorate half the wall in the lift area. From a distance the blue colour is more prominent than the signs announcing the Red area. Unfortunately the inconsistent use of colour appears to cause more confusion in that the same colour used to aid wayfinding is also used decoratively. Those who solely depend on colour to find their way often express their frustration at the ambiguity created by this oversight. It is clear in this setting that this mostly affects those who are unable to read because of failing visual acuity or because English is not

their first language. For this particular journey the problem of colour is more pronounced on the first floor where the wayfinder exits into an enclosed area situated between both the Blue and Red areas (seen Figures 38 and 39). On either side of this enclosure, are two doors which are directly opposite each other. One opens up to the Blue area (see Setting 8) whilst the other leads the wayfinder to the space that marks the end of the Red area and is also the entry to the connecting corridor (see setting 9).

Figure 38 Setting 8-showing the door leading to the blue area in addition to four pieces of coded information found here.

Figure 39 Setting 9- Inside the lift area on the first floor

Two signs hanging from the ceiling with the directions for the Outpatients department on the ground floor and the Surgical Admissions Lounge on the third floor lead the wayfinder back into the lifts. The directory containing information on various departments within the Red Area and the sign confirming to the wayfinder that they are in the Red area is in exactly the same position as that in the lift area on the ground floor. Here wayfinders can be seen displaying 'a looking lost behaviour' (e.g. pacing to and fro and looking this way and that several times) in search for further clues once they have established that the signs contained in the lift area and the door leading to the Blue area are redundant.

However, the open door in setting 9 seems to encourage an intuitive movement towards the sign which has been strategically positioned on the wall directly opposite the lift area. This intuitive movement is certainly more pronounced when the door is left open: a clear invitation to walk through. Beyond the open door can be seen a DMP positioned on the wall (see Figure 40 below for a close-up the sign). Once outside the lift area and closer to this DMP instructions for the Green area are indicated by an arrow pointing to the left followed by the words 'Access to...'. Interestingly the Yellow area previously omitted from the directory in the lift area reappears here.

Figure 40 Setting 9- A close-up of the Decision Making Point seen beyond the door in the lift area.

Figure 41 shows the most challenging wayfinding setting for the wayfinder on this route so far. The challenge, as will be explained in more detail later, arises from the complex architectural layout of this part of the hospital. Notice the crucial relationship between the DMP and the door to the left and the positioning of the directional sign with instructions for the other areas at the bottom of the DMP. Read in conjunction with the initial instruction on the key DMP on the ground floor gives the impression that access to the Orange, Yellow, Green and Purple areas is through the door seen here.

Figure 41 Setting 10 -The proximity of the DMP to the door

Those visiting the hospital for the first time can be observed walking up to the door only to find that the door is private to staff. A digital key pad positioned near the door handle plus a sign with the words **staff only** on it clearly communicates that one cannot proceed beyond the door. However, some, depending on the state of their mind at the time, some go as far as attempting to open the door. In this part of the hospital spontaneous help is offered by fellow wayfinders or staff with prior knowledge of the setting. If help is not readily available, the wayfinder can be observed looking for further clues by walking all the way to the door which marks the exit to the Red area and entrance to the connecting corridor (see Figure 42). The spatial arrangements here clearly allow the wayfinder to perform this intuitive movement towards a possible route. The open door once again invites the wayfinder to walk through.

Figure 42 Setting 11- Entrance to the connecting corridor

On leaving the Red area through the open door seen in setting 11 one is presented with the spatial layout of the full corridor with a DMP made up of several signs hanging from the ceiling (see Settings 12 and 13).

Figure 43 Setting 12-Starting point of the connecting corridor just outside the Red area.

Figure 44 Setting 13- Decision Making Point inside the corridor connecting the Red and Blue areas to four other areas of the hospital.

Noticeable here is the use of the colours blue and purple on the floor and skirting boards which some wayfinders mistakenly think is designed to help them finding their way to the respective areas. Some can be heard muttering to themselves in frustration and others openly express it as soon as they find out that the purple and blue seen here are for decorative purposes. One such conversation occurred between two women visiting a hospitalised relative and the researcher. The older of the two women admitted that she uses colour on the floor and not signs '*which I cannot make sense of love'* to find her way. *'They say it is the green area but all the floors are purple and blue. You see I do not read signs me. I look at the floor'*. This becomes apparent as the wayfinder looking for the Green area continues along the corridor in search for further clues. As it happens, the blue and purple decoration is used throughout the entire hospital corridors.

5.2.2 Finding the way to the Accident and Emergency department

This journey takes the wayfinder through the same route described above up to the receiving area outside the lift area on the first floor. It is noticeable that up to this point the A&E department is mentioned three times: first; on the key DMP on the ground floor; second on the directory found inside the lift areas and third; on the DMP seen in setting 10. It has been omitted from the DMP in the receiving area on the ground floor located at the back of the Plaza. The first two mentions are for informational purposes and the last is to give the wayfinders directions. According to the directions seen in setting 10 one must turn right into a corridor with fairly easy to follow instructions. This is largely due to the uncomplicated layout of the route which is constituted of a straight corridor with sufficient information and good sightlines (see Figures 45 and 46 and Appendix 5 floor plan for level 1). The corridor has two turns; first a left then a right before the wayfinder is presented with yet another challenge arising from the complex relationship between the physical configuration of the built environment and coded information designed to aid wayfinding.

Figure 45 A Corridor stretching all the way from the door seen in setting 10 with doors left open to allow free movement and clear sightlines.

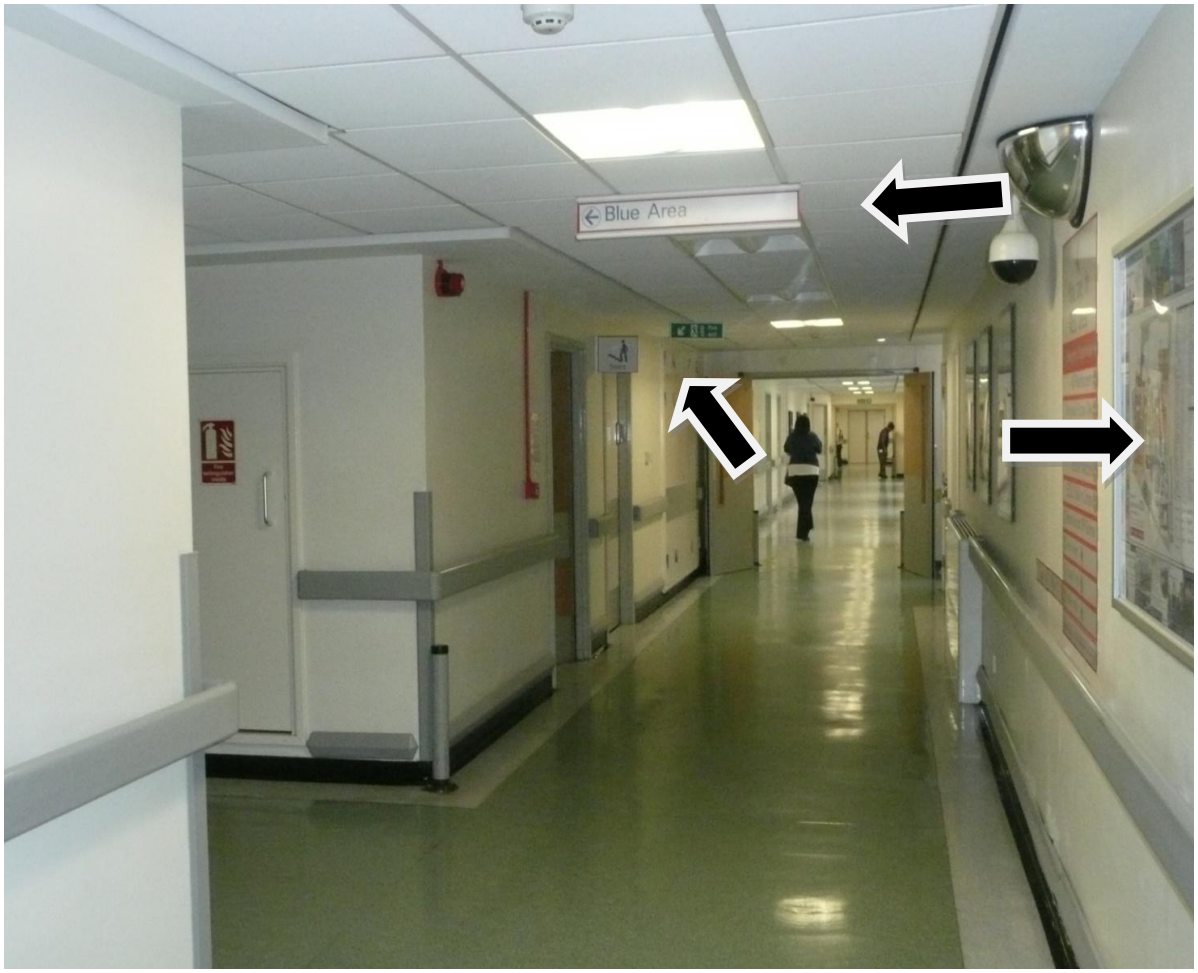


Figure 46 Same corridor showing how signs are strategically positioned in agreement with the spatial arrangements.

Figures 47, 48; and 49 show what wayfinders see as they walk through a set of double doors at the end of a short corridor. Both the stairs and the door are in full view as are the signs above and to the right of the door. On the sign above the door are written the names of two destinations (A&E and Entrance/Way Out). To the right of this text is an upward pointing arrow indicating direction. But what direction is it indicating? The two signs on the wall also indicate two destinations (Way Out and ECDU), this time the arrows point to the right. A short corridor leading to the right ends in a left turn in front of a floor to ceiling window through which signs announcing the location of the ECDU can be seen (see Figure 49, the signs beyond the glass are not visible in the photo).

Figure 47 Door with wayfinding signs

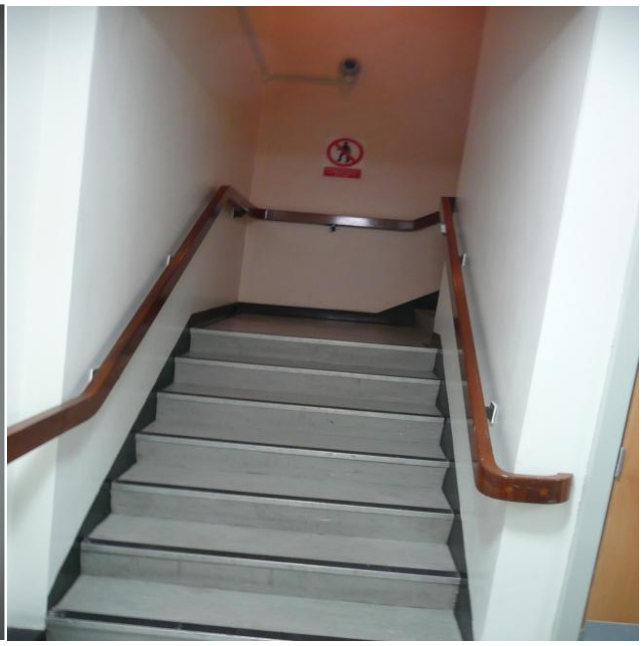


Figure 48 Stairs with no entry sign

Figure 49 Corridor leading to the Accident and Emergency and the way out

In the first instance, the sign above the door is typically read by wayfinders as meaning straight ahead through the door, a reading that relies upon the understanding that a sign above a door indicates that the destination written on the sign is to be reached through that door (Rooke *et al*, 2010a). Users can be seen walking up to the door and looking first at the sign above the door then immediately to the ones on the wall and back again. This is followed by

an expression of frustration once one discovers that going through the door is not an option because this door is to a cupboard and it is locked with no handle. A second interpretation, relying on the omission of the A&E destination from the signs on the wall, read in conjunction with the upward pointing arrow above the door, is that the A&E is on the next floor up and can be accessed via the stairs.

However, at the top of the first flight of stairs is a sign forbidding entry (see Figure 48). While the text on this sign is quite small, the pictogram is clear from the bottom of the stairs, but the sign itself is not visible until one approaches the stairs. This ambiguous relationship between the physical properties of the built environment and the encoded information on the sign is apparent in the behaviour of users of the setting, who issue spontaneous expressions of frustration or irritation, pacing up and down looking this way and that.

The positioning of the arrow in Figure 47 leads to three observable interpretations which are clearly dependent on the physical layout of the environment at this precise point. The first interpretation depends upon the proximity of the wayfinding instruction to the door. The second which is clearly an effort to repair the breakdown created by the first interpretation is determined by the proximity of the door to the stairs once it becomes apparent that the door in question is to a locked cupboard. The third interpretation is a reading that arises from realising that entry to the next level via the stairs is prohibited. Here the wayfinder is left with three options: going back the way they came; following the corridor on the right; or soliciting help from staff or from other visitors more experienced in the setting

5.3 DISCUSSION OF EMPIRICAL FINDINGS

This Chapter has presented uniquely adequate analytical descriptions of how wayfinders make sense of the wayfinding information presented to them in three forms: coded information on signs, the physical properties of the built environment and objects within it and verbal instructions given by volunteers, members of staff and other visitors to the setting. The confusion caused by misleading and/or ambiguous signs, inconsistent use of colour or too much use of it and information overload or lack has been articulated taking extra caution to ensure that the methods used by wayfinders in the social production of these wayfinding settings described are represented with minimal distortion. Effective use of the researcher's own experience, the observed behaviour of other wayfinders and spontaneous conversations occurring in various wayfinding settings is apparent.

The various wayfinding settings described are made up decision making points with cues that inform and/or direct the wayfinder and common to the two journeys chosen for detailed description are several breakdowns in the flow of wayfinding information resulting from the omission of crucial information, too much information, inconsistent use of colour coding and the ambiguous placement of directional signs. It is clear that some crucial information in both examples is either completely missing or not in the right place. The latter is particularly pronounced in the wayfinding settings where directional signs instruct the wayfinders to go through forbidden doors. Observations of the behaviour of wayfinders here make it is clear that spatial properties are integral to the interpretation of text. The consequential social practices which emerge as a solution to the breakdown in this case have been formalized as hospital policy.

Also apparent is the complex relationship between social practice, information and the physical properties of the setting. The physical placement of the information bearing signs is critical to their interpretation. Inappropriate placement so affects the context in which the information is perceived as to render it ambiguous, leading to a breakdown of the knowledge flow. The effects of this breakdown and consequent efforts to repair it are directly observable within the setting and are thus available for analysis, along with its immediate cause. The two examples described above provide a prominent example of how knowledge is poorly communicated and managed in this environment. When considering the fact that complex environments such as these are visited by a wide range of people, it can be said that coded information alone is insufficient to meet the needs of all. This endorses Arthur and Passini's (1992:140) point about redundancy in wayfinding communication where they assert that the '...use of multiple means to communicate the same information is the best guarantee that the message gets across'

Evidence, from both empirical research and the review of literature, points to poor wayfinding performance in old and complex environments (DOH 2005, Rooke et al. 2009, 2010, Carpman and Grant 2001). From the findings of the empirical research it is demonstrable that the problems of wayfinding are linked to two physical factors identified by Arthur and Passini (1992): the layout of the built environment (e.g. spatial content, form, organisation, and circulation) and the quality of environmental communication (e.g. architectural, audible, and graphical expressions). In old and complex environments the ill defined circulation systems and paths are largely responsible for getting people lost. Arthur and Passini (1992) do warn

that communicating the former is the most challenging aspect of architectural wayfinding design and yet the most useful for efficient wayfinding.

There is also a new problem arising from linking together existing and new buildings. At the time of conducting fieldwork at Salford Royal hospital this potential problem was highlighted in one of the meetings with the various stakeholders. It was clear in this meeting that the hired architects were mostly interested in developing a wayfinding strategy for the new building and that the finished product would be divorced from the existing wayfinding system. The same can be said in the case of Stoke Mandeville hospital, Manchester Royal Infirmary and Queen Elizabeth where it is clear that the administration is yet to decide whether to treat the two as one complex where wayfinding is concerned. A visit to both Stoke Mandeville and Manchester Royal infirmary proved to the author that despite her in-depth knowledge of the layout previous to the upgrade she found herself extremely disoriented failing to rely on her previously developed cognitive maps of the spatial layout.

A closer analysis of old and complex hospital environments reveals three problems that occur at the interface between the physical properties and coded information:

1) Ambiguity caused by ill positioned signs;
2) Confusion caused by inconsistence in the use of colour;
3) Confusion caused by information overload or lack of it.

In such cases the indication is that this is largely due to the piecemeal fashion in which older environments have evolved over time. As Huelat (2007) rightly notes this has resulted in ‘complex mazes of long and confusing corridor systems with bends, turns, and foreign-sounding signs’ Below is a graphical representation positioning the identified problems within the tri-partite framework identified in the literature review Chapter.

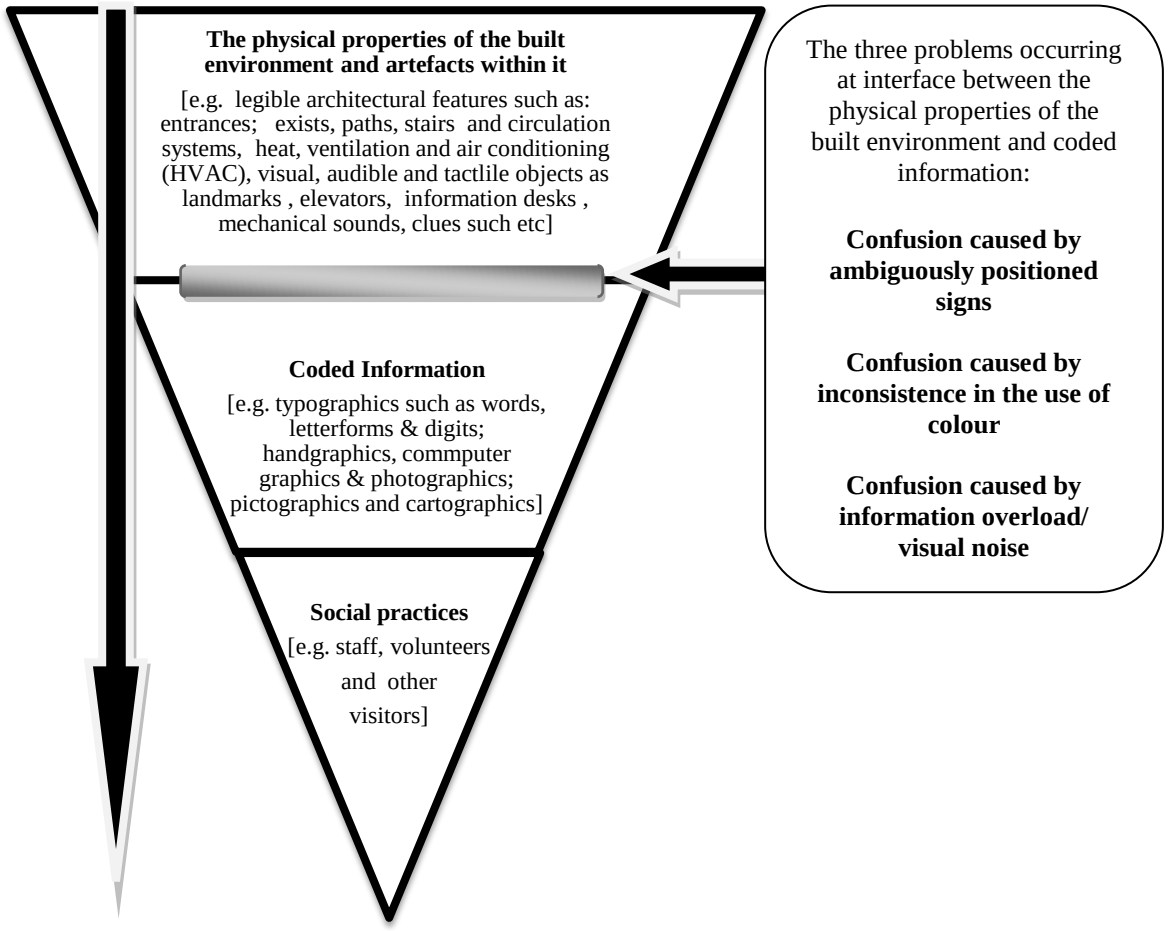


Figure 50 Positioning of identified problems within the tri-partite framework

As with the conclusions of Chapters 4.0 and 5.0 it can be said that the tri-partite conception of knowledge flows is highly relevant for the purposes of managing the flow of wayfinding information. This validates similar findings from the review of literature on wayfinding. Its usefulness as a prescriptive framework arises from the fact that it prioritises communicating wayfinding information through the physical properties of the built environment over coded information and the practice of verbal directions. In the form that it is presented in, the conception should provide a robust tool for focussing the attention of designers on the precise parts of the environment where right wayfinding information should be place in order for it to be accessed at the right time.

5.4 SUMMARY

This Chapter has achieved its objective of establishing the extent to which empirical research provides answers to the two central issues: the relevance of the tri-partite conception of knowledge flows and how wayfinders make sense of the wayfinding information presented to

them during a wayfinding task. In the next Chapter is an in-depth consideration of how uniquely adequate descriptions led to the suggestion of context specific recommendations and the development of heuristic guidelines for improving wayfinding in old and complex environments such as hospitals. The activity represents what Crabtree (2004) refers to as the exploration of the topics identified in the breach through the study of perspicuous settings, a fleshing out of abstract concepts and a repetition of the process in order to meet until the satisfy the research agenda for all practical purposes.

6 DESIGN AND DEVELOPMENT

6.1 INTRODUCTION

This Chapter focuses on establishing that from uniquely adequate accounts of the behaviour wayfinders in complex environments guidelines for designing effective and efficient wayfinding systems can be developed. This is achieved by closely examining the problems of wayfinding occurring at the interface between the physical properties of the environment and coded information. The Chapter starts by reviewing current solutions as given by the review of literature. The efficacy of such solutions is examined with a view to comparing them to those derived from uniquely adequate descriptions of the behaviour of wayfinders. The second part examines solutions arising from conducting empirical research focussing in particular on local solutions improvised to meet ongoing problems, the proposal of a generic principle based on a knowledge management approach and establishing rules for indexicality based on uniquely adequate descriptions.

6.2 SOLUTIONS ARISING FROM THE REVIEW OF LITERATURE.

In the literature review Chapter a handful of the many wayfinding principles/guidelines aimed at solving the problems of wayfinding in general are briefly discussed. Section 5.2 examines the value/utility of some of the solutions arising from these principles. Specific attention is paid to the three problems occurring at the ***Physical properties/Coded information*** interface.

Tables 8, 9 and 10 contain best practice guidelines found in the guidance document for healthcare facilities (DOH 2005). The advice has been chosen for analysis because it is specific to the problems of wayfinding occurring in existing hospital environments. As indicated in introductory Chapter such environments are the focus of this study. However, it ought to be said that this guidance is fairly representative of what is found in wayfinding literature in general whether professional or academic.

- Sites should not rely entirely on colour-coding as a wayfinding aid , it should be used to support other information
- Only colours that can easily be differentiated visually and easily described verbally should be used for colour-coding. The system must be identifiable as a colour-coding systems rather than simply a decorative use of colour
- Colour combinations used for sign backgrounds and text should always have high contrast to ensure optimum legibility
- Colour-coding should be introduced at entrances to the site or building by a colour-coded sign
- For a colour-coding system to be effective and noticeable, the system must be used consistently and prominently throughout the site, and on all wayfinding information (signs, maps directions) and also on architectural features.
- Avoid colour-coding department, rather than geographical areas of your site because if a department moves location and colours used on signs and architectural features will have to be changed
- Avoid using shades of colour that are similar to each other in the same colour-coding scheme, for example: **yellow** and **orange**; **purple** and **pink**, and **turquoise** and **green**

Table 8 Best practice guidelines on use of colour coding (DOH 2005: 37)

- Be visible and readable from all directions
- Not be obscured or surrounded by clutter such as non-wayfinding information or posters.
- Not be too high for people to read comfortably
- Not be too low so that they are easily obscured
- Be placed consistently so that people know where to look for information they require
- Directional signs must have clear direction indicators_ usually arrows
- The direction the arrow is indicating should be easy to understand and easy to relate to the actual environment
- Arrows should be positioned consistently, and should comply with standard positioning prescribed by British Standard BS 5499: 1990: Part 1
- Directional signs should be consistently positioned so that people know where to look for information.
- The destination on directional signs should be consistently listed in a logical order , such as alphabetical, or by type of destination
- There should be a directional (or location) sign at each key decision point
- The direction shown by the arrow should relate to the actual environment. If a route is not visible from the directional sign, additional reassurance signs may be necessary until the indicated route is visible
- Avoid using unclear misleading arrows which may cause confusion
- Avoid trying to direct people back the way they have come
- Avoid listing too many destinations on one sign.
- Avoid leaving too big a gap between the text and arrow

Table 9 Best practice guidelines on positioning of signs and directional arrows (DOH 2005: 89 and97)

Text layout and grouping (DOH 2005: 77)

- Ideally no more than five destinations on one list
- Avoid randomly ordered lists of information. It makes it difficult to find the required information
- Lists of directions or words to grouped visually using space, lines, colour etc
- The order in which destinations are listed to be consistent, understandable and logical
- Avoid ungrouped alphabetic lists on directional signs as the large number of arrows makes them confusing and easy to mis-read
- Avoid listing destinations in the order in which people will arrive at them as this is difficult to understand

Text and arrow alignments (DOH 2005: 79)

- Have lists of less than five words on most signs with text aligned left
- Where longer lists are unavoidable group destinations into shorter lists of up to four or five words
- Avoid long lists of destinations and aligning longer lists of text to the right as this can make it slower and more difficult to read through the list

Emphasising information and use of symbols (DOH 2005: 81 and 83)

- Avoid emphasising too much information on one sign. This can cause confusion and reduce prominence of key information
- Avoid long lists of text with no visual grouping or differentiation between them
- Use symbols as an alternative to using words. Symbols or pictograms can often be understood more quickly than words if the meaning is clear

Table 10 Best guidelines on avoiding information overload (see guidelines for text layout and grouping; text and arrow alignment, emphasising information and used use of symbols)

From the guidelines presented here it can be said that some of the problems encountered in the settings studied can been resolved. For example the advice relating to text layout and grouping seen in Table 10 could be usefully applied to solving the confusion caused by information overload witnessed at the decision making point seen in Figures 29. Similarly some of the confusion caused by inconsistent use of colour (e.g. Figure 18) and the ambiguous positioning of signs (e.g. Figure 34) witnessed on the two journeys described in Chapter five can be resolved by following the advice contained in Tables 8 and 9 respectively. However, as will become clear in the paragraphs that follow the greatest challenge is that of following the guidelines for directional signs. In the examples discussed below, it is apparent that following of such guidelines in the old and extremely complex setting of Salford Royal hospital has created more confusion. Here it is shown that the meaning of the directional arrow is defined by the context within which it is found.

6.3 SOLUTIONS ARISING FROM EMPIRICAL RESEARCH

This section focuses on showing how an in-depth understanding of the behaviour of the wayfinders during a wayfinding task, gained by adhering to the demands of the unique adequacy criteria, led to the recommendation of solutions to contextual problems and the development of abstract wayfinding guidelines. To achieve this researcher had to:

1. Situate herself in various wayfinding settings in order to pay attention to how people;
    - perceive and understand the environment,
    - situate themselves in space,
    - make sense of the wayfinding information and cues made available to them
2. Produce a detailed description of the wayfinders behaviour as it occurs in that setting.
3. Make suggestions for design or improvement based on descriptions you have produced.

The section is presented in three parts: 1) a discussion of local solutions improvised to meet ongoing problems; 2) a proposal of a generic principle based on a knowledge management approach; and 3) an establishment of rules for indexicality based on uniquely adequate descriptions.

6.3.1 Solutions improvised locally

In settings where wayfinding performance is poor due to poor circulation everyone in the setting (e.g. staff, volunteers, visitors and the administration) will suggest repairs/solutions to the breakdowns encountered. For example, the practice of leaving the doors open at Salford Royal hospital, as has been indicated in the previous Chapter, clearly improves circulation whilst allowing quick identification of vital decision making points. In some settings staff or other wayfinders can be heard suggesting the type of sign (informational or directional) needed, where and how it should be positioned and what should be contained in it. In such cases temporary signs can be seen (see Figure 51 below, an example of a repair in need of a further repair).

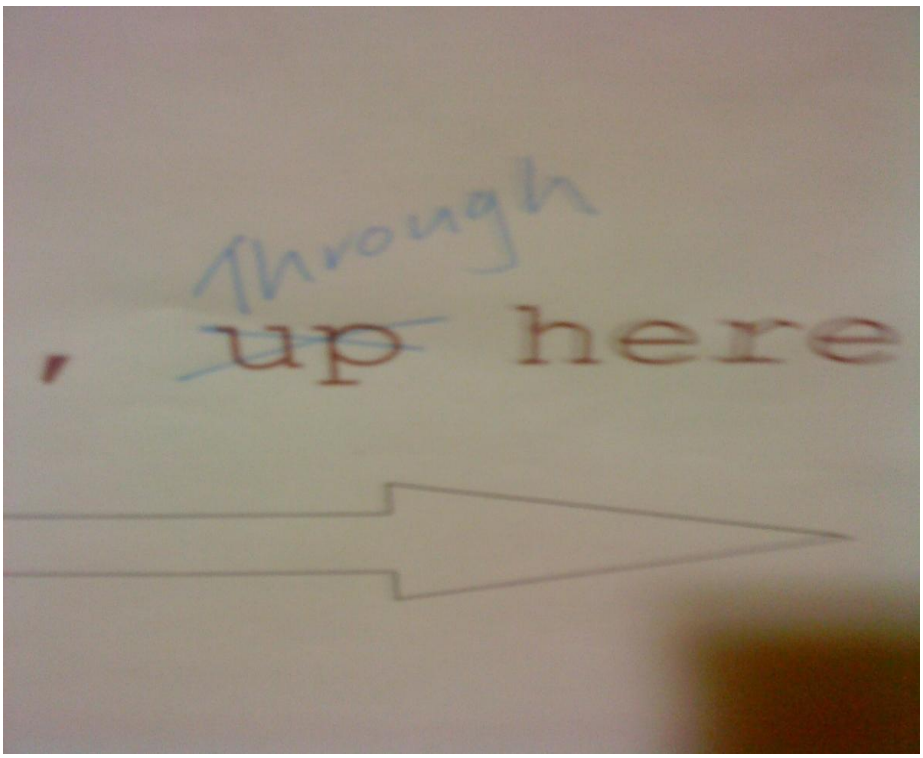


Figure 51 A local repair found in one of the old and complex settings.

6.3.2 Solutions for the ill-positioned directional arrows

As indicated in section 5.2.2 (see Figures 47 and 48), the positioning of the arrow in the setting analysed leads to three observable interpretations which are clearly dependent on the physical layout of the environment at this precise point. The first interpretation, ***through here,*** depends upon the proximity of the wayfinding instruction to the door. The second reading, ***up a level,*** which is clearly an effort to repair the breakdown of the first instruction, is determined by the proximity of the door to the stairs once it becomes apparent that the door in question is to a locked cupboard. The third interpretation, ***right from here and out*** is a reading that arises from realising that entry to the next level via the stairs is prohibited

Following the analytical analysis of the behaviour of wayfinders at this wayfinding setting, the replacement of the upward pointing arrow with one pointing to the right and removal of signs to the right of the door was recommended. The reasoning behind this was that this would give the wayfinder the right information thus eliminate the confusion experienced here. In this case it is clear that this is the only way the destination in question is to be reached. The removal of the signs to the right of the cupboard door was also recommended as leaving them

in place would amount to unnecessary repetition. The thinking behind this was that redesigning the wayfinding system in this way would ensure that the ***right information*** is in the ***right place***. A successful correction would no doubt lead to an effortless interpretation of the wayfinding instruction as**: *turn right and follow the direction of the arrow*.** The successful repair of this obvious breakdown would mean total elimination of the confusion caused by the ambiguously positioned wayfinding instruction.

The immediate reaction to both recommendations was the complete removal of all the signs seen in Figure 47 followed by repainting of the setting. The transformed setting is represented in Figure 52 below.

Figure 52 The changed setting following the removal of all directional arrows.

As with the journey described in section 5.2.1, the problem encountered by wayfinders is that of the positioning of arrow seen in the setting represented in Figure 41. The analysis of the reaction of wayfinders to the positioning of the arrow at this precise point leads to the interpretation that in order to access the destinations indicated on the sign one must turn ***right from here*** and then go through the door positioned a few meters away from the sign. The second interpretation is, ***right from here*** and then follow the corridor arises from the realisation that the door in questions is private to staff. The observable behaviour of wayfinders at this point makes it clear that the wayfinding information is in not in the right place. The use of colour-coded arrows representing each colour-coded area accessible via the connecting corridor was recommended as a viable solution (see Figures 53 and 54 below).

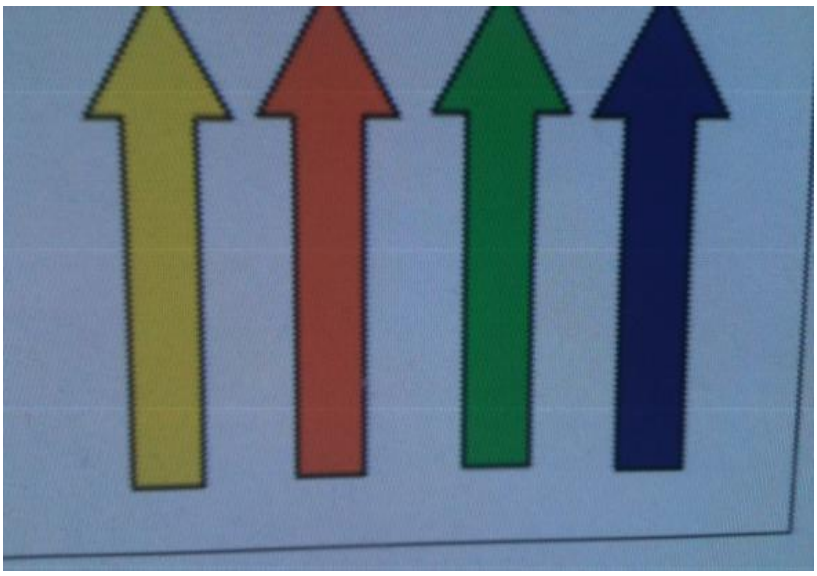


Figure 53 Colour coded arrows representing each area accessible via the connecting corridor.

The thinking here was that the use of colour-coded arrows would reduce the need to rely exclusively on text as both the destination and direction are contained in a single artefact. This would in turn effectively eliminate the distress that is likely to be suffered by those who cannot read for one reason or another. Equally important is the positioning of the arrows in relation to the complex physical layout of this part of the hospital. It was suggested that the arrows be positioned at a height that would cater for all kinds of users including those in wheelchairs. Appendix 5 contains an elaborate description of the precise recommendations for the precise points where to position the arrows along the four different routes.

Below is a description of the recommendations made for the part of the connecting corridor presenting the most challenges for the wayfinder: the area that marks the end of the Red area and introduces the entry to the corridor that connects to other colour coded areas of the hospital (see Figure 54 below)

Figure 54 Part of the hospital presenting the most challenges for the wayfinder.

The space on the protruding wall in this part of the hospital was seen as ideal for placing the colour-coded arrows. The hope was that placing the arrows on the part next to the door seen here would eliminate the confusion that the door a few meters to the left of the sign seen to the right is the desired entrance. The attention of the wayfinder who emerges from the lift area seen in Figures 38 and 39 and walks to the sign seen here for further clues would be immediately caught and directed to the appropriate exit/entrance seen in Figure 42. This would also benefit wayfinders who approach this wayfinding setting from the corridor leading to the A&E department (see Figure 45). However, as this part of the wall is not immediately visible from the lift area, it was suggested that a second set of arrows be placed on the part of the protruding wall facing it as in the second photograph in Figure 63. The rationale here was that this would greatly improve the wayfinding performance of those unable to read whilst eliminating the need to approach the sign for further clues even for those able to read. Positioning the signs here would also effectively eliminate the door as a source of confusion.

The belief was that the solutions proposed for the two problems described above would lead to a reduction or total elimination of the confusion that is observable in the behaviour of the wayfinders approaching these is setting. Two experiments to test the efficacy of the proposed solutions were suggested. They are described in detail in Chapter 7.

6.3.3 Deriving a generic principle from uniquely adequate accounts

From uniquely adequate descriptions of the observed behaviour of how wayfinders respond to wayfinding information presented to them in old and complex environments it is possible to arrive at the conclusion that if the ***right information*** is in the ***right form*** and in the ***right place,*** it can be accessed by the ***right people*** at the ***right time.*** The careful consideration of how wayfinders make sense of the way in which signs are displayed; the use of the colour-code systems; the design of signs themselves (i.e. quality and quantity of coded information on them) and the complex architectural layout typical of old environments leads to this conclusion. This thesis maintains that this ought to be the fundamental guiding principle for designing new or improving existing wayfinding systems regardless of how complex or simple the environment is.

This thinking is underpinned by a lean approach to knowledge management (KM) based on a tri-partite conception of knowledge flows (Rooke et al, 2010) which assumes that any wayfinding strategy or systems should integrate all three aspects of the tri-partite conception: encoded information; social practice; and the physical properties of artefacts. From a lean perspective, it can be argued that the tri-partite conception can be used by designers to identify where and how loss of value resulting from getting lost can be eliminated or reduced (Fillingham, 2008, Shingo 1988, Koskela, 2000). Applying this thinking to wayfinding, focuses attention on the communication of the designers' knowledge of how a complex environment should be navigated to the wayfinders. Thus, the tri-partite conception can be used as an evaluative framework which should focus the designers' attention on the most effective way of communicating wayfinding information to the customer, bearing in mind that such complex environments cater for varied needs.

The next three illustrations are of: 1) a diagram representing how inseparable the three aspects of the tri-partite concept are or should be when it comes to wayfinding (see Figure 55); 2) a diagram showing an overview of the relationship between the generic principle and the three aspects of the conception (see Figure 56) and; 3) a table showing how the three aspects of the conception can be turned into an evaluative framework that could be used to assess the problems encountered before suggesting possible solutions (see Table 11)

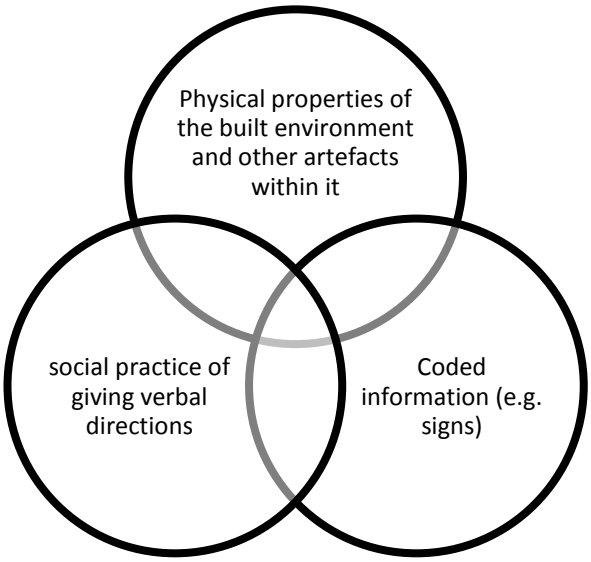


Figure 55 The tripartite conception of knowledge flows adapted from Rooke et al (2010).

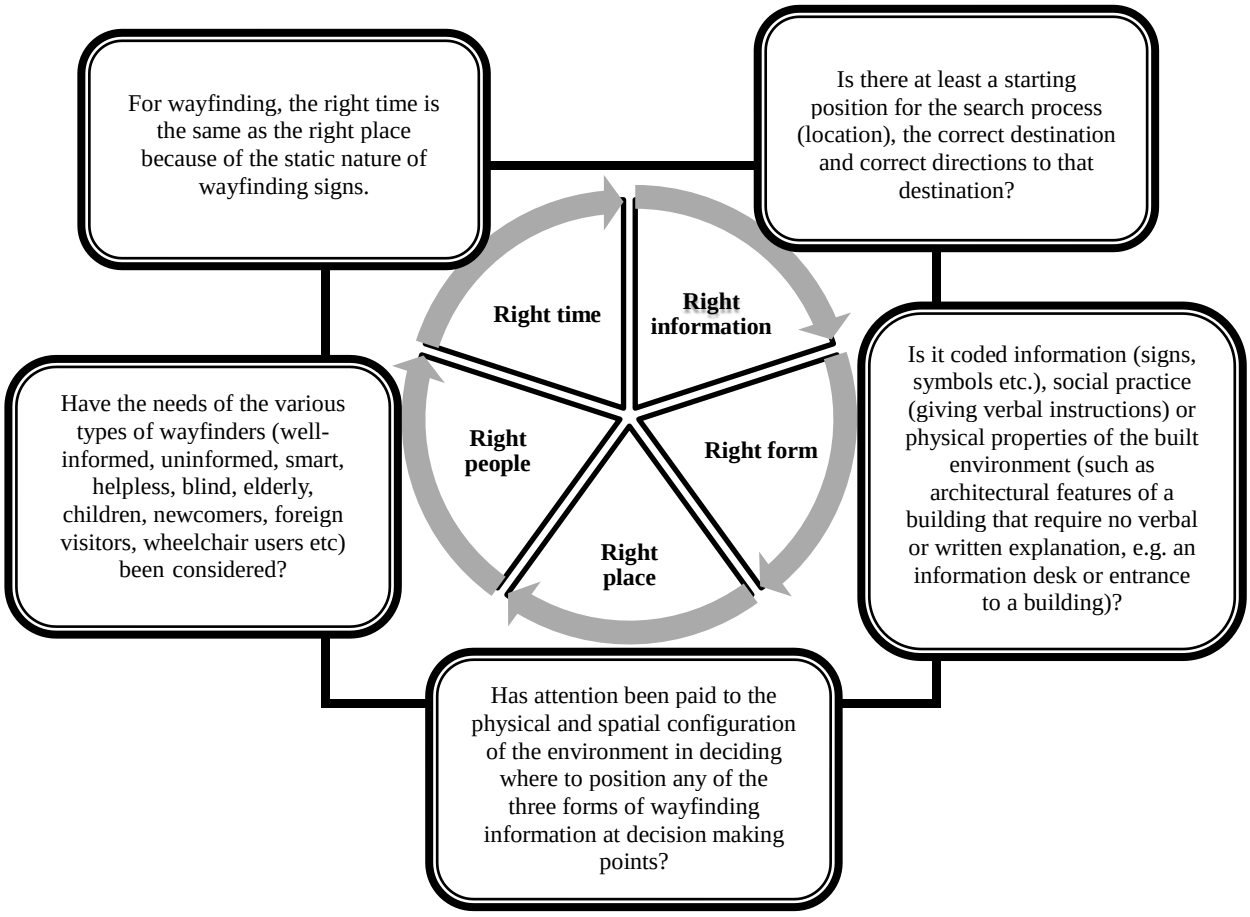


Figure 56 Overview of the key terms of the proposed generic principle.

Wayfinding route	Number of Decision making points (DMP)	Type of wayfinding information and its positioning	Number and type of Breakdowns encountered if any	Proposed solutions based on Uniquely adequate descriptions
Getting to the Green area through entrance 4 via the lifts in the Red area	3 on the ground floor and 2 on the first floor	Coded information: directional and informational signs on walls, hanging from the ceiling and placed above entrances Information desk manned by volunteers	Architectural layout on the first floor so complex that both verbal instructions and coded information are rendered useless. (e.g. a directional meant to guide the wayfinder out of the Red area takes them to a door forbidden to all but staff)	Use colour coded arrows to improve the flow and guide the wayfinder and to the correct exit

Table 11 Use of the tri-partite conception of knowledge flows as an evaluative framework.

6.3.3 Establishing guidelines from uniquely adequate accounts

This section analyses the way in which the directional arrow derives its meaning from the spatial configuration of the setting in which it is found. This is described as indexical expressions by Garfinkel (1967:5) who observes that '...just what region a spatial indexical expression names depends' on its location. He further notes that the properties of indexical expressions and actions are ordered properties which 'consist of organizationally demonstrable sense, or facility, or methodic use, or agreement among "cultural colleagues' (p: 11).

The next subsection offers an examination of the indexical qualities of directional arrows with a view to; highlighting implications for the existing wayfinding principles and; establishing rules for positioning directional signs in old and complex environments. A comparison of res abstract and contextual meanings of widely used directional arrows is offered.

6.3.3.1 Standard vs. indexical meaning of directional arrows

In table 12, eight widely used directional arrows are presented for analysis. The abstract definition of each arrow seen in the second column is that provided by the British Standard BS5499:1990 Part 1cited in DOH (2005:95). In the third column can be seen various meaning

derived from various wayfinding settings across the world. Examples of highlighted meanings can be seen in Figures 57, 58, 59, 60, 61, 63 and 63. A brief explanation of the settings in which they were found is included. Illustrations seen in Figure 63 are photographs taken from Sheila Pontis' fieldwork on wayfinding. They are used to emphasise the pitfalls of adhering to standard wayfinding guidelines without first gaining an in-depth understanding of the spatial layouts of complex environments and how wayfinders make sense of them.

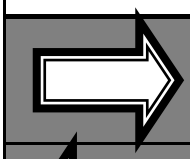
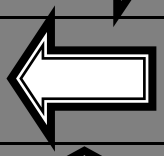
Directional arrow	**Meaning according to British Standard BS 5499**	**Contextual meanings found in various settings (see corresponding Figures for examples of highlighted meanings)**
	Right from here	Right from here, **right here** (see Figure 57) **through here** (see Figure 51)
	Left from here	Left from here, **through here**, **right here** (see Figure 58)
	Straight on from here, or straight on and up from here	Straight on from here, **up a level**, **through here** (see Figure 59)
	Straight on and down from here	**Straight ahead** from here, down a level, **through here** (see Figure 60)
	Right and down from here	Right and down from here, **right here** (see Figure 61)
	Right and up from here	Right and up from here
	Down and left from here	Down and left from here, **right here** (see Figure 62)
	Up and left from here	Up and left from here

Table 12 Meanings of eight widely used directional arrows.

Figure 57 Example of alternative meaning of a right pointing arrow.

The wayfinding setting in Figure 57 is a corridor in the Blue area of Salford Royal hospital. The pharmacy indicated on the sign hanging from the ceiling is to the right. A counter behind which members of staff operate from is positioned immediately below the sign. The message communicated is ***right here.*** It arises from the fact that the counter is recognised as a physical feature for services rather than one allowing entry.

Figure 58 Examples of alternative meaning of left pointing arrow.

The photographs seen in Figure 58 show the left pointing directional arrow denoting the meanings ***through here*** and ***right here*** respectively. Beyond the door seen in the first setting are stairs that lead the diner to a dining room on the first floor. The combination of the door and the stairs gives rise to the interpretation of this meaning. The second setting is the same setting seen in Figure 54 above but approached from the other end

Figure 59 Examples of alternative meanings of upward pointing arrows.

The two settings seen in Figure 59 show an upward pointing directional arrow communicating the message ***straight ahead*** from here, ***through here*** and ***up a level.*** In the first setting, the presence of the corridor, a feature recognisable as a path, beyond the door gives rise to the first meaning. The second meaning arises from the positioning of the sign above the door; a feature recognisable as an entrance. The second setting is the same one described in detail in Chapter five: the journey to the A&E department. Here the last two meanings are readable as previously discussed. These arise from the proximity of the sign to the door and the door to the stairs.


Figure 60 Examples of alternative meaning of downward pointing arrow.

The two settings seen in Figure 60 carry mandatory safety information guiding the wayfinder on which way to go in the event of a fire. Both settings are on the ground floor. In the first setting the downward pointing arrow placed above an entrance communicates the message ***through here*** and the availability of the corridor beyond the door tells the wayfinder to continue ***straight ahead*** from where they are. In the second setting both the downward and upward pointing arrow placed above an exit communicate the message ***through here*** and out

Figure 61 Examples of alternative meaning of right/downward pointing arrow.

In Figure 61 can be seen two directional arrows communicating the message ***right here***. Despite the fact that the first setting is on the first floor the reading of the arrow does not appear to be mistaken for ***down a level*** as per standard definition. The door to the unit indicated here is immediately to the right of the sign. No other physical feature such as stairs or lifts is available here to give rise to any other interpretation. In the second setting the arrow announces the entrance to the car park which caters for disabled people. One is guided by additional directional arrows from here to the designated spaces found at the back of the car park. Again the sign does not appear to be read as down and right from here.

Figure 62 Examples of alternative meaning of left/downward pointing arrow.

In Figure 62 can be seen two settings with the directional arrow pointing left and down. In the first setting the messaged communicated is that the toilets and baby care facilities are ***right here***. Immediately to the left of the sign the entrance to these facilities can be found. In the second setting the arrow announces that the fire exit is ***right here.*** The second sign announcing the stairs prepares the wayfinder for what lies beyond the door thus giving rise to the interpretation ***down a level*** from here.

Figure 63 Photographs of directional arrows taken from Sheila Pontis' Blog.

The set of four photographs seen in Figure 63 can be found on Sheila Pontis' blog entitled *Mapping Complex Information: Theory and Practice; Case study: Underground Diagrammatic Maps.* Although the wayfinding settings represented in them are no different to the ones examined above they are used emphasise the pitfalls of research which does not seek to understand the situated behaviour of wayfinders. The first two photographs represent what Pontis was presented with in Terminal 1at Barcelona airport. Of the wayfinding and signage in the relatively new terminal, opened in October 2009, Pontis (2011) writes:

I notice that there is something wrong about the wayfinding and signage

> *system. As can be seen in the images below, the wayfinding signs have been designed exactly in the opposite manner that the advice is given by Spiekermann. The directionalities of the arrows are all pin pointing to misleading directions...Gates A, B and C are located on the same floor, even though the arrows seem to indicate that gates A and B are in a lower floor (top-right image).*

Pontis also criticises the positioning of directional arrows found at a bus station in her hometown, Mar del Plata, in Argentina (see the last two photographs in Figure 63):

> *In my first visit, the first thing I noticed was the arrows directionality of the signs and the lack of information design in the whole station. Similarly than the previous picture the arrow of Salida (Exit) points literally 'down' direction, instead of pointing 'ahead'...Andenes (Platforms) are located in the outside area of the station, however the arrow seems to indicate that platforms are in a lower floor...As in January 2010, the station was still underconstruction,[SIC]my hope was that these were provisional signs and that more appropriate ones would be replacing them soon... unfortunately, it was not the case, I have been there again last August, and the same wayfinding signs were there.*

Pontis points out that the force of her criticism derives from **'**a lecture of Erik Spiekermann, which was exclusively addressed to airport signage, highlighting that these concepts may be applied to similar problems and different contexts'. In this lecture Spiekermann gives tips which 'seem to be pretty obvious' but hardly adhered to 'in quite new airport terminals or bus stations' observes Pontis (2011). Three of them are listed below.

1- The arrows should be placed always at the same side that they are pointing out, to allow information to *flow*

2- The arrows should be always pointed out UP, when depicting straight direction

3- The arrows should never be pointed out DOWN, because it is not clear if that means straight direction or going to a different/lower level

Pontis' concluding remarks in this section entitled **Signage and Wayfinding** are:

> *There are many more aesthetic principles that take part of information design projects, such as Visual arrangement, Typography and legibility, Grid system, etc. However, as I have explained in a previous post, to obtain effective design results, it is not enough to apply these (or other) design principles as a recipe. In any area of design, principles should be purposely applied, instead.*

6.4 DISCUSSION

There appears to be a contradiction between the sentiments expressed in the quote above and Pontis' clear call for the need to adhere to what she refers to as 'pretty obvious' tips. Unfortunately she does not offer further insight into what purposeful application of design principles would amount to. Pontis is not alone in emphasizing the importance of adhering to standard rules on the one hand and the need to demonstrate an awareness of the unique nature of a problem at hand on the other. Miller and Lewis (DOH 2005), for example, do the same where they insist on compliance with standard positioning of arrows prescribed by British Standard BS 5499: 1990: Part 1 but also advice that care should be taken to ensure that the positioning should relate to the actual environment. In the wayfinding setting seen in Figure 41, for example, the actual environment is so complex that following standard guidelines results in a clear breakdown in information flow.

However, as can be seen in the examples discussed in this section, a deviation from the standard rules has no detrimental impact on people's ability to understand the message communicated as long as it clearly relates to the actual environment. In the case of Pontis' examples, it is difficult to say the same as it is not clear from her descriptions whether the actual environment where these sign are found is designed in such a way that would lead to the reading: ***down a level.*** It is also unclear if Pontis took time to observe other wayfinders in order to establish whether the confusion was exhibited in their behaviour. It is quite likely that such an exercise may have led her to the conclusion that frequent users of these settings fully understand the messages communicated on the signs as ***straight ahead*** in the first setting and ***right here*** in the second. These meanings, as has been discussed earlier, arise from the positioning of arrows in relation to the physical configuration of layout of the environment. However, her clear preoccupation with the desire to find out where and how standards rules are being violated leads her to advice that is somewhat contradictory.

The properties of the indexical expressions of the arrows considered in this section are indeed ordered properties and consist of demonstrable sense and methodic use (Garfinkel 1967). However, Garfinkel (1967:5) observes that despite the unanimous agreement about the properties of indexical expressions and actions, among student of practical sociological reasoning, laymen and professionals as there unfortunately exists impressive agreement that:

1) although indexical expressions "are of enormous utility" they are "awkward for formal discourse;

2) a distinction between objective expressions and indexical expressions is not only procedurally proper but unavoidable for whosoever would do science;
3) without the distinction between objective and indexical expressions and without the preferred use of objective expressions the victories of generalizing,...would fail.

These observations could partly explain the reason why Pontis and indeed many others find themselves in a difficult position where they are required to demonstrate objectivity. As Garfinkel (1967:3) further observes, they invariably make 'use of the "et cetera," "unless" and "let it pass" clause to demonstrate the rationality of their achievement. This is evident in Pontis' concluding remarks above.

6.4.1 Rethinking standard guidelines in view of indexical properties

In view of what has been discussed above, this section re-examines two standard guidelines with a view to suggesting an alternative reading. They are:

1. Arrows should be positioned consistently, and you **should use standard positioning** shown below, (see British Standard BS 5499: 1990: Part 1 in Table 8) on all directional signs on your site.
2. The direction the arrow is indicating should be **easy to understand** and **easy to relate to the actual environment**

Current guidelines	**Proposed changes to the standard guidelines bases on the indexical meaning of arrows**
No 1	Arrows should be positioned consistently. Great care must be taken when following standard guidelines such as those prescribed in British Standard BS 5499: 1990: Part 1. Whilst such guidelines are useful, a blind adherence to them may lead to more confusion for the users of your site especially where the physical layout of the environment is too complex to explain with signs.
No 2	The direction the arrow is indicating should be easy to understand and easy to relate to the actual environment. When positioning the arrow be mindful of alternative meanings that could arise from its relationship with the physical features around it. For example: • An upward or downward pointing arrow when placed: above a door can be read as ***in here***, or ***straight ahead through the door***; near a flight of stairs of a lift it can be read as ***up or down a level via the stairs or lift***

	• An arrow pointing straight to the right or left can be read as ***right or left from here***, ***through here***, ***in here*** or ***right here*** • An arrow pointing right and down can be read as ***right and down from here***, ***right here*** or ***in here*** • An arrow pointing left and down can be read as ***left and down from here***, ***right here*** or ***in here.***

Table 13 An example of two revised standard wayfinding guidelines currently in use.

6.5 SUMMARY

This Chapter has demonstrated that from uniquely adequate observations and descriptions of the behaviour of wayfinders three things have been possible. First, it is possible to derive a generic principle which is underpinned by a lean approach to knowledge management and also based on the tri-partite conception of knowledge flows. Second, the latter is validated as a robust evaluative framework. Third, that beyond the objective meaning of directional arrows lies alternative indexical meanings which arise from the proximity of the arrow to the physical layout of the physical environment. Starting with a review of existing solutions as given in literature and those improvised locally the Chapter has demonstrated how the study of the behaviour of wayfinders led to the derivation of wayfinding guidelines for use when designing wayfinding strategies and systems for old and complex environments.

7 EVALUATION OF PROPOSED SOLUTIONS

7.1 INTRODUCTION

In line with the demands of design science research this Chapter examines in more detail the various types of evaluation that occurred throughout the study. The following were evaluated: the fieldwork report; the tri-partite conception of knowledge flows; solutions for local problems; and generic wayfinding guidelines

7.2 EVALUATING THE IMPACT OF THE FIELDWORK REPORT

The fieldwork report seen in Appendix 3 was presented to the Redevelopment team for consideration on schedule. The report, which identifies helpful and unhelpful aspects of the environment as seen by the users of the setting, including the researcher, was positively received. The team showed keenness to represent the users' needs in the final wayfinding design. The positive impact of the report can be summarised as follows:

- The report helped the organisation to see the depth of their problems through what they called a fresh pair of eyes.
- Compared to a more theoretical solution suggested by their contracted architects and graphic designers the report was said to be effective in that it provided an in-depth representation of the extent to which the visitors to the hospital were getting lost highlighting precisely those elements of the environment or wayfinding system responsible for the confusion and distress.
- The report was used by the redevelopment team to encourage the contracted architects and graphic designers to revisit their proposed wayfinding strategy. Thus it served as a useful tool for stalling the process of signing a contract which would have resulted in the purchasing of signs that would have failed to address the problems occurring in the most challenging part of the hospital.
- When the contracted workers failed to meet the new demands, the redevelopment team felt confident to design their own wayfinding strategy and system as the report gave them sufficient guidance on how the local

problems could be tackled.

- Based on the strength of the report the researcher was invited to make a more active contribution to the process of improving their current wayfinding design both in the existing and new buildings. She stayed on board as an adviser and further permission was granted to continue using the site for the purposes of furthering the aims of the academic research.

The question of whether a report born out of surveys or semi-structured interviews would have had a similar impact received an immediate answer as it was possible to compare the work of the contracted workers with that of the researcher. It can be said that in this instance adhering to unique adequacy criteria allowed for the identification of subtle but important details which may have been overlooked had other methods been adopted.

7.3 EVALUATING THE TRI-PARTITE CONCEPTION OF KNOWLEDGE FLOWS

The practice of testing an existing artefact in the real world is condoned by van Aken (2004), Crabtree (2004) and Peffers et al (2008) as long as one can find an organisation willing to allow the deployment of the artefact in the first place. Efforts aimed at evaluating the tri-partite conception in the case of this study were not strained because the hospital at which the main fieldwork was conducted was keen to solve their wayfinding problems as a matter of urgency. As with the other case studies, the fact that the environments considered are public places also made the job of assessing the relevance of the tri-partite conception manageable. In all the stages where evaluation occurs it is demonstrated that wayfinders and indeed designers of wayfinding systems rely on the three modes of communication presented in the tri-partite conception of knowledge flows. It can be said that despite the varied nature of the wayfinding settings considered, that is, hospital, hotel, tube network or airport, the testing of the tri-partite model revealed similar findings across the board. What follows is a description of how the evaluation was conducted.

The relevance of the tri-partite conception is strongly indicated in Chapter three where following the review of literature it became possible to suggest a possible prescriptive wayfinding framework based on the three modes of communication of the theoretical conception. Figure 9 shows the proposed framework in the shape of an inverted pyramid. It

prioritises communicating through the physical properties of the built environment over coded information and social practice. However, it has been pointed out that suggesting this framework as a solution to the problems of wayfinding at Salford Royal hospital without conducting fieldwork would have been a violation of the fundamental principle of design science research to fully understand the local problem in need of a solution. In addition it would have been failure to heed the call for broader research into real-world observation into the behaviour of wayfinders and decision making by organizations faced with the job of providing effective wayfinding systems. Thus it is highly likely that such abstract guidelines would have suffered the problem of relevance commonly associated with most management research.

However, the successful operationalisation of the tri-partite conception during the second, third and fourth phase of the research lead to confirmation of its relevance for the purposes of managing and communicating wayfinding information. Once the fieldwork commenced it became clear that the breakdowns encountered in various wayfinding environments could be classified into three categories: coded information, social practice and physical properties. The researcher was able to concentrate on articulating the nature of the breakdowns, where exactly in the wayfinding system they occurred and how such breakdowns led to getting lost. Thus it was possible to demonstrate the usefulness of the conception in designing a robust tool for evaluating and categorising existing wayfinding problems whilst sensitising designers to possible solutions. In the case of Salford Royal Hospital this exercise led to suggestions of solutions to contextual problems. It also made it possible to develop abstract wayfinding guidelines moulded on uniquely adequate descriptions of the behaviour of the wayfinders. However, the value of the conception as a prescriptive framework is yet to be proven.

7.4 EVALUATING SOLUTIONS PROPOSED FOR LOCAL PROBLEMS

The subsections that follow pay closer attention to two practical examples where recommendations for change were made based on the careful consideration of both the objective and indexical meanings of directional arrows. They are taken from the old and complex setting of Salford Royal hospital.

Salford Royal hospital gave further permission to conduct experiments testing suggested solutions to specific problems caused by ill positioned arrows in the setting. Two experiments

were proposed: one testing the suggested solution to the ambiguity caused by the sign above a cupboard door as discussed below and the other testing the efficacy of colour coded arrows designed to solve several breakdowns encountered by wayfinders seeking to reach departments accessible via a connecting corridor on the first floor (Appendix 2 contains a proposal of the second experiment). With both experiments, the original intention was to use participant observation to monitor the behaviour of the wayfinders in order to produce yet another set of uniquely adequate analytical descriptions of the changed setting. Some of the wayfinding guidelines developed in phases 3 and 4 were evaluated during phase 5 of the study.

7.4.1 The problem of the arrow above a cupboard door

The setting discussed here is that which is analysed in section 5.2.2. The original intention to install and test the right pointing arrow in order to solve the problems occurring here did not materialise. However, the simple removal of all the signs amounted to a change in the design of the wayfinding system enough to justify testing. Further permission to monitor the response of wayfinders to the changed setting was granted. This monitoring amounted to observing the behaviour of wayfinders at different times of the day chosen at random. This pattern allowed for the inclusion of the hours when it is almost impossible to turn to anyone for directions. The direct observations were supplemented by conversations with other visitors to the hospital and with members of staff and hospital voluntary workers.

As soon the wayfinder walks through the set of double doors seen in the first picture the stairs and the corridor to the right become apparent. The sign forbidding entry via the stairs is now the first piece of information that catches the wayfinders attention unlike in the previous arrangement where attention was immediately directed to the sign above the door. The installation of the right pointing arrow did not materialise but as the simple removal of all the signs amounted to a change in the design of the wayfinding system it was enough to justify a fresh study of the behaviour of the wayfinders in response to the changed setting.

The complete removal of signs appears to have greatly reduced the confusion that used to occur in the setting described earlier. The behaviour of the wayfinder in the new setting has now changed from clear confusion to what appears to be an effortless navigation which amounts to following the corridor to the right as soon as the wayfinder establishes that the stairs do not lead anywhere. In the previous setting, the presence of the wayfinding instruction

above the door clearly gave rise to several possibilities one of which presented the stairs as a problem.

However, it is clear from the behaviour of the wayfinder in response to the transformed environment that this is longer the case. Here the physical properties of the environment appear to allow smooth wayfinding with little need for signs or verbal instructions. Currently the task of making sense of this part of the hospital appears to be so effortless that a counter argument for not solving the problem by placing a right pointing arrow can be justified. This goes to further justify the importance of prioritising the physical properties (affordances) of the environment in designing wayfinding strategies and systems. From a lean point of view it can be argued that this would lead to a reduction of waste in resources as there is no need to produce costly signs.

7.4.2 The problem of the arrow in the connecting corridor

As with the problem of the connecting corridor two methods for testing the impact of the colour-coded arrows on wayfinding behaviour were suggested: participant observation (ethnography) and direct observation in the Virtual Environment of Second Life. It was proposed that over an intensive period of 7 days the behaviour of wayfinders at the transformed setting should be monitored using the participant observation method. Half of the week would be spent on observations starting as early as 0700hr ending at 1400hr and the other half was spent on observations starting at 1400hr lasting until 1900hrs. Direct observation in Second Life was suggested as means of comparing the behaviour of wayfinders in the real setting of Salford Royal hospital with that of wayfinders in the virtual model of the same hospital. It was hoped that extending the testing in this way would provide more insights into the value of using information technology to aid wayfinding. A more detailed description of the proposed experiment can be found in Appendix 4.

Unfortunately for reasons beyond the control of the researcher, this experiment did not materialise. Time and timing were largely the deciding factors. However, although the original intentions failed part evaluation of the efficacy of colour coded arrows was done at three separate stakeholder meetings two of which were attended by the researchers from the university. The researchers were informed that a team of executive decision makers at the

hospital had accepted the proposed solution as a viable solution to the current problem of the connecting corridor. Thus time and resources allowing the experiment is yet to be realised.

7.5 EVALUATING GENERIC WAYFINDING GUIDELINES

The work reported here was conducted in the final phase of this study when a unique opportunity to offer consultative services to the Facilities Management department availed itself. At the time the University of Salford was engaged in an intensive exercise of upgrading signage in general and all university facilities to meet the requirements of the Equality Act 2010, which has replaced most of the Disability Discrimination Act (DDA). The input of the author was invited as soon as the graphic designers were engaged to design new signs for the university. In a series of five meetings, which spread over a period of four months, the author offered her wayfinding expertise to building managers, the project manager and the graphic designers. The advice given was based on findings from both the review of literature and empirical research.

In addition brief ethnographic studies were conducted around the university and in four buildings on the project manager's priority list. The aim was to establish the level of effectiveness of the existing signage system prior to suggesting improvements. Two walkthrough exercises involving the project manger and the graphic designers were also conducted in two of the four buildings referred to above. The photograph seen in Figure 64 is of one of the buildings where the author was involved in the process of identifying and assessing the nature of the problem, suggesting a solution, implementing the suggested solution and evaluating its usefulness.

7.5.1 Upgraded signage at the University of Salford

Figure 64 One of the University buildings where change was implemented.

This building houses the Operation and Facilities/Estates Management offices and is open from 0800hrs to 1600hrs, Monday to Friday. Members of staff, student and visitors report here for security related issues such as identity and proximity card, car parking permits etc. All visitors to this building must report to the reception which is located on the first floor. The reception can be reached via the stairs or a lift. The stairs which can be seen through the glass wall on approaching the building start from the second glass panel from the left and spreads diagonally all the way through the third and fourth panel. The first panel to the left is an automatic door which opens up to a small foyer. Once inside the visitor is presented with two doors needing a pass code to entre and a starting point for both the stairs and the lift (see top right and left photographs in Figure 65).

Figure 65 Photographs of the new wayfinding instructions for the route to the reception area.

The wayfinding information seen here is what the visitors are now presented with. In the previous setting none of the signs seen here were present. The visitor entering the building would have found an improvised sign giving directions for the reception and nothing else. The directions constituted of an A4 sheet with the word RECEPTION on it followed by an upward pointing arrow and was positioned at the precise point where the new directions are seen in the top left photograph.

At the top of the stairs on the first floor nothing else informed the visitor which way to go out of the four possible entrances (doors) plus a short corridor found to the right of the sign seen in the bottom left photograph. The reception is situated behind a wall to the right and cannot be seen from the position of this sign. Previously a smaller sign with the word RECEPTION

(without a direction arrow) written on it hung from the same position where the new sign is. The proximity of the sign to the two doors seen here: one to the left and another straight ahead gave rise to the interpretation that the reception was reachable via these doors. The visitors would often walk past the entrance to the reception which is situated in an office approximately five meters away from the sign.

The changes seen here were recommended on the strength of the proposed principle (*right information, right form, right place, right people, right time*) and the established indexical properties of arrows as discussed above. In the new setting the information is right as there is clear a starting point, destination, and directions for both wheelchair users and able bodied visitors (see top left photograph). The starting point for the wheelchair users is made clear through the perfect combination of wayfinding instruction made up of the word ***lift***, a graphic symbol widely recognised as denoting disability, a directional arrow and a pop-out sign announcing the precise location of the lift (see top right photograph in Figure 65). It was also agreed that coded information was the form as it is generally assumed that everyone in an educational setting is literate. Paying attention to the needs of the disabled user demonstrated an awareness of the need to cater for the right people and the positioning of signs at strategic positions throughout the route demonstrated an awareness of the right place for the right time. The rationale behind positioning the signs where they are now is explained below.

At the bottom of the stairs the team settled for the ***right and up from here*** directional arrows because of the two-tier zigzag design of the stairs. However, it has to be said that the improvised sign with an upward pointing arrow previously found here worked perfectly too. A directional arrow indicating a ***right turn*** and ***straight ahead*** move plus an additional pop-out sign announcing the precise location of the lift was seen as necessary because of the presence of the door seen beyond this sign. Read in conjunction with the directional arrow seen in the previous sign a ***straight ahead*** move would lead the visitor straight into this door.

At the top of the stairs directional arrows that would immediately catch and direct the attention of the visitor to the corridor on the right by way of a right pointing arrow was seen as the most appropriate display. This would effectively eliminate the four doors mentioned earlier as possible entries. To the left of the sign seen here is the exit from the lift so the wheelchair user would be immediately supplied with crucial information as soon as they emerge from it. Along the short corridor positioning the sign for the reception where it is now

(see bottom right photograph in Figure 65) would catch and direct the attention of the visitor to the correct entrance to the reception by way of a right pointing arrow. This would effectively eliminate the two doors mentioned earlier as possible entries. Following the installation of the new system in this building the author managed to evaluate the changed setting through observing the behaviour of visitors on numerous occasions over an extended period. They are discussed in detail under the section on evaluation below.

The author was able to evaluate wayfinding solutions both locally and at a more generic level. Evaluating the effectiveness of the changes implemented at the University of Salford took the form of directly observing the behaviour of visitors on several occasions over an extended period of time. This was supplemented with conversations with fellow staff and students aimed at getting immediate feedback on their experience of finding their way. The length of observations ranged from 15 -30 minutes at any given time. The first time was immediately after the installation of the signs which was in the last quarter of the year 2010. The rest were during year 2011, the year in which all existing staff and students were required to update their ID cards in line with the university's new corporate image (most of the year 2011). This also included the academic registration period of September for new students. In all the cases observed, it was clear that finding reception is now an effortless activity. However as the researcher was not fortunate enough to come across a wheelchair user during these times the experience of this group remains unknown

7.6 DISCUSSION

So far it has been demonstrated that the meaning of directional arrows is determined by the spatial arrangements around it. It has also been shown that these indexical expressions of arrows are fully understood by the wayfinder. In all the settings observed it is also clear that the wayfinder is not necessarily distressed because the positioning of the arrow violates the standard guidelines. In most cases they successfully perform their task completely oblivious to the fact that rules exist outside the environment they are faced with. It would appear, therefore, a faithful adherence to the standard guidelines of how to position directional signs does not necessarily lead to effective results. This clearly begs the need to rethink the current guidelines taking into account the indexical properties of arrows: the spatial grammar of wayfinding. Section 6.4.1 offers a revised and expanded version of some of Miller and Lewis' (DOH 2005: 97) guidelines which have already been identified as problematic

In Chapter three a question was raised regarding the possibility of solving contextual wayfinding problems from the review of text alone and without recourse to empirical research. From what has been discussed so far it can be said that abstract guidelines alone are insufficient. The value of learning from the situated behaviour the wayfinder is strongly emphasised throughout the entire thesis. Emphasised too are the methods by which an in-depth understanding of this behaviour and a consequent development of guidelines for improving design can be achieved. Table 14 below presents an overview of a series of conceptual steps that can be usefully followed in order to achieve effective wayfinding design.

Guidelines	**Underpinning theoretical domain and Method**
Situate yourself in the setting and pay attention to how people 1. perceive and understand the environment, 2. situate themselves in space, 3. make sense of the wayfinding information and cues made available to them	**Ethnomethodology and Design Science** Adhere to the weak requirement of unique adequacy in order to achieve the level of problem identification and definition required for the development of an artefact of utility. This requires ethnographic participant observation and/or self-reflection
Produce a detailed description of the wayfinders behaviour as it occurs in that setting.	**Ethnomethodology** Adhere to the strong requirement of unique adequacy which require a production of analyses free of pre-existing theories.
Develop or suggest solutions (both contextual and abstract)	**Design Science** Use the theory-free analytical descriptions produced in the previous step to develop guidelines for improvement according to the criteria prescribed by Design Science Research
Deploy/Demonstrate and Evaluate	**Design Science and Ethnomethodology** In order to establish that the solutions work for the people for whom they are designed an evaluation of their utility is paramount. Both the weak and strong criteria of unique adequacy can be usefully applied to studying the efficacy of the solutions in real life.

Table 14 An overview of the steps that can be followed in order to achieve effective wayfinding design.

7.7 SUMMARY

This Chapter has successfully discussed how the process of evaluating the proposed

wayfinding solutions was conducted. Section 7.2 has presented the evaluation of the impact of the fieldwork report followed by the evaluation of the tri-partite conception of knowledge flows in section 7.3. The evaluation of solutions to local problems has been offered in section 7.4. Section 7.5 has discussed how solutions developed following the analysis of the behaviour of in hospital environments was tested in a different context of the University of Salford with similar wayfinding problems. In the last section of steps that can be usefully followed in achieving people centred wayfinding designs have been stipulated.

8 DISCUSSION AND CONCLUSIONS

8.1 INTRODUCTION

This Chapter provides a summary of the entire study rationale was based on the fact that people visiting old and complex settings such as hospitals continue to be lost in spite of the impressive developments in wayfinding in terms of theories and guidelines since the coining of the term in the early 1960s. The complexity of such settings is largely due to the piecemeal way in which hospitals have evolved over long life cycles. As indicated from the outset the fundamental thinking in this research is that effective wayfinding guidelines aimed at improving wayfinding performance in such settings can be derived from a careful real-time observation and analysis of the behaviour of wayfinders. One of the central arguments is that this it is possible through a careful consideration of how wayfinders make sense of wayfinding information communicated via the three knowledge flows of the tri-partite conception: coded information, physical properties, and practice.

The key findings of the research are discussed under the three main steps of design science research: problem identification and definition; design and development and evaluation. The contributions made are also discussed as are its limitations followed by recommendations and opportunities for future research. The Chapter also comments on the extent to which the aim and objectives of the research were achieved.

8.2 CONCLUSIONS ABOUT PROBLEM IDENTIFICATION AND DEFINITION

In view of the emphasis attached to the importance of effective problem identification and definition by the proponents of design science research it can be said that this research has demonstrated appropriateness of the unique adequacy approach for this purpose. Adhering to the demands of the unique adequacy criteria in conducting research at Salford Royal hospital allowed for the identification of subtle but important details which may have been overlooked by surveys and interviews. Drawing principally on the researcher's own experience of attempting to navigate the hospital site, the author conformed to the weak requirement of unique adequacy that the researcher must know what any member of a research setting would ordinarily know about that setting.

To recap: in a questionnaire survey the method employed is simply the everyday one of asking questions. By restricting the answers to replies on a printed form, a vast amount of data is eliminated from the research process. Thus, for instance, the mood and context, as conveyed by body language, tone of voice and subsidiary explanation are lost. So also is the opportunity to ask further questions to clarify or extend understanding. The ability of participants to contribute their own ideas, indeed to point out new directions which research should take, is severely restricted (see Garfinkel 1984, pp 193-197 for a further elaboration of these points. Francis and Hester's (2004) three-part methodological procedure was central to achieving a high level of uniquely adequate observations which led to an in-depth knowledge of the state of the problem and the importance of its solution as per Peffers et al.'s (2008) observation.

Justifying the value of a solution indeed motivated the researcher and the identified organisation to pursue a suitable solution to identified problems. It also helped the researcher to understand the reasoning associated with his or her understanding of the problem. The in-depth understanding of the nature of problems, existing solutions and their efficacy made it possible to rationally infer the objectives of a solution from effective problem specification. These were presented in qualitative terms where it was made clear how the new artefact is expected to support solutions to problems of wayfinding.

8.3 CONCLUSIONS ABOUT DESIGN AND DEVELOPMENT

Highlighted in Chapter 2 is that the key to designing testable artefacts is to determine the desired functionality of the artefact and its 'architecture' before creating the actual artefact. A review of the existing wayfinding solutions as given in literature helps to answer the question raised in Chapter 3 regarding the possibility of solving contextual wayfinding problems from the review of text without recourse to empirical research. Here it is shown that abstract guidelines alone are insufficient and the value of learning from the situated behaviour the wayfinder is strongly emphasised. A close examination of empirical findings reveals that the problems of wayfinding in complex environments occur at the interface between the physical properties of the environment and coded information as predicted in the tri-partite conception.

Chapter 6 has demonstrated that from uniquely adequate observations and descriptions of the behaviour of wayfinders, offered in Chapters 4 and 5, it is possible to derive solutions to both

local problems and those occurring in similar contexts. Here a generic principle (see section 6.3.3) which is underpinned by a lean approach to knowledge management and also based on the tri-partite conception of knowledge flows has been proposed. In addition the Chapter demonstrates that beyond the objective meaning of commonly used directional arrows lies alternative indexical meanings which arise from the proximity of the arrow to other features in the layout of the physical environment. This observation has lead the study to challenge the widely circulated wayfinding guidelines based on the standard meanings of arrows and an encouragement to rethink some of guidelines. This is seen in Chapter 6, section.6.4.1.

8.4 CONCLUSIONS ABOUT EVALUATION

It can be said that the various forms of evaluation conducted at different stages of this research meet the qualitative criteria suggested by the proponents of design science research. As has been demonstrated in Chapter 7 the evaluation took the form of client feedback and experiments involving observations and analyses underpinned by the unique adequacy criteria. It is important to reiterate that adhering to both the strong and weak requirements of unique adequacy allowed an in-depth assessment of the efficacy of suggested solutions in a manner that questionnaire surveys or interviews may have failed to achieve.

8.5 CONTRIBUTIONS TO KNOWLEDGE

This research makes both academic and practical contributions in three ways. First is the novel contribution to how research is currently conducted in wayfinding through adopting the design science research methodology complemented by an ethnomethodologically informed approach of unique adequacy. This represents a new way of researching wayfinding problems the latter being a response to the current call for a better and deeper understanding the situated behaviour of wayfinders. In Section 2.5 can be seen the proposed Wayfinding Conceptual Framework (WCF) showing the complementary nature of design science and unique adequacy (see Figure 3). The relationship is also emphasised in Table 14 seen in Chapter 7, section 7.6.

Second, is the theoretical contribution made to both the knowledge management and design disciplines. To knowledge management it is the conceptual contribution showing the value of physical properties in communicating knowledge. The successful operationalisation of the tri-partite conception of knowledge flows for the purposes of wayfinding serves to fulfil the

original goal of the KIM project which was to find robust ways of handling information and knowledge over the lifetime of product-services of which hospitals are part of (see section 3.3.1). It usefulness for the purposes of developing wayfinding prescriptions is first emphasised in Chapter 3 (see sections 3.4 and 3.5).

The conception is proven to be a robust framework for evaluating and categorising wayfinding problems thus sensitising designers to effective solutions. This has been emphasised throughout Chapters: 4 (see section 4.5); 5 (see section 5.3); and 6 (see section 6.3). The exercise of articulating the importance of each knowledge flow for the purposes of designing better wayfinding systems/strategies brings design thinking in line with knowledge management. The idea of colour coding direction arrows as a means of communicating both direction and destination (see subsection 6.3.2 and Appendix 4) represents a novel to contribution to the graphic design community.

Third is the contribution made to practice in the form of an easy and simple to use tool containing guidelines for improving wayfinding in old and complex environments: ***The Wayfinding Wheel***. A point must be made that the Wayfinding Wheel is not necessarily the main artefact of the research but its by-product which serves to demonstrate the communication aspect of Peffers' (2008) DSRP model. The wheel has been designed in response to the observation that most wayfinding guidelines tend be to hidden in large volumes of text thus making their access difficult when needed. Bearing in mind that those charged with this responsibility are '... busy people, with very practical concerns...' (DOH 2005: 10) the tool has been designed in such a way that suggested guidelines are readily available when decisions relating to design or improvement are being made.

Thus the tool is designed to aid quick decision making for those charged with the duty to design effective wayfinding strategies/wayfinding systems. It is hoped that the tool will make the job of classifying the breakdowns in a wayfinding system manageable making it easier to articulate the nature of breakdowns, where exactly in the wayfinding system they occur and how such breakdowns lead to getting lost. The Wayfinding Wheel is composed of two sides both containing easy to access and follow instructions. Side one (see Figure 66) contains a set of instructions on how understand the behaviour of wayfinding prior to suggesting solutions. Side two (see Figure 67) contains the generic principle as suggested in section 6.3.2. The physical Wayfinding Wheel can be found inside the pocket at the back of this book.

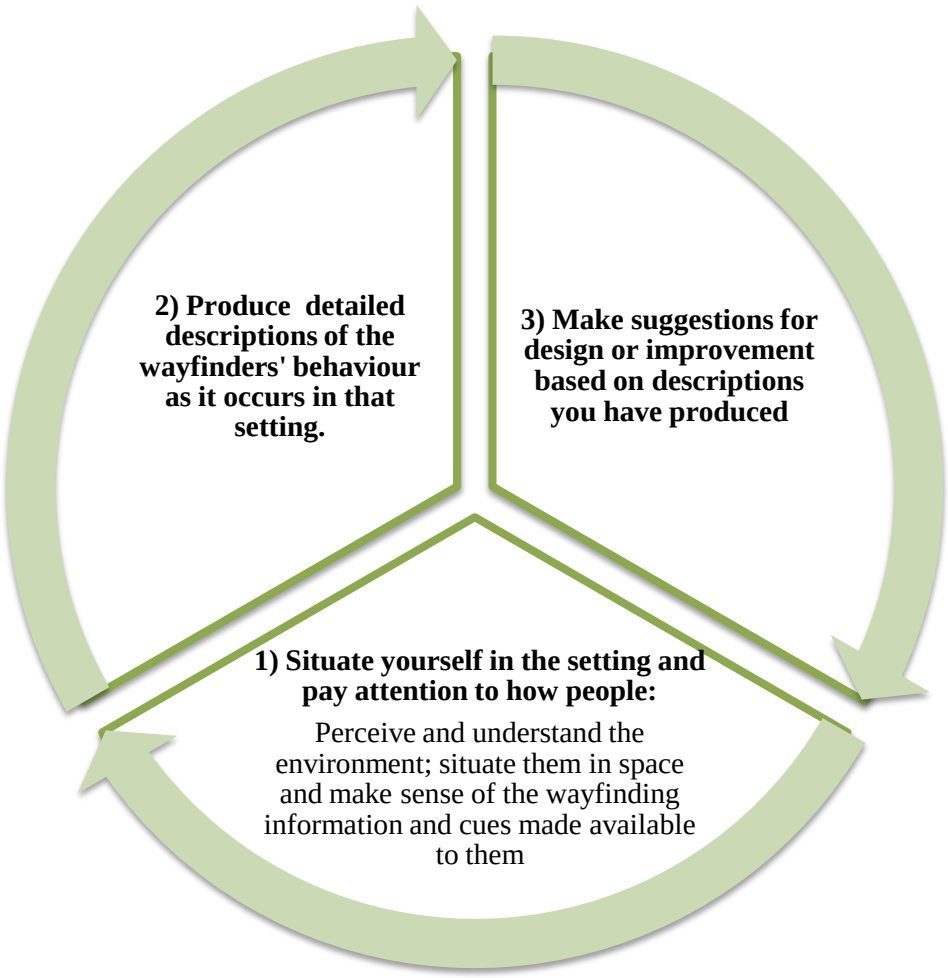


Figure 66 Side one of the proposed Wayfinding Wheel showing three key steps to improve wayfinding in old and complex environments.

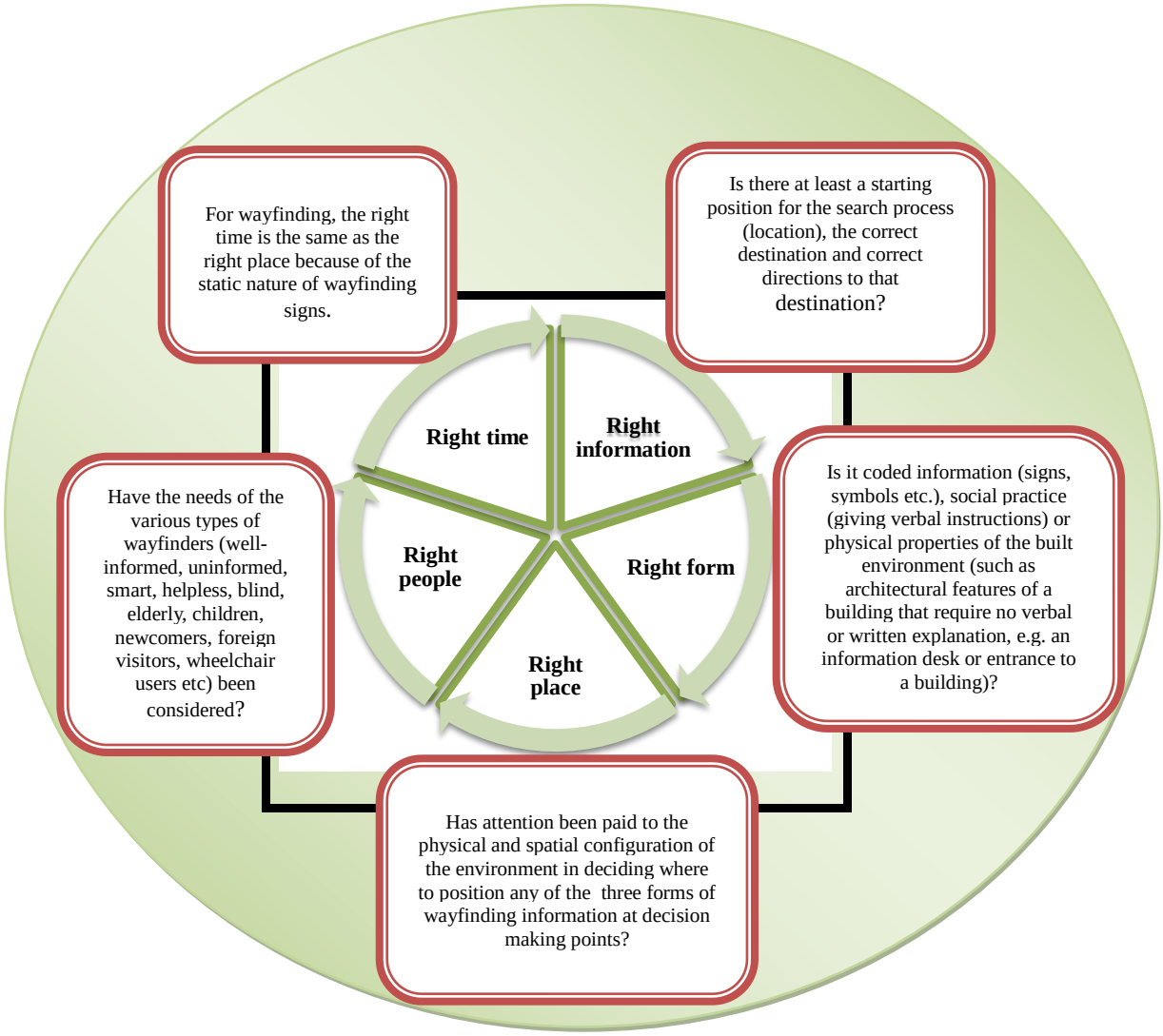


Figure 67 Side two of the Wayfinding Wheel showing the key elements of the proposed generic principle serving to sensitise designers to the problems encountered.

The criteria contained in the ***Wayfinding Wheel***, makes the following assumptions and demands:

1. that the job of designing any wayfinding systems ought to be seen in terms of knowledge flows between designers and wayfinders;
2. that those charged with the responsibility for improving existing wayfinding systems or design new ones in the first place must possess an in depth knowledge of the environment to be navigated before setting out to design or improve and that of the behaviour wayfinders within it. This group includes designers, facilities and estates managers and patient service mangers and those responsible for the actual positioning

of wayfinding information in relation to the physical layout of the environment.

3. that this knowledge can be effectively and efficiently transferred to wayfinders through three knowledge flows: coded information, the social practice of giving verbal instructions and physical properties of the environment; and
4. that any wayfinding system must incorporate all the three knowledge flows in order to ensure that the varied needs of visitors to any setting are met.

8.6 KEY LIMITATIONS

Although the main aim and objectives of this research were met and all the research questions were adequately answered some intentions of the study were not realised. Next is a catalogue of the limitations of this research in the order in which the event occurred.

Not being able to conduct the experiment detailed in Appendix 4 was one limitation. Due to communication problems between the administrators at the hospital and the researcher a valuable window of opportunity was missed. Consequent efforts to conduct the experiment failed largely because a suitable time could not be found. A successful completion of the experiment would have helped validate the idea of communicating both direction and destination through colour arrows thus making evidence based contribution to the graphic design field. It may have also helped resolve the problems of wayfinding at Salford Royal hospital both in the short and long term.

The second limitation was that of the language barrier encountered during the visits to hospitals in Italy and Germany. Here the researcher could not rely on the practice of verbal direction giving as she did in UK and USA hospitals. Signs giving directions were written in the local language and effort to engage in conversation with fellow wayfinders and those at the information desk were met with blank stares followed by utterances to the effect that they could not speak English.

The third limitation was failure to obtain inside information on how decisions about incorporating wayfinding at design stage for some of the new award winning hospitals were made. Telephones and e-mails of enquiry were simply not responded to. An interview with whomever the decision makers were would have provided insights into the extent to which existing wayfinding theories and guidelines have helped shape the thinking around including

wayfinding matters as part of the design process right from the beginning

Similarly, not being able to engage with the award winning Wayfinder UK meant that the research could not embrace the latest thinking in wayfinding consultancy. The other limitation is that a critical review of the organisation's work based on the findings of the brief ethnographic fieldwork conducted at their flag ship hospitals was constrained because the organisation was not part of the research.

8.7 RECOMENDATIONS FOR FUTURE RESEARCH

This research project has suggested conceptual frameworks and practical tools for improving wayfinding performance in old and complex hospitals which have been evaluated during the course of the study. It is recommended that further research evaluating these on a wider scale be undertaken by interested researchers. For example:

- Research aimed at testing the efficacy of colour-coded arrows in communicating both direction and destination would help prove or disprove the hypothetical suggestions made in the second paragraph.
- A positive outcome from testing the Wayfinding Wheel would help generate insights into its usefulness for the purposes of aiding quick decision making and accessibility, thus making it a *must- have* tool to be incorporated into the design process from an early stage.
- Research aimed at testing further the evaluative and prescriptive wayfinding frameworks based on the tri-partite conception of knowledge flows would validate further the findings of this research.
- A successful operationalisation of the wayfinding conceptual framework (see Figure 3), developed from a close examination of relationship between design science research and the unique adequacy approach, would serve as evidence to support the arguments for an approach that should focus on mitigating the problem of relevance often associated with most management research.

It is hoped that successful testing of the efficacy of colour-coded arrows would help prove or disprove that this would lead to:

- A reduction in the need for staff to stop to offer help to anyone lost or appearing to be lost meaning the staff would not have to divide their working day between direction

giving and their normal duties, the result being improved service delivery and customer satisfaction.

- Improved physical health for the wayfinder due to reduced levels of anxiety. The later may impact negatively on diagnosis (elevated blood pressure etc.)
- Improved fiscal health for the organisation due to: cutting down or eliminating the hidden costs associated with direction-giving by people other than information staff or those that may arise from missed appointments etc.
- Reducing the need to continue purchasing signs that are unlikely to solve the problems of a complex layout.
- Increased awareness, on the part of key decision makers, of the need to design a wayfinding strategy and system that ensures that the right information in the right form is in the right place, thus communicating with the right people at the right time

In view of the observed fact that the guidance document for healthcare facilities 'Wayfinding: Effective wayfinding and signing systems (DOH, 1999, 2005) which is more than a decade old appears not to be effectively utilised by those whom it is designed for, research into the reasons why is worthy. This document, which focuses on '...assessing and improving wayfinding systems at healthcare sites' (p.10), is written for people who work with wayfinding systems on a day-to-day basis such as estates and facilities managers and patient services managers. The document makes two important claims:

- that rather than set out a series of rules that everyone must follow it provides information that will enable the development of local solutions as '...each trust, and each site, has its own problems and priorities' (p.10).
- that in view of the fact that the targeted groups are '… busy people, with very practical concerns...' (p.10) the document is designed in such a way that its users should find it less cumbersome.

As indicated in section 3.2.3 the claims beg answers to questions around issues of decision making relating to the design and management of wayfinding systems and whether the guidance document might need updating or improving in order to facilitate greater ease of understanding and consequently, greater commitment to the improvement of wayfinding systems. This research would seek to find answers to the questions that follow:

- Who is responsible for designing wayfinding systems/strategies in hospitals and who makes the decisions on the type of information to be included in a wayfinding system?

- Who is responsible for the physical placing and positioning of wayfinding information in relation to the physical layout of the environment over the building's life cycle?
- Given the extent of extension, upgrading and demolition in part (DOH 1999) that occurs throughout the long life cycles of NHS buildings, who is charged with the responsibility for ensuring that wayfinding information is clear and updated?
- How is the existing guidance document currently used to support decision making and how could it be improved?

8.8 CONCLUDING REMARKS

It can be said that the aim of the research which is to develop guidelines aimed at improving wayfinding in old and complex hospital environments was largely achieved. In the introductory Chapter the research was situated within the concerns for the need to find a more suitable solution for wayfinding problems that continue to occur in old and complex hospitals has been identified emphasised. The importance of both a human-centred and problem centred research approach in doing so was emphasised and explored in Chapter 2. The design science/constructive research approach complemented by the ethnomethodologically informed approach of unique adequacy was suggested as the appropriate way forward. Here the contribution made to design research by demonstrating the ways in which ethnographic fieldwork can contribute, both to the development of design principles and directly to the design of wayfinding systems in complex built facilities were emphasised.

Chapter 3 established the extent to which the review of literature can be relied upon to provide solutions to the problems of wayfinding. The conclusion was that a simple examination of methodological descriptions found in academic publications is insufficient, thus reiterating the need for wayfinding solutions that are underpinned by an in-depth understanding of the situated behaviour of wayfinders remains outstanding. Chapters 4, 5, 6 and 7 presented empirical work underpinned by both the design science research and unique adequacy approaches highlighting the value of both in designing testable wayfinding guidelines. The primary goal to establish that better wayfinding design is possible through an in-depth study of the situated behaviour of the wayfinder was realised. This was possible through a careful consideration of how wayfinders make sense of wayfinding information communicated via the three knowledge flows of the tri-partite conception: coded information, physical properties, and practice.

It can also be said that the study has successfully demonstrated, albeit on a small scale, the complete cycle of the design science approach as suggested by the proponents of design science research. However, the proposed recommendations deriving from both the review of literature and the main findings from the empirical work emphasise the need for further research in order to support ideas that are worthy of attention.

Finally, the study must comment on the subject of reflexivity often associated with ethnographic research of this kind. Many will want to know how the multiples roles of the author as ethnographer, nursing practitioner and wayfinder were reconciled. As a wayfinder the researcher was a visitor to the hospital who was unfamiliar with the hospital lay-out. As such, she was in the same position as any other visitor to the setting, whether patient, visitor, or new staff member. This approach clearly has its limitations, with each visit familiarity with the site layout increases and the researcher's natural sensitivity to way-finding problems is consequently diminished. Apart from the fact that the author’s background as a nurse practitioner made her feel comfortable to entre hospital settings and engage in conversation with other users, it was of no significance when it came to understanding the behaviour of wayfinders herself included.

However, the roles of wayfinder and researcher, which may appear to some as inextricably intertwined, were effectively separated by drawing a distinct line between the demands of the UA approach and those of Design Science. Once the wayfinding task was achieved, treating it as a first time through, the researcher then analysed her own experiences and those of other wayfinders to meet the demands of UA. As design scientists the researcher then made use of the rich ethnographic descriptions to inform the development of wayfinding guidelines.

APPENDICES

APPENDIX 1: ETHICAL APPROVAL DOCUMENTS

Approval letter from the University's Research Ethics Committee
Letter of introduction by Prof Lauri Koskela (Academic Supervisor)
Letter of clarification from a chair of an NHS Research Ethics Committee
Permit to conduct research at Salford Royal Hospital

P.T.O

APPENDIX 2: EXAMPLES OF WAYFINDING INFORMATION FOUND ON MOST HOSPITAL WEBSITES

1) A general Google map
2) Directions from home to hospital and mode of transport
3) A site map

Retrieved 1 January, 2012 from Central Manchester Foundation Trust's Plan your visit section of their website http://www.cmft.nhs.uk/royal-infirmary/plan-your-visit.aspx.

P.T.O

APPENDIX 3: REPORT OF THE INITIAL FIELDWORK CONDUCTED AT SALFORD ROYAL HOSPITAL

P.T.O

APPENDIX 4: DOCUMENT DETAILING THE PROPOSAL FOR EXPERIMENT USING COLOUR-CODED ARROWS

P.T.O

APPENDIX 5: FLOOR MAP SHOWING THE GROUND AND FIRST FLOOR OF THE RED ZONE AT SALFORD ROYAL HOSPITAL

P.T.O

APPENDIX 6: DOCUMENT EXPLAINING THE WAYFINDING WHEEL

P.T.O

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