Hospital Ward Design: Implications for Space and Privacy

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'A great building must begin with the unmeasurable, must go through measurable means when it is being designed and in the end must be unmeasurable.' Louis Kahn (1901-1974).

ABSTRACT

This thesis examines the relationships between hospital ward design and aspects of visual privacy as a design criterion. It involves three stakeholders: users (potential and actual patients), experts and architects. In particular it explores the relationships between the spatial design of the plan configuration of buildings, in this case hospital open wards, and subjective judgments on spatial location for privacy across different demographics and cultural backgrounds. These variables are considered in the context of the current guidelines on, and regulations of, ward design criteria, and architects' prioritisation of these criteria.

Mixed methodological approaches – i.e. qualitative and quantitative methods – are employed. Space Syntax theory and its particular technique Visibility Graph Analysis (VGA) are used to quantify the spatial structure of six generic open ward types. A series of statistical analyses allowed the investigation of the relationships between measures of plan configurations and patterns of preferences in relation to beds' spatial location for privacy assessed by means of a questionnaire. This is followed by qualitative policy analyses and semi-structured interviews with experts to provide a set of the relevant ward design criteria, which is used to conduct choice-based conjoint analysis to explore architects' prioritisation of ward design criteria including patient's privacy.

Results showed a systematic relationship between the chosen location for privacy and spatial properties of the ward plans best represented by two measures: Integration and Control, with integration being the best predictor of preference. This was found to encompass universal preference for spatial locations of privacy across culture, age and gender and a specific significant difference as a result of previous experience of space. A reasonable awareness of the importance of patient's privacy as a design criterion was found not only in the current guidelines and regulations on ward design but also in experts' perception and architects' prioritisation of ward design criteria. However, it appears that there is no framework to assess people's privacy preference or specific information to guide architects on spatial preference. Systematic findings with respect to plan configurations are not only important in themselves, they provide the context within which detailed design choices can be made.

DEDICATION

بسم الله الرحمن الرحيم

I dedicate this modest piece of work to My Family.

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To my father: Rajab Alalouch, and my mother: Hana Kayali

"It is a wise father that knows his own child." Shakespeare, *The Merchant of Venice*. Thanks for putting me on the right track for life… Papa.

‘*For rarely are sons similar to their fathers: most are worse, and a few are better than their fathers.’* Homer, *the Odyssey*. Thanks for pushing the boundaries to the limits… you are the exemplar for me… my task has been difficult.

‘*The art of mothering is to teach the art of living to children*’. Elain Heffner. Mama… you are the best artist and teacher… thanks.

‘*A mother is not a person to lean on but a person to make leaning unnecessary.’* Dorothy C. Fisher. For all your bountiful love, tenderness and support a million words would be too short.

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To my wife: Ayah Abbasi

You are my soulmate as described by *Aristophanes* in Plato's *Symposium*, yet as adorable, smooth and innocent as the dew on Jude’s, our son, morning smile. You are as provocative, paradoxical and engaging as ‘*For the love of God*’ by Damien Hirst, yet as emotional, harmonious and transparent as *Chopin’s* melodies.

Thanks for your diligence in juxtaposing my extremes and spelling out my sophistication. Without you and Jude, not only this work but also my life would not be possible….. Thanks.

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GLOSSARY

ACA: Adaptive Conjoint Analysis.

AEDET: Achieving Excellence Design Evaluation Toolkit.

ASPECT: A Staff and Patient Environment Calibration Tool.

BIC: Bayesian Information Criterion.

BVR: Bivariate Residuals.

CA: Conjoint Analysis.

CABE: Commission for Architecture and the Built Environment.

CART: Classification and Regression Tree.

CBC: Choice Based Conjoint analysis.

CIC: Construction Industry Council.

CVA: Conjoint Value Analysis.

DQI: Design Quality Indicator.

HB: Hierarchical Bayes Estimation for CBC Data.

HBNs: Health Building Notes.

HFNs: Health Facility Notes.

HTMs: Health Technical Memoranda.

IDEAs: Inspiring Design Excellence and Achievements.

K-S test: One-sample Kolmogorov-Smirnov test of normality.

LC: Latent Class Analysis.

LCA: Latent Class Cluster Analysis.

MARU: Medical Architecture Research Unit.

MRSA: Methicillin-Resistant Staphylococcus Aureus.

NEAT: NHS Environmental Assessment Tool.

NHS: National Health Services.

OLS: Ordinal Least Squares.

PCA: Principal Component Analysis.

PFI: Private Finance Initiative.

RIAS: Royal Incorporation of Architects in Scotland.

RRA: Real Relative Asymmetry.

VGA: Visibility Graph Analysis.

VIF: Variance Inflation Factor.

List of Papers Published From This Work

1) C. Alalouch, P. Aspinall. (2007). "Spatial attributes of hospital multi-bed wards and preferences for privacy". *Facilities*, 25:9/10, 345-362.

2) C. Alalouch, P. Aspinall, H. Smith. (2008). "On locational preferences for privacy in hospital wards". *Facilities*, in press (accepted 26/08/2008).

Posters Presented at Academic Events

1) Spatial Design and Privacy in Hospital Wards, in JRI research poster evening. Napier University, Edinburgh. October 2008.

Chapter One:

Introduction

1.1 Background

A hospital is not just an architectural envelope which accommodates clinical functions and facilities; rather it is a synthesis of sophisticated interconnected systems which work together to meet the functional requirements of the different activities that are carried out within a hospital setting. This requires a special attention from the early stages of the design process to meet the wide range of issues which are involved in hospital design. Among these are user needs. The architectural design of hospitals should respond to these, including psychological needs, which are less often considered but equally important.

In spite of the fact that patients are key users of hospitals, the change in hospital design and planning has been driven mainly by the interest of architects, nursing staff and physicians aiming at achieving more effective staff functioning. As a consequence less attention has been paid to patients' preference regarding hospital design (Hutton, 2002). However, recent trends in hospital design promote the integration of patients' preference and needs as a significant contribution to the design of a modern hospital, e.g. Healing Environments and Patient First Approach. Such proposals take on board a physical environment in hospitals which is responsive to patients' preferences, expectations and needs in order to support the healing process and contribute positively to the well-being of patients. In particular, patients' privacy is known to be important for patients' physical, mental, emotional and spiritual well-being.

A patient's privacy has been considered as one of the important concepts in nursing and healthcare ethics and addressed in many declarations of patients' rights, e.g. World Medical Association Declaration of Helsinki: *Ethical principles for medical research involving human subjects*; and World Health Organisation Regional office for Europe: *A declaration on the promotion of patients' rights in Europe* (Leino-Kilpi et al., 2001). In addition, patients themselves have viewed privacy as an important issue during their stay in hospitals (Schultz, 1977; Back and Wikblad, 1998).

In the UK, a patient's privacy has been recognised as a key feature in designing the internal environment of hospitals in the Health Building Note (HBN) series, e.g. *HBN04-01: Adult In-patient Facilities* (2008) and many other Department of Health publications, e.g. *Exploring the Patient Environment: an NHS Estates Workshop* (2003); and *The Architectural Healthcare Environment and its Effect on Patient Health Outcomes* (2003). Improving patients' experience by providing a better level of privacy and dignity is one of the major schemes included in *The NHS Plan 2000* which was reinforced later by the guidance and benchmarking document '*Essence of Care*' (2003) by the Department of Health, which reflects the government's strategy to improve the quality of fundamentals of healthcare, one of which was privacy and dignity.

This small, but representative, selection of studies and documents demonstrates the cumulative focus which has been given to the importance of privacy in hospital settings. However, despite the wide recognition of the importance of patients' privacy, the frequent loss of privacy in hospital settings is still a problem that faces hospital designers and planners (Annas, 1981; Matiti and Trorey, 2004).

Within this context, hospital wards appear to be the most relevant department due to the fact that patients spend most of the time of their hospital-stay in wards, which occupy more floor area than any other individual department in a hospital. In a ward environment patients are likely to be weak, stressed, and more importantly experiencing a limited amount of control over their environment. For these reasons the impact of the physical environment on their well-being is amplified and they tend to be more sensitive to their privacy requirements and preference. This is particularly relevant to multi-bed wards where privacy that negatively affects the hospital-stay satisfaction of the patients has always been in question (Harris et al., 2002; Ulrich et al., 2004). Moreover, getting a better level of privacy seems to be one of the main reasons which make patients prefer single-bed rooms more than multi-bed wards (Kirk, 2002; NHS Estates,2003).

On a psychological level, it is agreed that privacy, despite its complex nature, is one of the basic human needs which are manifested in people's behaviour, values, expectations and preferences. It is related to effective individual and group functioning and its converse, lack of privacy can result in a range of problems. In addition, psychological concepts such as personal space and territoriality were seen as mechanisms to obtain privacy which present privacy as a central approach among other space management processes (Altman, 1975). In spite of the existence of differences in privacy mechanisms across a number of variables – e.g. cultural background, age groups, and gender – the desire for and the therapeutic effect of privacy have been acknowledged to be universal. This was clearly reflected in Maslow's hierarchical structure of basic human needs in which privacy was seen as relevant to the top four out of the five levels in his model (Moleski and Lang, 1986).

In the field of man-environment relationships, an individual is perceived as a material entity surrounded by invisible shelters extended beyond its physical being. These shelters are controlled and protected by the achieved level of privacy. The role of the physical environment is to materialize these shelters by facilitating the provision of the desired level of privacy. In other words, the spatial arrangements of an architectural environment act as regulators for the distribution of information which are directly relates to human senses. People receive and distribute information in an architecturally bounded environment using their senses. Hence, five factors can be identified in relation to privacy and the physical environment: visually, acoustically, olfactory, accessibility and proximity (Hall, 1969).

In spite of this categorisation, privacy is usually studied in terms of acoustic and visual distribution of information. While acoustic privacy seems to be related to the properties of the materials as well as to the architectural design of a spatial environment, visual privacy is more governed by the spatial arrangements of a physical environment. This was conceptualised in Archea's Visual and Exposure model of privacy (Archea, 1977) in which he hypothesized that visually conveyed information is crucial in monitoring one's surrounding and as a consequence controlling the distribution of information from and to one's self, which is in turn governed by the organization of the surrounding physical environment. Hence, people's locational preference within a physical environment can be considered as a function of their desired level of visual privacy, which is governed by their capabilities, expectations and intentions. Similarly, Benedikt (1979) suggested that people perceive their architecturally bounded surroundings based on the visual field generated from their location within a spatial environment. He called the 2D representation of this field the Isovist.

The former approaches to understanding the effect of the physical environment on visually conveyed information, and as a consequence human perception and behaviour, naturally focus on the local and immediate surrounding spaces only. On the other hand, a more recent, but well-established, theory – i.e. Space Syntax (Hillier and Hanson, 1984) – has shown that what matters is the global structure of the whole spatial configuration rather than the immediate surrounding in terms of understanding the relationship between people and space. This was evidenced for people's movement in urban areas (Hillier, 1996a) and in buildings (Turner, 2000) in the first instance. It was later extended to include different aspects of human behaviour, e.g. traffic flow (Penn et al., 1998) and crime patterns (Hillier and Shu, 2000); and perceptions, e.g. quality of life (Hanson and Zako, 2005) and privacy in work environments (Rashid et al., 2005).

Thus, combining these two approaches to understanding the relation between privacy and the physical environment suggests that people's locational preferences for visual privacy are a function of the global structure of the spatial configuration. As a consequence, privacy is defined in this thesis as the amount of visually communicated information as a function of one's location in relation to the immediate spatial arrangements of the physical environment and the wider surrounding spatial configuration. Hence, locational preference for privacy is the location within the spatial configuration which facilitates the achievement of the desired level of visual privacy. Given a hospital open-ward as a spatial configuration, it is an assumption of this research that people's locational preference for privacy, which positively reflects on their well-being, is a function of the spatial attributes of that configuration.

In spite of this well-established relationship between visual privacy and the physical environment in the field of environmental psychology, it would seem that there is no comprehensive measure or framework to assess people's privacy preferences in this spatial configuration sense nor information to guide designers. Moreover, when privacy has been investigated, it is mostly with surveys, questionnaires and/or interviews. There has been a lack of environmental measures, such as the impact of the spatial layout, that are both important and under the control of architects or designers. The significance of such an approach in relation to plan configurations is not only important in itself but also provides the context within which detailed design choices with respect to different design criteria can be made. In this case the increase or decrease of privacy can be influenced by the spatial properties inherent in the basic architectural design itself.

However, this seems to be subject to how architects prioritize design criteria given the fact that any design task involves logical prioritization between different combinations of design criteria, which in turn is related to the available guidance and policies. This becomes more complicated in the design process of open wards due to the clinical function of the wards and the presence of different people with different needs and preferences within the ward's environment at the same time.

This research brings together these different aspects that link patients' privacy and the architectural design of hospital open wards. It involves different groups of ward design stakeholders: patients (actual and potential) who are a key user of a ward's environment, whose needs and preferences the architectural design of wards should respond to; architects who are key decision-makers in the production of the spatial environment of a ward and whose interests can influence and give priority to a particular design criterion; and experts or policy makers whose perceptions and views have a direct effect on the final product through guidance and policies.

1.2 Research Aims and Objectives

The current study aims to investigate the relationship between measures of the plan configuration of buildings (in this case multi-bed wards), and subjective judgements on spatial locations for privacy; and to evaluate the awareness of the designers of the importance of patients' privacy in hospital wards. This broad area of interest has led to the formulation of four objectives which are related as shown in Figure 1.1. These are as follows:

1- To explore the relationships between people's preferences for locational privacy in multi-bed wards, and the corresponding spatial attributes calculated by space syntax.

2- To assess the effect of the spatial attributes of the layout (i.e. multi-bed wards) on the identification of subgroups of people with different privacy preferences.

3- To identify criteria for hospital ward design at two levels: formal ward design criteria and the criteria that seem to be important to experts in ward design.

4- To explore architects' priorities in relation to ward design criteria, in order to evaluate their awareness of the importance of patients' privacy in hospital wards.

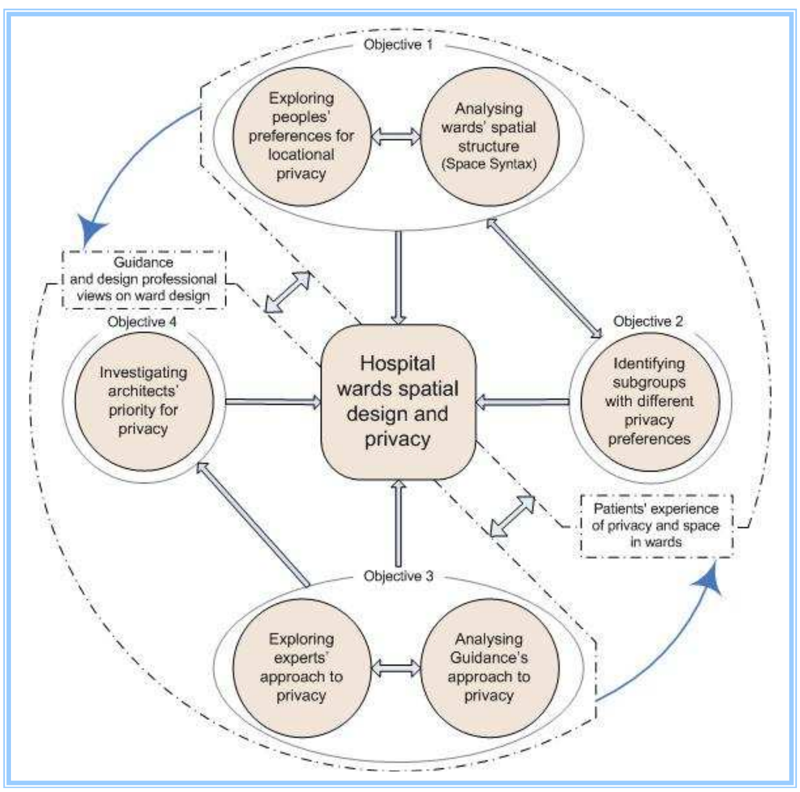

Figure 1.1-The relationships among the objectives of the thesis (Source: the author)

1.3 Research Approach and Methods

In response to the identified research objectives, a process by which these objectives could be addressed and fulfilled efficiently was needed. This is usually guided by different research philosophies and approaches which in turn are informed by epistemological understandings. In fact this has been a subject of a wide and long-lasting debate in the literature, particularly in the field of social science. For example, Crotty (1998) suggested four elements of social research process: *Methods,* which are the techniques employed for data collection and analysis in response to the research objectives; *Methodology,* which is the strategy of choosing the methods and linking them with the results; *Theoretical perspective,* which guides the methodology and links it to a philosophical stance; and *Epistemology* or the theory of knowledge inherent in the theoretical perspective and therefore in the methodology. Whereas Creswell (2003) described three elements: knowledge claims, strategies of inquiry and methods.

Within this framework the question is where to start? Is it from our understanding of knowledge to theoretical stance to methodology and arriving at methods or vice-versa? Such a debate can be dated back to the time of Aristotle (Kelly, 2004) cited in (Bageis, 2008): whether the focus of the study indicates a consequent approach to the research or whether the researcher's understanding of knowledge leads to specific research methods. Crotty (1998) explained that most research starts with a *real-life* problem which proposes a set of questions, objectives and/or hypothesis upon which the research is planned. Then, researchers tend to relate this to a theoretical perspective and epistemological understanding in order to ground their claims and defend their processes as a form of *human inquiry*. In fact this is the way in which the current research was constructed, from the objectives to method and methodology to theoretical perspective and epistemology. The author argues that this may be the way in which many PhDs are undertaken due to the focus on the research topic and the available methods. However, in later stages of the researcher's life, epistemology and theoretical approaches may lead to future research projects.

1.3.1 Approach to knowledge

In epistemology and the research philosophy literature several strands have been developed and various terms have been used. Objectivism and Subjectivism are seen as the main epistemologies or *knowledge claims* (Creswell, 2003). It has been claimed, however, that Constructivism is an epistemology rather than being a theoretical perspective (Crotty, 1998).

A theoretical perspective is an abstract way to look at the world and understand it in relation to ourselves. This involves dealing with knowledge in which different epistemological approaches, or in other words 'how we know what we know', explain why theoretical perspectives are informed by epistemological understanding. An objectivist approach holds that meanings exist independently of our consciousness and it is a matter of when we discover them. On the other hand, Subjectivism claims that subjective experiences of individuals impose meanings on an object and hence, meaning is independent of the object itself, whereas in Constructivism humans construct knowledge and meanings from their experience and interaction with objects rather than discovering them (Crotty, 1998).

The author views the social world as based on regularities rather than truths. This does not mean that truth does not exist but the limited capability of the human mind, perhaps, does not allow truth to be captured; rather regularities can be distilled from the interaction between the human mind and a social phenomenon. These regularities may differ according to individuals' 'inner' world of experiences and capabilities. *''The human understanding is of its own nature prone to suppose the existence of more order and regularity in the world than it finds.''* (Francis Bacon, Aphorism XLV, p. 50 cited in Hillier, 1996a). In line with this understanding, Bill Hillier in his book *Space is the Machine* described architecture as analogous to language in the sense that language can be described by elements, i.e. words, which are set out in the dictionary and syntactic rules, i.e. grammars. However, without the involvement of human beings combining words that are taken from the dictionary in a grammatically correct sentence no legitimate meaning can result. It seems then that human interpretation is what makes sense of an existing reality.

1.3.2 Approach to research and methodology

These ways of understanding knowledge have informed different theoretical perspectives such as positivism and interpretivism in terms of social research. These present the two extremes of the scene between which several approaches have been erected, e.g. post-positivism, empiricism, realism, idealism and relativism.

In summary, in positivism or the natural science approach, the theoretical perspective is informed by objectivist epistemology, holding the following tenets: the objective world is existing and independent of our perception but governed by natural laws which are measurable independently of the researcher's values, with the researcher being regarded as a *neutral collector of facts*. It is argued that social life can be explained in the same way as natural phenomena by applying standard scientific procedures to produce social facts or broader generalization about human behaviour. This type of argument tends to be considered as deductive, i.e. either valid or invalid. Positivists claim that personal opinions and values may cause a bias and hence have no place in research. As a consequence of these tenets, positivists tend to use quantitative data. Contrary to this, interpretivists argue that the social world is different from the natural world and in both cases researchers themselves are part of the system they are studying and their values can not be neutralised. They aim to discover how different people interpret the world that surrounds them by focusing on the meaning that people give to their environment rather than the environment itself. They tend to encourage inductive arguments i.e. accepting the results of the research as it is without questioning whether it is valid or invalid. Observation and qualitative data are the most used methods for the interpretivists' philosophy (Crotty, 1998; Creswell, 2003; Walliman, 2005).

Between these two extremes, it is argued that in order to understand the social world, both approaches are needed, or what is called *two-fold articulation* (Kulkarni and Rajan, 1991) cited in (Smith, 1999). The author pretty much agrees with this trend. In other words, what works is what is useful, and should be used, regardless of any philosophical or methodological constrains (Johnson and Christensen, 2004). This type of thinking allows the researcher to make use of the advantages of the two methodological approaches: quantitative and qualitative. The combination of these two approaches to data collection and analysis has developed a so-called pragmatism[1] (Tashakkori and Teddlie, 1998). The author has developed his methodological approaches out of the philosophy of pragmatism. This allowed the researcher to employ a wider range of data collection methods and analysis techniques in a way that is most likely to achieve the research objectives. Following this understanding of the methodology and given the thesis objectives, data were collected with an equality of qualitative and quantitative approaches but analysed mostly using statistical techniques.

1.3.3 Research methods

As explained earlier, a mixed approach was used for data collection and analysis. Some of the research methods used in this thesis were purely qualitative, some were of a quantitative nature and some combined the two approaches together but indeed were all interlinked. A particularly innovative dimension to this study is the use of a rigorous combination of qualitative and statistical methods. The use of questionnaire, interviews, space syntax analysis, choice-based survey and statistical analyses has permitted more detailed analyses than possible using qualitative or statistical analysis alone. Table 1.1 shows data collection and analysis techniques used to address each objective of this study.

methods / objectives	**Semi-Structured Interviews**	**Policy Review**	**Questionnaire**	**Case Studies**	**Spatial Analysis Techniques**	**Conjoined Analysis**	**Latent Class Analysis**	**Statistical Techniques**
Objective 1			√	√	√			√
Objective 2			√	√	√		√	√
Objective 3	√	√						
Objective 4			√			√		√

Table 1.1 - Thesis objectives and the corresponding data collection and analysis methods

[1] Different terms have been used. Terms such as mixed approach and mixed methodology are relevant.

A detailed explanation of each method and its limitations is provided in the respective relevant chapter. The following is a summary of the research methods adopted following the order in which they appear in the thesis:

- Case studies

Six different types of open wards in different hospitals in the UK were used for the study. James and Tatton-Brown (1986) have classified different types of wards into categories depending on the arrangements between the different types of spaces. This was used as a framework to choose a representative set of case studies from existing hospitals. A detailed description of the case studies is provided in chapter four.

- Spatial analysis Techniques (Space Syntax and Visibility Graph Analysis)

The evidence from space syntax theory is that there are deep rooted links between aspects of spatial structure as an organization and the way that structure functions to influence the behaviour of its users (Peponis and Wineman, 2002). One of the latest developments for spatial analysis in space syntax literature is Visibility Graph Analysis (VGA). Its particular software, Depthmap, was used in this study as the tool to conduct VGA and perform various measures which quantify the spatial environments under question according to certain criteria called spatial attributes. The visibility graph was generated and analyzed for each ward. Following this, the spatial attributes were calculated for each ward and for each bed in each ward. As a consequence, each ward and each bed was represented by the numerical values of its spatial attributes. This is reported in chapter four.

- Questionnaire

Questions in the questionnaire were designed around three areas in line with Canter’s (1977) research: environmental features; activities carried out in the space; and perceptions and attitudes towards the place. A number of closed and open-ended questions were asked to provide a wider insight into aspects of privacy in hospital wards from people's viewpoint.

In order to explore the relationship between people's preferences for privacy in open wards and the spatial attributes of the layout, two main questions were asked. Following an introduction, in which subjects were asked to imagine a situation in which they had to spend time in a hospital open ward, people were asked to: 1) rank the 6 wards shown in the questionnaire according to their preference for privacy; and 2) for each ward, choose (from the point of view of privacy) the bed they would prefer and the bed they would most dislike to stay in. A full description of questionnaire design and analysis is provided in chapter five.

- Statistical Techniques

Different statistical techniques were used to link the spatial attributes of the case studies calculated by VGA and people's preferences for spatial location of privacy obtained by the questionnaire. These included tests of differences; factor analysis; correlational analysis; analysis of variance with repeated measure; logistic regression; and answer tree. SPSS (14) was used to perform the statistical tests. The procedures, results and findings of the statistical analysis carried out are reported in chapter six.

- Latent Class Analysis (LC)

Latent Gold (4.0) software was used as a tool to perform the latent class analysis in order to investigate the possible existence of subgroups of people with different privacy preferences. Latent classes are hidden or latent subgroups. Subjects in the same latent class are homogeneous on certain criteria, while subjects in different latent classes are different from each other in certain criteria. A full report is provided in chapter six.

- Policy Review

A comprehensive survey of policies and guidelines was carried out to distil the formal criteria of ward design. The literature survey covers two main sources: NHS toolkits for hospital design (i.e. AEDET, ASPECT, IDEAs and NEAT); and NHS guidelines in relation to hospital design (i.e. HBNs, HFNs, HTMs and others). These were then analysed qualitatively to establish a hierarchy of ward design criteria. Chapter seven provides a description of this survey and analysis.

- Semi-structured Interviews

Qualitative semi-structured interviews were carried out aiming at collecting ward design criteria which seem to be important from the point of view of a selected group of experts who are experienced in hospital design. The additional aim was to obtain the perceptions of those experts regarding patients' privacy. This was carried out with experts from the UK and Syria, the home country of the author. More detail of the selection of interviewees and interview process, as well as a a qualitative analysis across them is provided in chapter seven.

- Conjoint Analysis (CA)

For the aim of this study, Choice Based Conjoint Analysis (CBC) was used to prioritize the ward design criteria from the perception of professional architects, in order to evaluate their awareness of the importance of patients' privacy in hospital wards. The conjoint data were collected using an online conjoint questionnaire by which the author managed to reach a wider sample. This was undertaken and analysed using several software utilities which were provided by Sawtooth Software package.

Conjoint analysis technique is a quantitative method which has been developed to measure human psychological judgments (e.g. importance or preferences) based on subjective information obtained from the respondents. It has been used widely in marketing research. Conjoint analysis is a 'trade off' technique between different profiles of attributes with different levels. The design, analysis and results of the study are reported in chapter eight.

The following section describes the structure of the thesis and illustrates the relationships between the thesis's chapters.

1.4 Structure of the Thesis

This research project was developed in three interrelated stages. It started with the notion of the potential interaction between patients' preferences for privacy, space syntax theory and hospital ward design. This, in turn, highlighted the need to provide a deeper insight into how the current policies and views of policy makers may influence the degree to which the spatial design of wards can improve patients' experience of privacy. The results obtained led to the third stage, namely, an investigation into the views of design professionals i.e. architects, on ward design given that their interests can influence and give priority to a particular design criterion. The significance of this study is that the involvement of three key types of stakeholder allowed the provision of an integrated insight into the phenomenon under question i.e. patients' privacy.

The progression of the thesis is described in nine interconnected chapters which follow a logical and clear way to address the research objectives. It starts with an introduction of the research; reviewing the literature on hospital design and development; and exploring the theories and principles related to privacy. The research structure then describes the data collection methods and process; and highlights the analysis carried out. Due to the wide range of data collection and analysis methods, which were utilized to address the research objectives, each chapter in the main body of the thesis reviews the methods, describes the analysis and reports the findings that are related to that particular step in the research. Then, the findings of the research are synthesised and reviewed; the limitations of the study are identified; and recommendations for future research are reported in the last chapter. Figure 1.3 shows the outline of the research and the chapters overview is as follow:

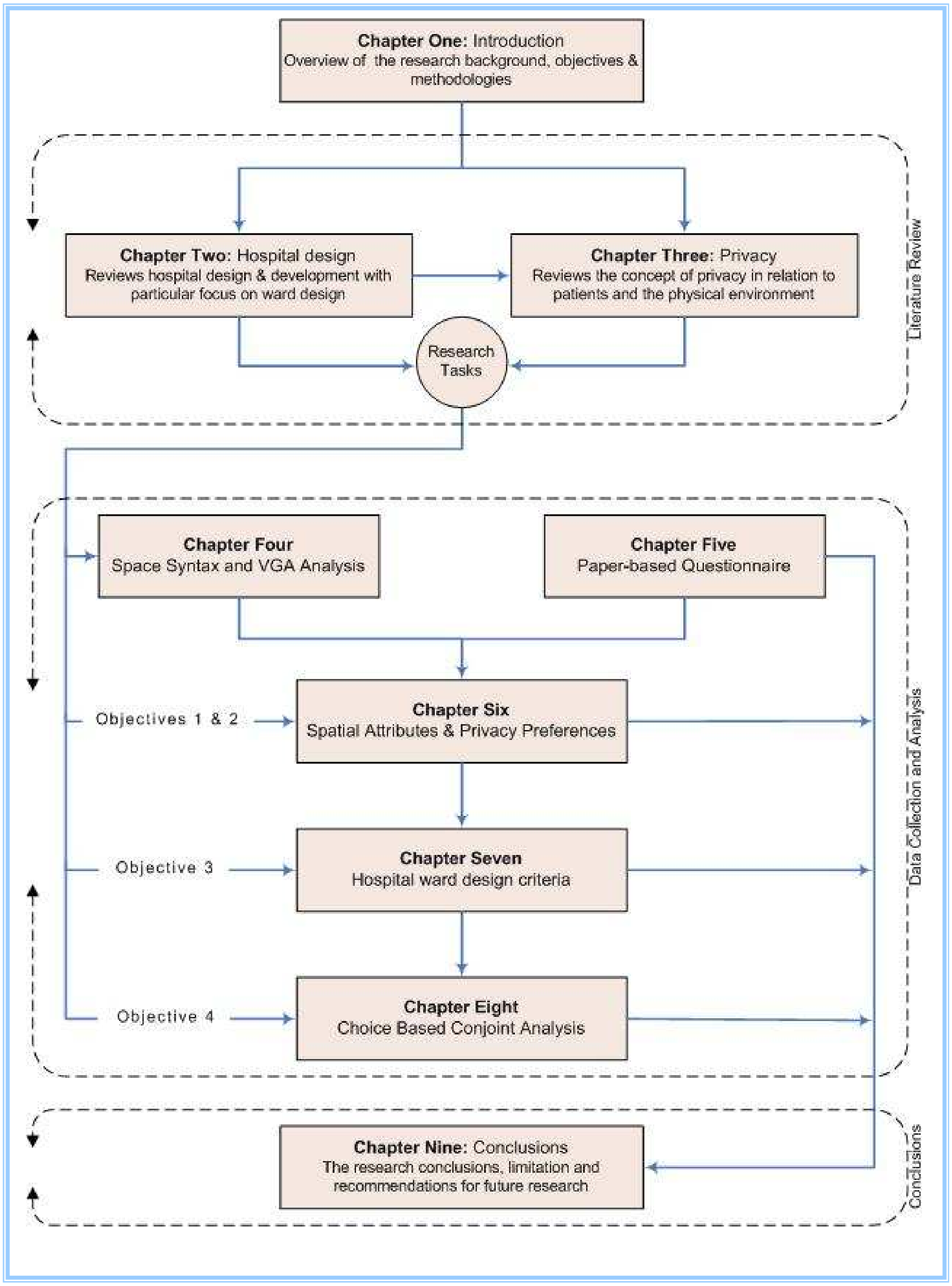

Figure 1.3 - Research outline

Chapter One: Introduction

This chapter provides the introduction to the thesis by giving an overview to the research topic; aims and objectives; approach to knowledge and methodology; and research outline.

Chapter Two: Hospital Design

This chapter summarises the literature in terms of hospital architecture with particular focus on ward design. It locates hospitals within the healthcare system and documents hospital design development in the UK from the Victorian era to the recent and future trends in hospital design. In doing this, this chapter draws attention to the importance of patients' privacy in hospital wards, especially in open wards.

Chapter Three: Privacy

This chapter attempts to explore, examine and understand the general concept of privacy by providing a review and analysis of the theories and intellectual insights related to the different aspects of privacy with particular focus on the field of human-environment relationships. It presents privacy as a function of the interaction between visually conveyed information and spatial organization. It then goes on to discuss the different aspects related to patients' privacy. It demonstrates the need to link aspects of visual privacy with recent spatial analysis approaches, i.e. Space Syntax.

Chapter Four: Space Syntax & Visibility Graph Analysis

In this chapter Space Syntax and its associated techniques are dealt with in detail. The history, capabilities and limitations of main strands within space syntax literature are determined and compared, which led to identifying Visibility Graph Analysis (VGA) as the appropriate technique to be used for the analysis of spatial structure of wards in the context of the current study. Then this chapter describes the six case studies and reports the results of the VGA graphically and numerically as applied to the case studies using DepthMap software. By doing this, this chapter provides an essential database to address objectives number 1 and 2 of this thesis.

Chapter Five: Paper-based Questionnaire

This chapter describes the paper-based questionnaire used in this thesis in terms of its conceptual design, structural framework and administration. Then, the descriptive analysis along with some inferential analysis carried out for each section of the questionnaire is reported. In addition to the fact that this chapter provides a wider insight into aspects of privacy in hospital wards, the importance of this chapter is that it provides data on peoples' subjective judgments on spatial location for privacy. This data is needed to address the first two objectives of this thesis.

Chapter Six: Spatial Attributes and Privacy Preferences

This chapter makes use of the numerical database produced in chapter four and people's subjective judgments on locational privacy provided in chapter five. It combines the two data sets in a statistical framework to address objectives 1 and 2 of this thesis. A wide range of statistical techniques were reviewed and applied in this chapter using different packages. The results and findings of these statistical analyses were reported numerically and graphically when possible and then discussed. In addition, some of the findings that resulted from this chapter are linked to wider debates taking place within architectural theory.

Chapter Seven: Hospital Ward Design Criteria

This chapter focuses on hospital ward design criteria as they are emphasised in design guidelines and perceived by experts in ward design. It reviews and analyses ward design criteria that are provided by the available regulations and guidelines in the UK including those on privacy. It employs the NHS Design Evaluation Toolkits to establish a hierarchy of ward design criteria. Then, it gives an in-depth exploration of ward design criteria that seem to be important from the perspective of a selected group of experts in ward design from the UK and Syria. It reports the results of the semi-structured interviews which were carried out with this group of experts. In doing this, this chapter addresses the third objective of this thesis. In addition, this chapter provided a context within which the CBC study reported in the next chapter is conducted.

Chapter Eight: Choice Based Conjoint Analysis

This chapter attempts to address objective number four of this thesis. It uses choice based conjoint analysis to understand the priorities of architects for privacy when it is placed within other environmental constraints and design criteria associated with the design of hospital wards. These design criteria are those which were seen as important by experts in the previous chapter. A review of CBC technique is provided and a step-by-step description of stages of building, administering and analysing the CBC study is documented in this chapter. This was conducted using a set of Sawtooth Software packages.

Chapter Nine: Conclusions

This chapter synthesises the conclusions and findings of the current study. It also highlights the research limitations and suggests directions for future research. In addition this chapter links the findings of this thesis with design and theory.

Chapter Two:

Hospital Design

2.1 Introduction

A hospital is not just a building; rather it is a synthesis of sophisticated interconnected systems which require special attention from the early stages of the design process to meet the wide range of issues which are involved in hospital design. However, the function of hospitals has been the same throughout history, i.e. the provision of aspects of healthcare facilities. Nevertheless, hospitals have been in a rapid continuous development worldwide in a variety of aspects as a reaction to the medical, social, cultural, environmental and political changes over history. Yet, the perfect hospital has not appeared. These developments introduce new trends and re-invent existing demands in addition to those still awaiting a solution. Patients' privacy is one of these increasing demands.

This chapter attempts to address the importance of patients' privacy in hospital settings by reviewing the design of healthcare buildings with a particular focus on hospital architecture and departments. It also covers subjects such as the ward concept and reviews the debates on single versus multi bed rooms. Finally, patients' privacy is located within the wider context of hospital development in the UK and recent trends and demands on hospital design.

2.2 Healthcare Buildings as Part of Healthcare Services

The provision of healthcare services includes a wide range of functions, activities and facilities which need to be accommodated in healthcare buildings. Health buildings form the environment in which the healthcare services are delivered to patients. The traditional classification of healthcare buildings, which splits the provision of healthcare services into two levels – primary and secondary or acute – is based mainly on the scale of healthcare services they provide. Glanville and Howard (1999) suggested that the recent development of healthcare services may establish an intermediate healthcare level which lies between primary and secondary levels. A more detailed classification is presented by Cox and Groves (1990), who suggested that healthcare services graded from primary services at a local level represented by family doctors, health centres and community hospitals through the secondary service at district level represented by general hospitals to tertiary services at regional level represented by specialist hospitals, teaching institutes and medical research schools.

The structure of the National Health Service in the UK (NHS) reflects the two-level classification. Figure 2.1 shows that the primary healthcare service, which has been considered as a frontline service, is related to the local medical needs. Whereas the secondary healthcare service is related to more specialist treatments, which are usually offered in hospitals. Nevertheless, the healthcare service on a regional level was recognized in the early publication of Health Building Notes (HBN1) (Department of Health,1988).

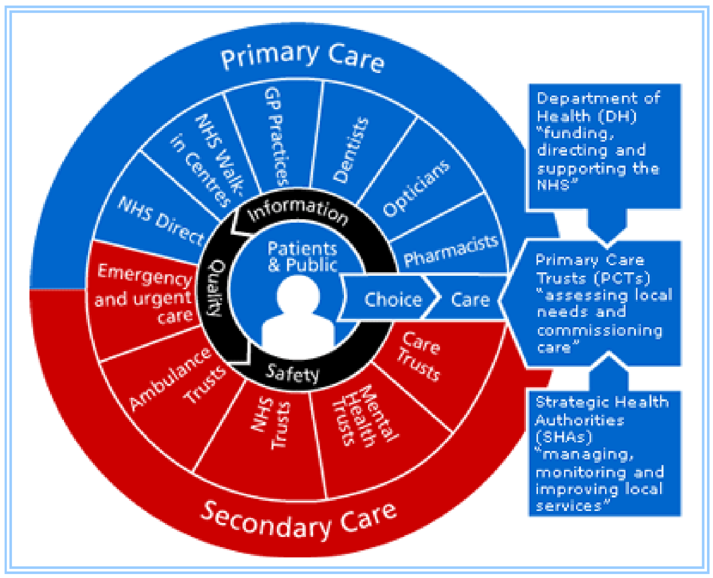

Figure 2.1-NHS structure (Source: NHS Choice, www.nhs.uk)

Primary healthcare provides the gateway for the first contact between the public and the healthcare workers. The main concern of primary healthcare is people's general health needs; it provides consultation and treatment of minor injuries, illnesses and surgery (Neufert and Neufert, 2006; NHS, 2007). In addition it deals with preventive care such as smoking cessation services (NHS, 2007).

Primary healthcare services have been delivered through four main building types located in the community they serve. These building types are: health centres, general medical practitioners' premises (GPs), clinics and dental practitioner premises (Noble, 2008). Although each one of these buildings is used to accommodate a particular scale of health services, the distinction between them has become more unclear as recently some of these building have been accommodating a wider range of health services. For example, services such as immunisation, child development and family planning which used to be offered in health centres are now provided in the GPs (Noble, 2008). Moreover, specialist treatments are increasingly being provided at a primary care level (NHS, 2007). According to Neufert and Neufert (2006) primary healthcare centres tend to serve a population of between 10 000 and 30 000 people.

Secondary healthcare refers to the services with which primary care is not able to deal because they require more specialist treatments, equipment or facilities. These acute services are usually offered in hospital environments. Hospitals may differ in the number of population they serve, and as a consequence the number of beds required, number and size of the specialist departments they support and standard of the accommodation and welfare they provide.

Accepting the size of hospitals as a categorization criterion, Neufert and Neufert (2006) subdivided hospitals into four categories: smallest (up to 50 beds), small (up to 150 beds), standard (up to 600 beds) and large hospitals. In the 1990s very few smallest and large hospitals were built in the UK. Moreover, in some cases smaller hospitals were closed (Glanville and Howard, 1999). A more common classification splits hospitals by function; with different terminologies used for this classification. For instance, Glanville and Howard (1999) described three types of hospitals: general acute hospital, specialist hospitals and community hospitals. Neufert and Neufert (2006) used the terms general hospitals, university hospitals and specialist hospitals. On the other hand, David Clarke rejected the use of this common terminology which he called '*stereotypes*'. He recommended a classification based on the separation of the activities and the physical requirements for these activities (Clarke, 2008). For example, rooms or suites which could be used in the context of different size healthcare facilities.

A community hospital serves a population of 30 000 to 100 000 and accommodates between 50 to 150 beds (Cox and Groves, 1990; Glanville and Howard, 1999). It provides medical and nursing services for patients who do not require specialist treatments but can not be treated at residential accommodation. The advantage of community hospitals is that they may achieve better economy as costs per patient-day are relatively low (NHS Estates,1992). A recent trend in the literature, policy and practice promotes the use of community hospitals rather than general hospitals. This issue is discussed later in this chapter.

A general acute hospital (or in the UK district general hospital (DGH) - HBN1 (Department of Health,1988)- a term not strictly applicable recently (Glanville and Howard, 1999)) provides continuous medical and nursing care and accommodates higher-dependency in-patients. The size of this type of hospital varies according to the population it serves and the country in which it is located. According to Glanville and Howard (1999) a general hospital may accommodate 300 to 1000 beds with optimum capacity of between 500 and 800 beds serving a population of between 100 000 and 150 000 people. However, a general hospital can serve a population ranging from 200 000 to 300 000 (James and Tatton-Brown, 1986).

Specialist hospitals focus on individual types of medical fields such as allergies or ophthalmology, illnesses such as cancers or skin problems, or groups of people such as the elderly or children. This type of hospital provides a better environment for research, training and teaching. Patients admitted to specialist hospitals tend to stay longer than those admitted to general hospitals as they require specialist treatment and continuous surveillance for prolonged periods of time. Figure 2.2 defines primary, secondary and tertiary healthcare in terms of the services they provide.

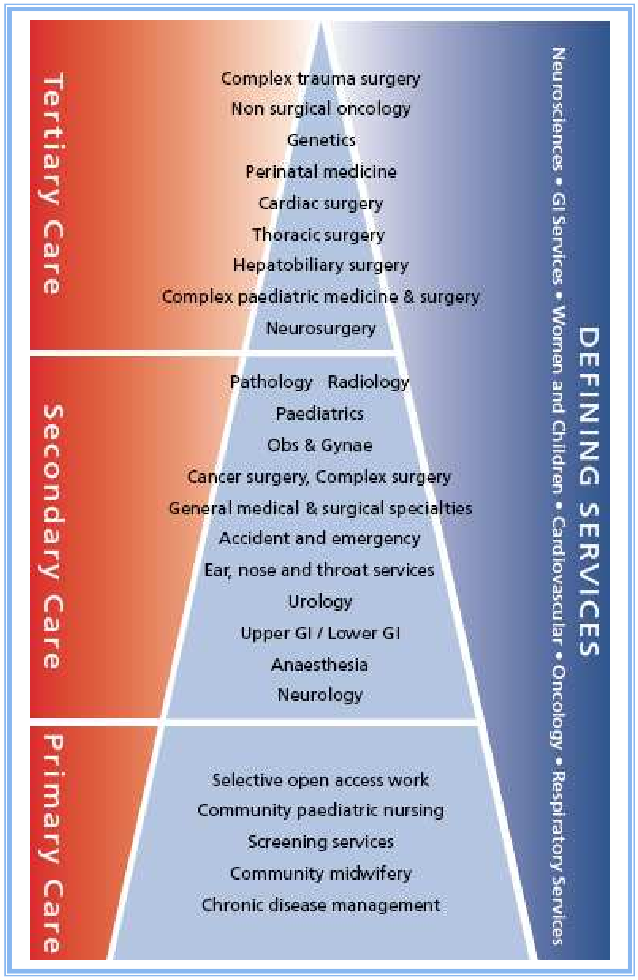

Figure 2.2- Primary, secondary and tertiary healthcare in terms of the services they provide (Southampton University Hospital NHS Trust,2007)

Figure 2.3 summarizes this section and locates hospitals within the healthcare system. This study may be relevant to both hospitals and any healthcare building that accommodates in-patient wards where patients are not extremely sick (e.g. intensive care units) and, as a consequence, are aware of their surrounding architectural environment. Studies showed that the patients who are not seriously ill are sensitive to and highly articulate about their architectural environment in hospitals (Lawson and Phiri, 2003; Hutton, 2005). Moreover, a large number of studies showed the effect of improving the architectural environment and the integration of art in hospitals on patients' recovery time and satisfaction, which reflects the importance of the architectural environment in hospitals (Ulrich, 1984; Davidson, 1994; NHS Estates,2002; Ulrich et al., 2004).

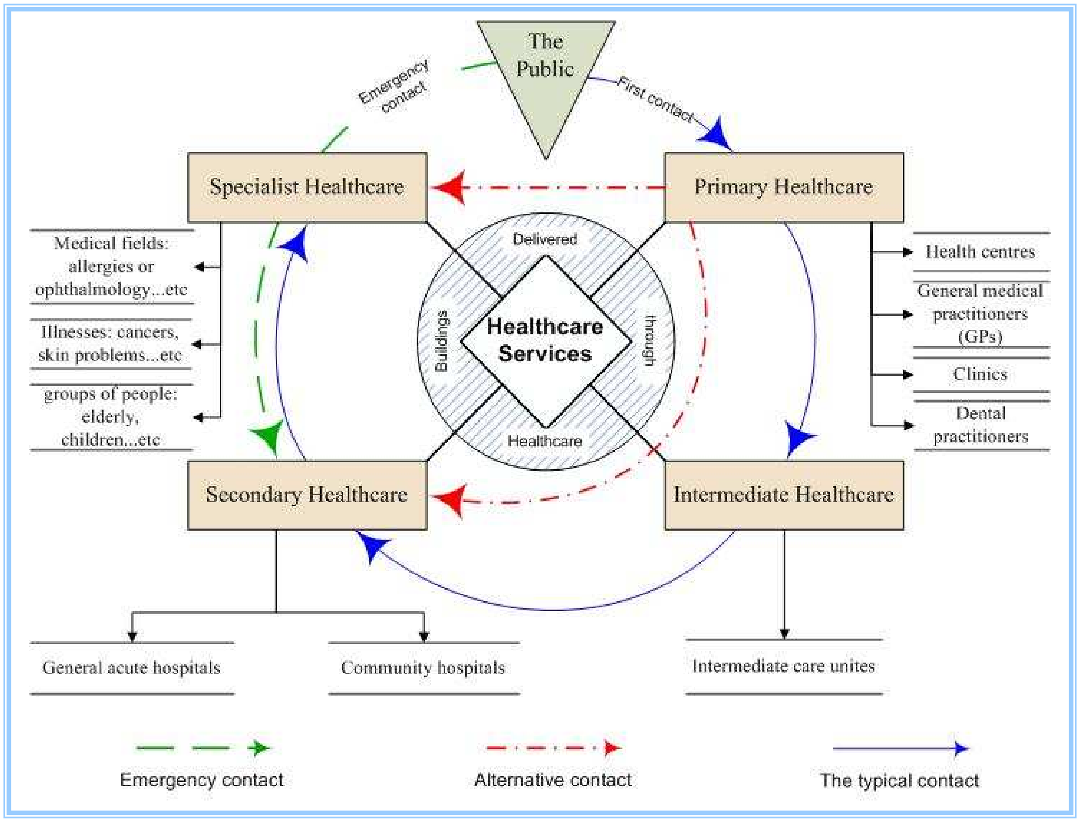

Figure 2.3- Hospitals within the healthcare system (source: the author)

The next section describes some general considerations related to general hospital architecture including its departments.

2.3 Hospital Architecture

Hospitals vary in their architecture and departments according to many factors, e.g. the population they serve, the budget and the site. However, there are common general considerations needed to be taken into account during the design process of any general hospital. Some key considerations are: its size, growth and change, ventilation and energy consumption, entrances and internal traffic, and the internal environment.

- Size: Although general hospitals can be divided into three functional areas – in-patient; diagnostic and treatment, and support – the in-patient accommodation seems to occupy as much floor area as the other departments combined, that is in-patient wards take up to about half of the floor area (Cox and Groves, 1990; Glanville and Howard, 1999). Hence, the size of a general hospital is usually specified by the number of beds. Table 2.1 provides a general estimation of bed numbers in a general hospital according to the population it serves.

Service	**No of beds per 1000 pop**	**Comments**
Acute medical and surgical	2	Assumes increasing extent of domiciliary care in community
Maternity	0.3	Depending on birthrate and no. of beds for ante-natal care
Geriatrics	1 to 1.5	On basis of 10 beds per 1000 population over 65; areas with good housing and social services manage with less
Psychiatry	0.5	Numbers required for DGH-based service
Children	0.5	Provides for all children requiring acute or long-stay care

Table 2.1 – Provision of beds in a general hospital (Source: Glanville and Howard, 1999)

- Growth and change: The history of hospital design development shows that future growth and change of hospitals is one of the main concerns in hospital design. Hospitals should be designed to have the ability to expand and change when needed as they can be affected by the development of other factors such as clinical, technical, economic, demographic and political forces. The physical change and growth of hospitals can be effected in three ways. Firstly, positive growth in which an adjacent space to the growth point is required. Secondly, negative growth in which the function of a space is changed to serve a growth function. And finally, rearrangement in space functions (Glanville and Howard, 1999).

- Ventilation and energy consumption: The ventilation policy and energy consumption are key choices in hospital design. Although the ventilation policy is affected by the climate, it has a direct effect on the building form and the running cost of the hospital. Although air-conditioning is a constant consumer of energy, certain departments require air-conditioning for functional reasons. Such departments are: operation theatres and intensive care units. Air-conditioning permits a compact building form and reduces the site required (Cox and Groves, 1990). The natural ventilation requires more site area to allow low-rise mass to form courtyards by which it is achieved. Infection spread is one of the problems when using natural ventilation, as air movement can spread the infections. On the other hand, natural ventilation has positive effects on reducing the capital cost, revenue cost and running cost of a hospital. In addition, natural ventilation improves the internal environment for patients and staff, as it allows more contact with the outside and more use of daylight than artificial ventilation, and that increases the local control (Glanville and Howard, 1999).

- Entrances and internal traffic: External entrances and internal traffic play an important role in determining departments' locations. According to security requirements the number of external entrances is usually limited. However, a general hospital may contain five external access points: accident and emergency, supply and catering, fuel, mortuary and finally the main entrance which includes patient admission, staff and visitors entry. In addition, the main entrance can contain a shop, bank and cafeteria (Glanville and Howard, 1999). The traffic within general hospital departments consists of patients, staff, visitors, beds and small items. This traffic is required to be moved directly and suitably to its destination in order to achieve a proper operation of the hospital. This traffic moves through what used to be called Hospital Street. However, it is recommended to avoid mixing between visitors and other traffic flows in the hospital. Moreover, and in order to reduce the infections, it is an advantage to ensure that the route for dirty materials is separated from patients and staff routes.

- Internal environment: The effect of the internal environment on the healing process of patients has been an interesting area to be investigated by architects and environmental psychologists (Devlin and Arneill, 2003). A number of studies have found that improving the internal environment in hospitals has a positive effect on patients' recovery (Ulrich, 1984; Davidson, 1994; NHS Estates, 1994). NHS Estates has published a document to foster improving the patient experience by using visual arts (NHS Estates, 2002). The use of art in hospitals reduces the stress of the patient, staff and visitors (Staricoff and Lelchuk, 2001). Moreover, promoting the internal environment by using the appropriate colours and lighting in different departments positively affects recovery rates and staff morale (Dalke et al., 2006). However, improving the internal environment requires meeting patients' expectation of privacy and dignity. Patients' privacy is a key feature in designing the internal environment of hospitals (NHS Estates, 1997). Increasing privacy and dignity of patients in health care buildings is one of the major schemes included in The NHS Plan 2000 (NHS Estates, 2005). In addition, patients' privacy is related to patient-central care (Devlin and Arneill, 2003), which represents a current and future trend in hospital design. This issue is discussed in more detail later in this chapter.

As mentioned earlier, general hospitals are varied in their departments but in general they are classified in three main zones: in-patient zone, diagnostic and treatment zone, and support zone (Glanville and Howard, 1999). The in-patient zone is the area of the hospital in which patients are fostered throughout their stay in the hospital while the support zone accommodates all the supporting services necessary for running the hospital. Each one of these zones contains several departments and services. Table 2.2 shows the contents of a general hospital of 600 beds. However, Neufert and Neufert (2006) suggested a more detailed classification of hospital departments: operational areas of care provision, examination and treatment, supply and disposal, administration and technology, residential areas, teaching and research and service operations.

The in-patient zone has a direct effect on the healing process of patients, because it is the place where the patient is accommodated to receive medical treatment, be prepared for surgery or recover after treatment. It is the place where patients spend most of their time during their stay in a hospital. As a consequence, the patient zone seems to be one of the most important zones in hospitals.

This zone consists mainly of wards for different specialties. The base unit of the ward is the patient bed. Beds in a ward can be located in a single-bed room or a multi-bed room. Hence, a ward probably contains single-bed rooms, multi-bed rooms and the services required, depending on the type of ward. However, some wards can contain only single-bed rooms or only multi-bed rooms. The area required for a ward is based on the area required for a single bed, and it can be calculated by summing the area required for the bed, the services area per bed and the circulation area per bed.

	Department	Size	Area (m^2)	Location	Relationship	Notes
A	**In-patient services**					
1	Adult acute wards	400 beds	9500	Level not important	Surgical beds to theatres	
2	Children's wards	75 beds	2800	Preferably Ground floor	Isolation unit; theatre Includes parents overnight stay	
3	Geriatric wards	80 beds	2200	Preferably Ground floor	Geriatric day hospital Rehabilitation	
4	Intensive therapy unite	8 beds	500	Level not important	Accident dept; theatres	
5	Maternity department					
	Wards	75 beds	2200		Delivery suite	
	Delivery suite		1700	Level not important	Wards, theatres SCBU	All dept area
	Special care baby unit	20 cots	450		Delivery suite	
6	Psychiatric department					
	Wards	100 beds	2700			
	Day hospital	120 places	2000			
7	Isolation ward	20 beds	800	Level not important	Children's dept	
B	**Diagnosis and treatment**					
8	Operating department			Level not important	Surgical beds; accident dept	Special ventilation needs. include refrigeration
9	X-ray department			Usually ground floor	Accident dept; fracture clinic	Special ceiling heights and heavy equipment
10	Radiotherapy			Level not important	X-ray dept	
11	Pathology department			Level not important	Radio isotopes, out-patient dept	Special attention to ventilation of anxious fumes
12	Mortuary and post-mortem			Level not important	Morbid anatomy	Special attention to ventilation of post-mortem area
13	Rehabilitation			Ground floor	Medical and geriatric beds	Includes physiotherapy gymnasium, hydrotherapy pool and occupational therapy
14	Accident and emergency			Usually ground floor	X-ray dept, fracture clinic, intensive therapy unit	Relationships assume no separate X-ray or theatres in accident department
15	Out-patient department: fracture clinic, ante-natal, dental, clinical measurement, ears, nose and throat, eyes, children's out-patient and comprehensive assessment			Main reception and waiting area usually ground floor but part may be on other level	Fracture clinic to accident dept, convenient access to pharmacy, good access to medical record dept	
16	Geriatric day hospital			Usually ground floor	Geriatric wards, rehabilitation dept	
17	Adult day ward			Level not important	Theatres, X-ray, pathology	Includes additional space for 'sitting' cases
C	**Support services**					
18	Paramedical					
	Pharmacy		800	Usually ground floor	OPD. Hospital	

					supply routes	
	Sterile supply department		500	Usually ground floor	Hospital supply routs, operating dept	Special ventilation needs, wild heat problem
	Medical illustration		150	Level not important		
	Anaesthetics department		200	Level not important	Theatres, intensive therapy	
19	Non-clinical					
	Kitchens	1500 meal	1200	May be ground floor	Hospital supply routs and bed areas served – dining room servery	
	Dining room	770 meal	700	Level not important	Access from kitchen to servery, good staff access from whole hospital	
	Stores		700	Usually ground floor	Hospital supply routs	Special height may be needed for mechanical handling
	Laundry		900	Ground floor	Hospital supply routs	
	Boiler house-fuel storage		500	Usually ground floor	Work and transport dept	
	Works-transport department		650	Usually ground floor	Boiler house	
	Administration		800	Level not important		Includes telephone exchange
	Main Entrance		200	Usually ground floor	In-patient reception area or medical record main hospital horizontal and vertical communication	Also includes facilities such as bank, shop, etc.
	Medical record		700	Usually ground floor	Main entrance. OPD. Hospital communication routes	
20	Staff					
	Education centre		1800	Level not important		
	Non-resident staff changing		800	Level not important	Hospital supply route for clean and dirty linen	
	Occupational health services		200	Level not important		May be on OPD complex
21	Miscellaneous: car park, garages, medical gas installation, flammable stores, recreational buildings					

Table 2.2 – Contents of a general hospital of 600 beds (Source: Glanville and Howard, 1999)

Wards occupy about half of the total area of a hospital. They are still generally the largest single element, and the one that causes most public interest (Dixon et al., 2002). In addition, NHS Estates carried out a comparison study between six different wards in six different hospitals in the UK. The study revealed that the total beds area (bed area + support area per bed + circulation area per bed) occupies a range between 55.97 % and 44.85 % of the total area of a hospital with mean of 53.59 % (NHS Estates, 1997).

To sum up, hospital wards seem to have a crucial effect on hospital design in terms of the size they occupy and the effect they have on patients. Hence, the following section attempts to understand the '*ward concept'* and the associated considerations.

2.4 The Ward Concept

> *''The healthful environment it provides for patients, the amount of privacy it allows patients, the extent to which it exercises supervision and control over patients, and the efficiency with which it can be operated. These we call the four element of ward design.''* (Thompson and Goldin, 1975, page xxviii)

The hospital ward is the section of a hospital where 20 to 36 in-patient beds are gathered for easy and efficient management. Each ward is catered for by a team of trained nurses under the leadership of a charge nurse. Patients receive the care they need from this team (feeding, sleeping, using toilet or bed pan, cleaning, etc.). Goods are supplied to the ward as well as wheelchairs and walking frames. In addition, this team is responsible for monitoring the patients 24 hours a day. Doctors visit the patients in wards daily, as well as other staff when the treatment (such as such as physiotherapy) requires it. However, more complex diagnostic and treatment may require taking the patient to other departments. The type of ward depends on the type of patient it serves. In a general hospital several types of ward can be found such as: an adult acute ward either medical or surgical, children's ward, a ward for elderly people and an intensive therapy unit. However, it is recommended that all types of ward share common standards and pattern in order to allow change in use when needed. The adult acute ward accommodates about half to three quarter of the total number of beds in a whole hospital (Clarke, 2008).

In order to allow the ward to achieve its function, some relationships between the activities in the wards are required. These activities and the relationships between them are shown in Figure 2.4.

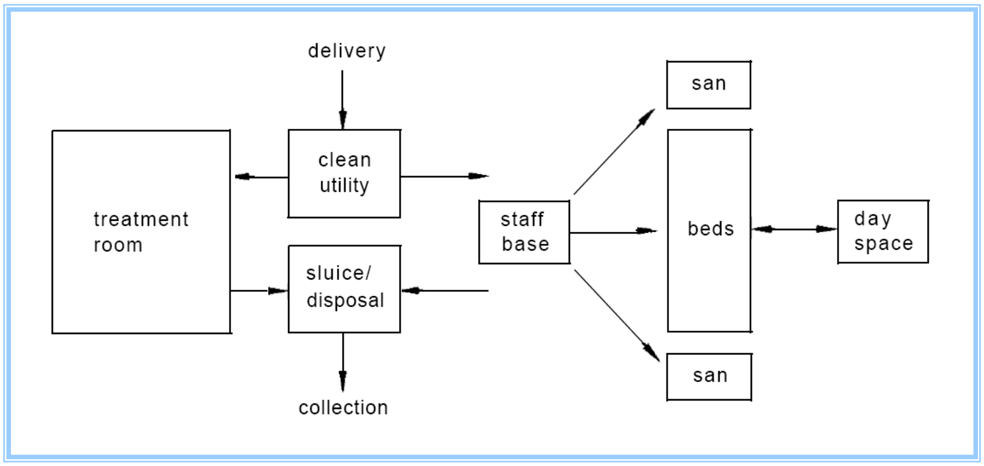

Figure 2.4 – Relationship diagram of care ward activities (Source: Glanville and Howard, 1999)

In addition, some requirements in the ward's layout need to be satisfied such as: nurses' observation, proximity to sanitary facilities, infection protection, restful atmosphere and patients' privacy (Glanville and Howard, 1999). Patients' privacy is one of the essential requirements as a ward design criterion that achieves better patient satisfaction and control of the environment, which in turn reflects on the healing process.

2.4.1 Ward layouts

Activities carried out in hospital wards can be grouped in three spaces: patient space, nurses' base and staff space. The way in which these spaces are arranged formulates the type of ward layout.

Patient space may contain single-bed rooms, multi-bed rooms or both. In Scandinavia the preference is for single-bed rooms, in USA for two-bed rooms and in the UK until recently for 4 to 6-bed bays (James and Tatton-Brown, 1986). However, the provision of single-bed rooms and multi-bed bays is the subject of a wide debate which is detailed in the following section of this chapter. In addition, a day space is required in wards and a toilet and shower should be provided for each bay.

The nurses' base is a very important element in the ward's environment, as it should allow nurses to monitor the largest possible number of patients. Hence, it is recommended to be central in the ward to act as an organisational hub to the ward. On the other hand, the staff space contains nurses' room, doctors' room, treatment room, clean utility, dirty utility and other rooms which are usually used by staff.

The types of hospital wards can be classified according to the arrangement of these three spaces together within the ward. (James and Tatton-Brown, 1986) classified the ward types into seven types. Each type is split into simple and complex forms. These types are: simple open or Nightingale form, corridor or continental form, duplex or Nuffield form for greater amenity for patient and staff, racetrack or double corridor form to achieve more compactness, courtyard form which achieves better natural ventilation, cruciform or cluster for better observation and finally the radial form to reduce staff travel distance. Figure 2.5 illustrates ward layouts or forms.

This discussion is related to the advantages and disadvantages of the use of single-bed rooms and multi-bed bays for patients in acute care, which we turn to next.

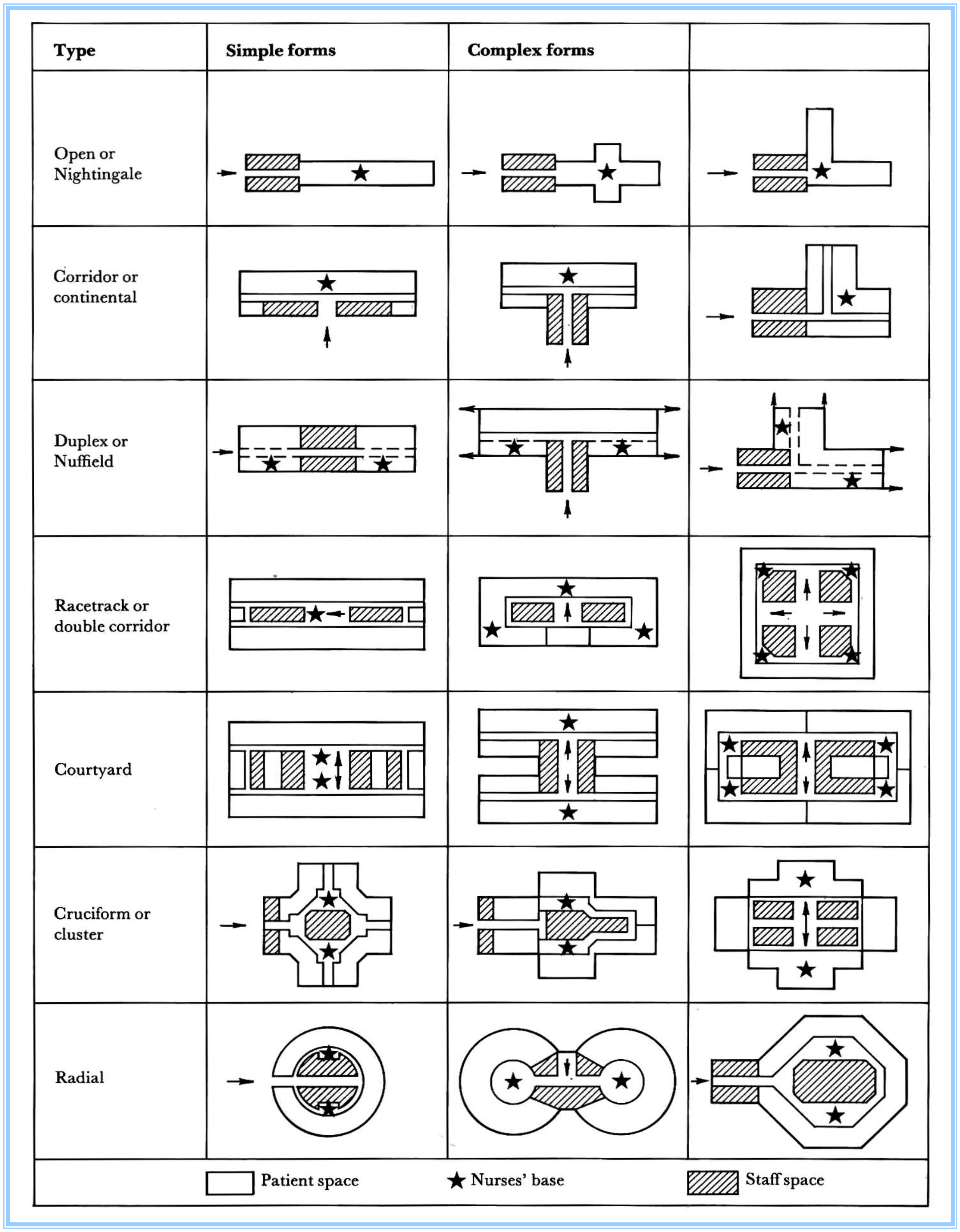

Figure 2.5–Ward layouts (Source: James and Tatton-Brown, 1986)

2.4.2 Single-bed rooms and multi-bed bays

Patients' privacy in multi-bed bays is subject to being violated, which negatively affects patients' experience and satisfaction in hospital settings (Harris et al., 2002; Ulrich et al., 2004). Hence, the call towards the provision of more single-bed rooms is frequently supported by the claim of providing a better level of patients' privacy.

The use of single-bed rooms versus multiple occupancy rooms in acute care environments has been the subject of long-standing debate in both academia and practice. This started with the emphasis on the importance of the provision of good nurses' observation at the expense of patients' privacy, which was illustrated in Nightingale wards, the ward type that was dominant in Britain from 1861 to the start of the Word War II (Thompson and Goldin, 1975). Later, however, the debate has been extended to include a wider range of issues such as infection control, staff travel distance, social space for patient, space for family members, therapeutic environments, patients' privacy, patients' satisfaction, patients' preferences, noise level, construction cost, operating cost and falls in hospitals.

A massive number of studies can be found in the literature on this topic. For example, Chaudhury et al (2005) have reviewed and analysed 222 articles which address different aspect of advantages and disadvantages of the use of single and multi-bed rooms. They categorized the articles into three types according to issues: first and operating cost (33 articles); design and therapeutic impact (158 articles); and disease control and fall prevention (31 articles). Each category was split into empirical and non-empirical articles. The results of their review and analysis of the related literature are shown in Table 2.3. They concluded that the literature generally suggests single-bed rooms as a trend in hospital design. This was supported later by several publications, one of which was *Ward layouts with single rooms and space for flexibility* (NHS Estates, 2005). This particular report is the result of a three-year programme of research by NHS Estates which found that there is a need to increase the provision of single-bed rooms in acute hospitals for the benefits they provide for patients, clinicians and NHS Trust. One of these benefits was a better level of patient privacy (NHS Estates, 2005).

However, a more recent systematic review of the literature related to the impact of the use of single-bed rooms on patient outcomes showed that the evidence is scarce, as most of the identified articles are opinion-articles in which the author '*expected*' effects of single-bed rooms by reasoning instead of evidence (Glind et al., 2007). This article was limited to six outcome measures: privacy and dignity of patients; noise and quality of sleep; patient satisfaction with care; hospital infection rates of MRSA; patient safety: fall accidents, medication errors; patient recovery rates; and complications and length of stay. The results suggested that more research is needed to explore the impact of single-bed rooms on patients, staff and management before policymaking can benefit from the knowledge of positive and negative effects of single-bed rooms.

Category	Issues and Findings	Single-Occupancy Room	Multi-Occupancy Room
Cost	Operating costs	↓	inconclusive
	First costs	↑	↓
	Occupancy rates	↑	↓
	Length of stay	↓	↑
	Medication errors & costs	↓	↑
Infection Control & Falls	Rate of nosocomial infection	↓	-
	Patient transfers	↓	-
	Patient length of stay	↓	↑
	Infection in burn patients	↓	-
	Infection when patients are transferred	-	↑
	HCV transmission between patients	↓	-
	Transmission of hospital-acquired diarrhoea	↓	↑
	Falls in patients requiring supervision	↑	↓
	Falls in elderly when previsions are taken	↓	↓
	Access to bathrooms	-	↓
Hospital design & Therapeutic Impact	Privacy	↑	↓
	Pain medication	inconclusive	inconclusive
	Patient consultation with physician	inconclusive	inconclusive
	Patient preference for room design	inconclusive	inconclusive
	Noise level	↓	↑
	Sleep disturbance	↓	↑
	Acuity-Adaptable rooms	inconclusive	-
	Patient satisfaction	↑	↓
	Patient control	↑	↓
	Crowding	↑	↑
	Stress reduction through music	↑	↓
	Benefit of roommates	-	inconclusive
↑ = Higher ↓ = Lower			

Table 2.3 – Single vs. multiple occupancy rooms based on the literature review (Chaudhury et al., 2003)

In terms of patients' preferences for single-bed rooms versus multi-bed rooms, mixed results were reported. For example, most of the patients who stayed in a hospice in Leeds, England, showed preference for single-bed rooms because of the better level of privacy, among other reasons, offered by this type of rooms (Kirk, 2002). In another study, 818 people in the UK were asked about their preferences for accommodation type in hospitals in a telephone survey carried out by British Market Research Bureau (BMRP) International. Most of the sample expressed their preferences for single-bed rooms. This was then followed by another survey with 823 people, most of whom would want a single-bed room for an overnight stay. Participants indicated that privacy is the most important reason for this preference (Phiri, 2004). According to Chaudhury et al’s (2006) study this is consistent with nurses’ preference. In their exploratory study they found that the majority of the sample they interviewed (77 nursing staff) favoured single-bed rooms over double-bed rooms for the majority of the 15 categories examined including patients’ privacy.

On the other hand, some studies found that multi-bed bays were preferred over single-bed rooms by patients. In a study by Pease and Finlay (2002) most of the oncology patients who were interviewed favoured four-bed bays. The main reason for this preference was their desire to be accompanied by others and avoid isolation. In a later study, Lawson and Phiri (2003) conducted a special study as a part of a wider scale study to investigate patients’ preference for single- or multi-bed rooms. They interviewed 473 patients at Poole General Hospital in the UK. Of these 106 (22%) were moved to a new accommodation which was opened during their stay. They found that 54% of the patients expressed a preference for multi-bed rooms, 43% preferred single-bed room and the rest did not express any preferences. The main reasons for this preference were similar to that of the previous study: having someone to talk with and avoiding being alone. However, they noticed that most of the patients who did not change their accommodation type during their move to the new accommodation expressed a preference for this type, either single- or multi-bed rooms, and most of the patients (76%) were in multi-bed bays. They concluded that there are a significant number of people who preferred to be in multi-bed bays. In addition, they found that patients who were accommodated in the type of wards they prefer felt that they have greater control over their environment, and as a consequence are more satisfied, than those who would have preferred the other type of wards.

One other aspect worth consideration here is the space requirements for each type of accommodation and the associated overall area. NHS Estates (2005) carried out an extensive study to establish clear evidence for the minimum space required around the bed based on earlier publication (NHS Estates, 1997) in which the categories of direct activities that take place around the bed were determined as: clinical treatment and care, personal care and maintenance and support activities. These activities take place in five zones around the bedside either in a single or multi-bed room: core bed space, bed-head services, sanitary facilities, clinical support and family support. The results of the former study were used in Health Building Note 04-01: Adult In-patient Facilities (Department of Health, 2008).

They found that a minimum clear space of 3.6 m width * 3.7 m depth for each in-patient bed is needed. This space is adequate to accommodate most activities at the bedside, including the use of equipment and the manoeuvring of wheelchairs and mobile hoists. However, this space does not include space for storage and clinical support. This space allowance was then applied to single-bed rooms and 4-bed bays.

They found that the area of the ideal single-bed room is 23.5 m². That is 3.6*3.7 m² clear space with 4.5 m² for the toilet and shower and up to 3 m² for clinical and storage facilities as shown in Figure 2.6.

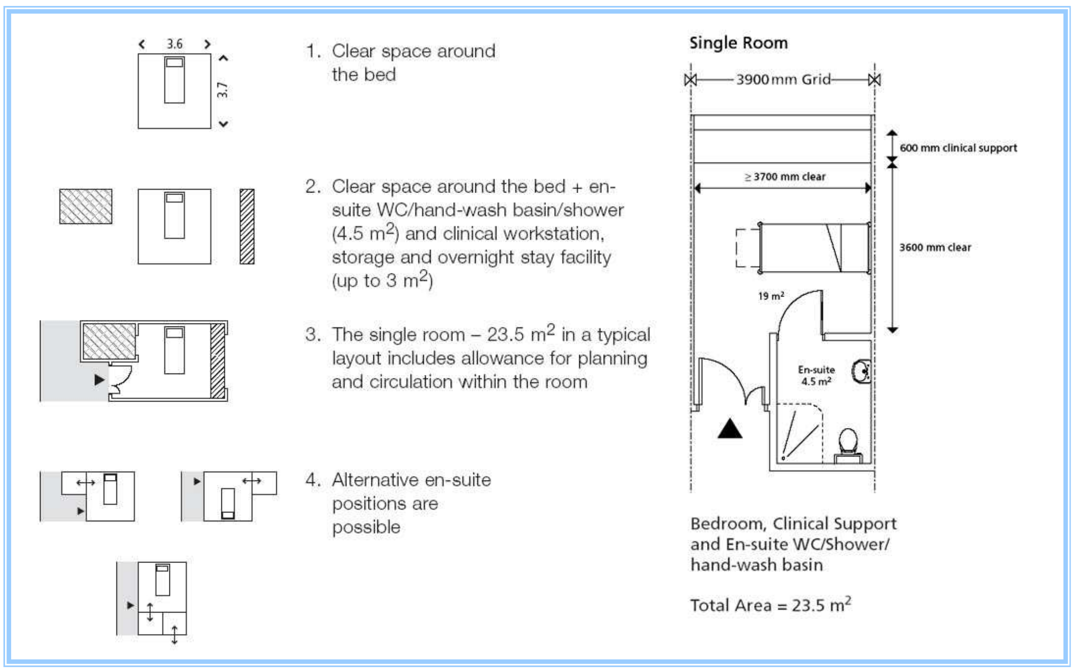

Figure 2.6 - The recommended space allowance for a single-bed room (Source: NHS estates, 2005)

When applying the proposed minimum clear space for beds to a four-bed room and adding the area required for sanitary services and clinical and storage facilities for each bed, the total area exceeded 93.5 m². Then, they preserved the minimum clear space around the bed and overlapped the clear space with access circulation. The resulting room has an area of 70 m² as shown in Figure 2.7.

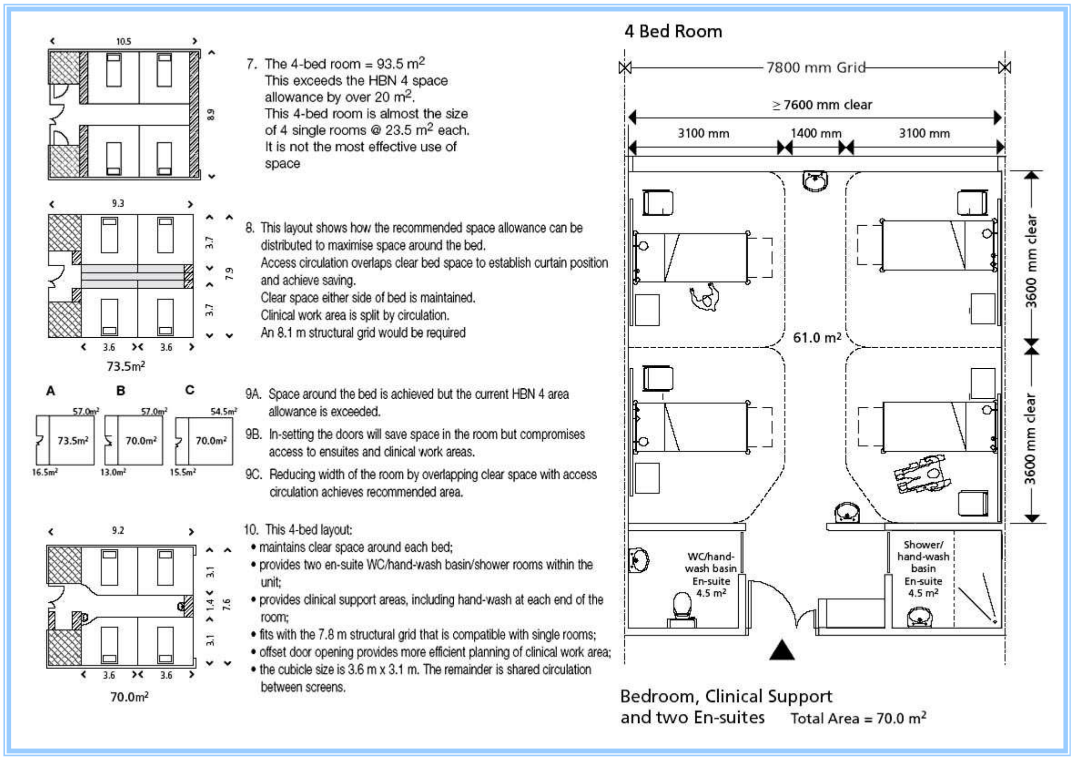

Figure 2.7 - The recommended space allowance for a four-bed bay (Source: NHS estates, 2005)

Then these were used to design several scenarios of wards which were compared later to each other. They concluded that the space required for 50% single/50% four-bed rooms can accommodate 100% single rooms with a minor modification to the schedule of accommodation; and the cost per bed of 100% single rooms accommodated within the 50% single room space allowance is negligibly higher.

To sum up, in spite of the inconsistency in the literature on the topic of single-bed rooms versus multi-bed bays, the provision of single-bed rooms seems to be considered essential but without eliminating the provision of multi-bed bays. According to Clarke (2008, page 25-3), *'The drive towards 100% single rooms is laudable but not universally agreed upon as an objective. Current good practice is inclined to the provision of 75% single rooms with four-bed bays providing the balance'*. The potential of violation of patients' privacy in multi-bed bays negatively affects patients' experience and satisfaction in hospital settings (Harris et al., 2002; Ulrich et al., 2004). Hence, providing a better level of patients' privacy has been frequently seen as one of the main reasons for the trend towards single-bed rooms.

Following the sequence by which hospital design in a country like the UK has been developed with a particular focus on ward design, provides an insight into the trends in this field within which patients' privacy can be located. This is discussed in the following section.

2.5 Hospital Design Development in the UK

Hospital design reflects social needs and attitudes towards welfare, design ideas and architectural trends of its time. Nevertheless, it can be influenced by political, technical, medical and financial factors. Accordingly, hospital design in the UK has been developed in many stages. These stages, however, can be categorized in two main periods: Victorian and Modern. The Second World War seems to provide the turning point from Victorian hospitals to modern ones. The adoption of Modernism is linked to the consolidation of the welfare state, with government having a strong role in planning (New Towns), housing and education during the post-war years. Government financed huge house-building and school-building (as well as hospital-building) programmes using in-house architects from the new generation who had Modern ideals. Within this context the National Health Service (NHS) was established in 1947 to lead the development of hospital design in the UK as a part of restructuring the country after the war.

Before the Second World War almost all of the hospitals in the UK were Victorian hospitals. These hospitals used to cater for only small proportion of the population and they accommodated outdated clinics compared with today's clinics. The architects of the Victorian hospitals probably were interested in the outer appearance of the hospitals more that the internal plan and room functions which are reflected nowadays on hospital forms (Monk, 2004). The Royal Commission on the Historical Monument of England found 2000 Victorian hospitals. Some of these hospitals have been restored for their historical and external appearance importance (Richardson, 1998).

Almost all wards of that period were Nightingale wards. This type of ward consists of one large room without subdivisions between patients and contains about 24 to 34 beds usually arranged along the sides of the ward. This type of ward allows maximum nursing supervision at the expense of patients' privacy. Although this type of ward was the dominant accommodation for 80 years (1861-1941) in the UK, it was changed slightly as a response to those who recognized the importance of privacy for patients and the medical requirements. The first hospital of this type was built without a single isolation room (Herbert Hospital – 1864). Later hospitals accommodated some single-occupancy rooms and utility rooms (e.g. Thomas's Hospital – 1871). However, these rooms were provided for medical reasons (e.g. contagious patients) or for wealthy people (Thompson and Goldin, 1975).

After the Second World War, the NHS was established to develop health care in the UK. The notion behind the NHS was to offer health care for all, even for those who can not afford it, and to develop the aspects of health care, one of which is hospital design. After controlling and administering the existing hospitals, NHS started to undertake research. During the 1960s the remarkable published series of *Hospital Building Notes (HBN)* contained the results of the research carried out by the Hospital Building Division. Hospital design in this stage was affected by the developments in medical treatment which created the need for specialized accommodations and the 'Form Follows Function' architectural principle (Llewellyn-Davis, 1955). Greenwich, Best Buy, Harness and Nucleus are four benchmarks in hospital design development in the UK.

Greenwich hospital was planned in 1963. It contains 800 beds and serves 165,000 people. The hospital was planned as a simple rectangular shape on three clinical floors separated from one another by a service floor. The hospital street was rectangular and surrounded by wards. On the other hand, the diagnostic, treatment and supply departments form the core of each floor within the rectangle of the hospital street with three courtyards. The horizontal circulation of the hospital and the location of the specialist departments facilitated the movement from one department to another and to the wards as shown in Figure 2.8. One of the main negative aspects associated with this design was the huge amount of expense due to the air conditioning and its limited ability to be expand due to the location of the specialised departments (Cox and Groves, 1990).

Figure 2.8 - Greenwich District Hospital 1968. Adopted from (Thompson and Goldin, 1975)

Although many ideas were tested by this pioneer project (e.g. hospital street for horizontal circulation to service the bed area and low rise forms), none of these focused on patients' needs in ward design. Hence, this type has not been seen either as patient-focused or as supportive of patients' well-being (Francis et al., 1999). Greenwich hospital included six-, five- and one-bed rooms run around the periphery of the hospital. However, there were some attempts to address the issue of patients' privacy at that time. An experimental ward was designed in 1956 according to the principles set by the Nuffield Trust as a result of the intensive research they carried out, one aim of which was reconciling the claims of privacy and supervision (Thompson and Goldin, 1975). This ward was attached to Larkfield hospital in Greenock and shown in Figure 2.9.

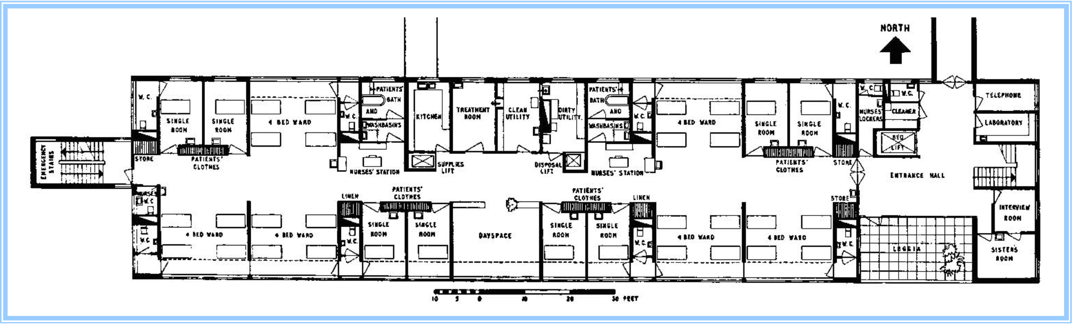

Figure 2.9 - Experimental ward, Larkfield Hospital, Scotland, 1956 (Thompson and Goldin, 1975)

After recognizing the increasing cost of running hospitals because of the increasing prices of fossil fuel, which is the main source of energy in hospitals, the number of beds per 1000 person was reduced (from 3 to 2). Consequently, the number of beds in the anticipated general hospitals became 550 instead of 800 beds. In addition, hospitals were planned according to standard designs in an attempt to reduce the running cost. Best Buy standard and Harness standard hospitals appeared as a response to these demands.

The Best Buy standard hospital was introduced in 1967. It was a simplified version of Greenwich to overcome the problem of the running cost and provide best value for money (Francis et al., 1999). The Best Buy standard hospital consists of two floors based on horizontal circulation in a rectangular street surrounding the central location in which the diagnostic and treatment departments are located and ventilated by internal courtyards. Wards in these hospitals are located in three outer sides of the street and separated from the street by courtyards. The fourth side of the street is occupied by the supply unit (Cox and Groves, 1990). In spite of the hope that this model could be used widely, only a few Best Buy hospitals were built due to the open flat sites required for such a model (Francis et al., 1999). The focus in this stage was, as mentioned earlier, on the reduction of energy consumption rather than any other aspect of hospital design.

In 1969 the Hospital Building Division developed the Harness model to combine the hospital policy with the best ideas at that time in environmental services requirements, standard building technology; and modular coordination. One key issue was ability of the hospital to be expanded on the one hand and the human scale in designing the modular coordination which is sensitive to patient-oriented requirements on the other (Monk, 2004).

This system was based on a standard operational policy by which a standard unit for most of the department was designed. The units varied in size but all were based on a 15 metre overall grid. These units can be arranged in different ways and up to four storeys in height. The Harness system was developed to be applied in a wide range of locations, and that made it a more flexible system than the standard Best Buy hospitals. Each department, including the accommodation units, was linked to a major hospital communication route which was also the distribution route for electrical and mechanical services. This way of assembling the units allowed courtyards to be formed which provided natural light and ventilation to all units (Cox and Groves, 1990). Seventy hospitals were designed on the Harness system but only two hospitals were built as a consequence of the economic recession which followed the oil crisis in 1973 (Francis et al., 1999).

The impact of the oil crisis increased the demand for greater economy in the capital and running cost of hospitals. As a response to this demand, the Nucleus system, which was a developed version of Harness, was introduced in 1975, Figure 4.10 illustrates a Nucleus template plan. This system was based on a basic template or cluster which contains a ward, department or combination of smaller departments. All clusters were placed side to side and linked by a central linear street. This gave the system the ability to expand linearly and vertically up to three storeys. Light and ventilation of all clusters were essentially naturally provided by the courtyards resulting from gathering the cruciform clusters side to side. The support service department can be designed according to the requirements and linking to the street at an appropriate point, or it can be a standard cluster connected to the free end of the street after elongating it (Cox and Groves, 1990). The estimated reduction in the running cost of this system was 50% to 60% compared with other systems (Monk, 2004). One of the main limitations associated with this system is the reduction in space provision even to below the standard in some cases. This was because of the need to fit all departments in the 1000 m^2 template. In spite of different viewpoints regarding the success that the Nucleus hospital has achieved over other systems and the vast development in healthcare facilities, many hospitals were built later (in the 80s and 90s) based on this system (Francis et al., 1999).

Although new ideas were introduced and earlier ideas were emphasized in the 1990s and 2000s such as therapeutic environments, design quality and patient-central care, the main focus was on the process rather than the product. This was done by introducing the Private Finance Initiative (PFI) which encouraged public and private partnerships. The PFI procurement process seems to limit the development in hospital design because of its urgency and financial constrain, which allow little time for investigating issues like patient-central need and architectural environmental quality (Monk, 2004).

In summary, the establishment of the NHS after World War II was a turning point in hospital, and indeed in other healthcare facilities, design development in the UK. Many trends were introduced and tested and many research schemes were carried out. The importance of patients' privacy was recognized from the early stages of this rapid development and always associated with supervision. However, priority was given to other issues such as form and function, low and high rise buildings and standard systems which were listed under the umbrella of capital and running cost reduction. Subsequently, attention was given to the construction process. Recently new trends and demands are introduced into the field of hospital design. These are discussed in the following section.

2.6 Recent Trends and Demands in Hospital Design

Recent trends in hospital design have been driven mainly by two ways of thinking. First, there is criticism of the 'Form Follows Function' principle as a method of design. Meeting the functional requirements is unquestionable but it should not be the only feature by which form is determined. More complete and responsive approaches need to be integrated in the design of hospitals and indeed other types of healthcare buildings. Second, attention needs to be given to the experience and emotional needs of individuals as a method of achieving better hospitals (Francis et al., 1999). These two ideas established a fundamental shift in the way in which hospital design is seen and evaluated. Interestingly, they share a similar approach to the design of hospitals. The emphasis here is on the interaction between people and space and the impact that the physical environment has on the well-being of patients. Prince Charles wrote in the foreword of the '*Better Health Buildings*' report:

> '*In recent decades we have become extremely skilful at treating the sick, aided by increasingly sophisticated clinical and medicinal advances, but there is now a need to become equally adept at creating built environments which are more conducive to the healing process. Achieving such a healing environment has, I believe, much to do with the care taken in designing and building the facility itself - both internally and externally to help to create what I might call buildings with a 'soul'.* Prince Charles (Centre for Healthcare Design, 2002).

Consequently, many studies were carried out and several reports were published. Some ideas introduced were new and others were re-invented. The following is a summary of the main trends and demands within this context.

2.6.1 Healthcare closer to home

There is a trend towards delivering healthcare services closer to home. This was introduced in a blueprint called '2020 Vision: our future healthcare environment' (MARU, 2001). This report summarized the results of a research project carried out by the Medical Architectural Research Unit and aimed at identifying the social, economic and technological developments in relation to the design of the future healthcare environments (MARU, 2001). Four major changes that may have a direct influence on the provision and design of healthcare services in the UK were identified: the rapid development in the information and medical technology; the increasingly aging population; citizens becoming more informed about healthcare choices and decisions; and modernisation of the health and construction industries. As a response to these influences, they found that healthcare environments need to be changed in a way by which care can be cascaded out of general hospitals into settings nearer to people. Consequently, four potential settings were proposed: home; health and social care centres; community care centres and specialist care centres.

This was supported later by several publications and conferences. For example, 54% of participants at the 2006 Citizen's Summit on 'Your Health, Your Care, Your Say' supported providing services more locally (Opinion Leader Research, 2006); and the 2006 White Paper 'Our health, our care, our say: a new direction for community services' promoted a shift of care into community settings (Department of Health, 2006). In addition, the Community Healthcare Design conference which was held in September 2007 in London supported the provision of more local healthcare services in community-based settings.

Although the above recommends a shift from large general hospitals to smaller community hospitals, it does not seem to affect significantly the design of hospital wards nor the privacy required in these wards.

2.6.2 Patient first approach

The aim of this trend is to develop hospital designs that respond to patients' preferences, expectations and needs. It deals with patients as individuals whose values and preferences can contribute to their well-being. The importance of respecting patients' choice and preference was emphasised in the Department of Health report 'Creating a patient-led NHS' (Department of Health, 2005). In spite of the fact that many ideas which were presented in this context seem to interact with each other, they can be distinguished. Patient-focused care, patient-centred care and patient-friendly care are three ideas that are related to the physical environment.

Patient-focused care is an operational management approach introduced by Booz Allen and Hamilton (1990) in the USA. It attempts to improve patients' satisfaction and experience, and reduce staff cost by providing all patients' clinical needs locally within hospital settings by a multi-skilled team. This can be done by decentralizing the different departments (e.g. diagnostic and treatment) to increase the local independency which may result in patients being transferred less often between departments. Consequently, the opportunity for the violation of patients' privacy can be reduced and patients' experience can be improved (Francis et al., 1999). This approach was reviewed by NHS Estates in *Health Facilities Note 01: Design for patient-focused care* (NHS Estates, 1993).

Patient-centred care has a wider scope. It aims at aligning the national health system with the needs, expectations and preferences of patients. It looks at patients as individuals, each with his/her own values and feelings, rather than as ‘ill bodies’. This requires improving patients’ access to treatment and information; informing them about their condition; and enabling them to share responsibility for decision-making about their healthcare and policy-making (Mead and Bower, 2002). Additionally, the design should be adapted to facilitate the implementation of new ideas such as improving patients’ access to family support rather than the traditional nursing care (Francis et al., 1999). This concept has spread widely and many terms have been used. For example, O’Flynna and Britten (2006) described a patient-as-person approach in which practitioners engage in a conversation with patients to elicit his/her ideas and concerns regarding his/her health in order to share the responsibility in decision-making, and compared this to the conventional biomedical approach in primary care settings. In another study, Duggan et al (2006) have examined the moral commitments that underlie the concept of patient-centeredness. They found different ethical theories related to the examined concept; all of these theories agreed that this concept is morally valuable.

The patient-friendly care approach aims at providing buildings and services that are intelligible and easy to use by patients. This concerns the balance between the environmental enhancements within which the service is provided, which may conducive to patients’ well-being, and the extent to which this service in understandable and easy to use by patients (NHS Estates, 1993).

2.6.3 Healing environments

Patients spend most of the time during their stay in hospital in wards with little to do, which makes them more sensitive to their surroundings. Lawson and Phiri (2003) in their study found that patients are aware of, and articulate about, their architectural environment in hospitals. This suggests that the environment of the ward may have a direct impact on patients’ well-being. Research has shown that patients’ satisfaction is increased when the environment is pleasant, comfortable and relaxing (Baker and Lamb, 1992). According to Shumaker and Pequegnat (1989) sources of patient stress in hospital settings are lack of control, lack of privacy, noise and crowding. In addition, natural light, elements of nature, calming colours, art works, pleasant sounds and the ability of the patient to control his/her environment enhances positive patient outcomes (NHS Estates, 1997; Murphy, 2000; Stichler, 2001). According to Professor Roger Ulrich, the main speaker in the workshop organized by NHS Estates in 2003 to explore the patient's environment, there are between 125-140 published peer-reviewed scientific studies on the link between hospital design and health outcomes. Most of them conclude that improving the environmental features in hospitals can positively affect health outcomes (NHS Estates, 2003). This issue has been studied by scientists, psychologists and designers (Francis et al., 1999). In Health Building Note 4 the key features of a desirable environment of in-patient wards were summarized. Table 2.4 shows these features.

Space for	
	clinical activity at the bedside
	clinical activity elsewhere
	storage/display of patients' possessions
	storage of bulky equipment
	staff support
	social support of patient
Suitability of	
	services and supplies at the bedside for clinical activity
	access to and within area for physically and sensorally impaired people
	services to enable personal communication by patient
	services to enable direct admin/clinical communication from the bedside
	a reassuring, stress reducing, environment
	a safe and hazard free facility
Privacy	
	during clerking and clinical discussion between patient and staff
	during clinical treatment
	for bodily functions and personal care
	for personal discussion and telephone calls
	for staff communication
	for staff rest and beverage breaks
Choice, control, comfort	
	to be alone or in company, including visitors
	of temperature, ventilation, lighting and sound
	of diversion, outlook, entertainment
	with access to beverages for patient and relatives
	with local storage of personal belonging staff
	with access to the outside world

Table 2.4 - The key feature of desirable ward's environment (Source: NHS Estates, 1997)

The growing evidence that the physical environment has an impact on the well-being of patients has supported the so-called '*healing environment*', which is rooted in complementary medicine and holistic healing. This seeks a therapeutic environment to replace utilitarian healthcare buildings. Although there is still no generally accepted definition of a healing environment, it has been perceived as the environment that supports the healing process (Berg, 2005). This seems to be more concerned with interior features of hospitals rather than form or location (Francis et al., 1999).

The design of a healing environment has been recently driven by research evidence. This trend is known as '*evidence-based design*', the architectural parallel to evidence-based medicine (Hamilton, 2004). Ulrich (1984) may be the pioneer in this context. His article showed that a view to a pleasant nature scene helped the healing process in a group of surgery patients. Following this study, a large number of studies have investigated the relationship between design features and health outcomes. Later, a review study identified about 600 rigorous studies that address the areas that evidence-based design can make a difference for patients and staff (Ulrich et al., 2004).

Patients' privacy has been seen as a key feature of designing a healing environment based on its direct relationships with patients' satisfaction, control over the environment and expectations. Ulrich (1997) has developed three guidelines to create what he called a '*supportive healthcare environment'* and took the idea further in Ulrich (2000), one of which was to '*foster control including privacy*'. Later, a strong link was established between the physical environment in hospital settings and patients' confidentiality and privacy based on an extensive literature review (Ulrich et al., 2004). Patients' privacy is studied in more detail in the next chapter.

In spite of the wide spread of the idea of evidence-based design, a recent study by Dijkstra et al (2006) showed that only 30 out of 500 potentially relevant studies concerning interventions involving health effects of environmental stimuli in healthcare settings on patients, were based on controlled clinical trials and published in peer-reviewed journals. They found that these studies do support the evidence-based design approach but this is not conclusive for all design features and can not be generalized. They recommended well-conducted, controlled clinical trials before proposing evidence-based guidelines for healthcare environment design.

2.6.4 Sustainable healthcare buildings

As a response to global warming, the need to reduce carbon dioxide (CO2) emissions and the increasing prices of fossil fuel and electricity, forces started to gather globally in order to adopt sustainable development in a variety of sectors (e.g. transport, industrial process, agriculture and buildings). Following this demand, the 2003 energy white paper committed the UK to reduce CO_2 emissions to 20% by 2010 with a further goal of 60% below the 1990 levels by 2050. However, there is also a call for 80-90% reduction below the 1990 levels (Meinshausen, 2006).

Being one of the largest employment sectors in the UK and maybe in Europe, the NHS has a considerable carbon footprint. The use of fossil fuel and electricity in hospitals is remarkably high compared with other non-domestic buildings. Energy use in NHS healthcare facilities costs £400 million annually and results in a net emission of around 1 million tonnes of carbon (Johnson and Simms, 2007). In spite of the great effort that the NHS had made to achieve a 20% reduction of its CO_2 emissions in 2000 (Department of Health,2006), recent research showed that a significant reduction in energy consumption in NHS buildings is needed before the NHS can meet the government target in the planned time (Johnson and Simms, 2007). Others suggested that the Triple E agenda (i.e. economic, environmental and ecological sustainability) is needed to achieve a more complete approach to sustainability in the NHS (Hyett and Jenner, 2004).

Achieving sustainability in hospitals seems to be more challenging than in other types of building. This may be due to functions of hospitals which require different types and sizes of spaces with particular facilities; and the environmental requirements within them (e.g. air quality, ventilation and air movement, temperature, infection control and lighting). Nevertheless, a sustainable approach to hospital design will result in not only environmental benefits but also in cost saving. Additionally, this will help in reducing the new impact that the global warming will introduce to the NHS. In addition to the challenges that are facing the NHS (e.g. aging population), global warming will introduce the challenge of a potential increase in health problems as a result of a warmer and more variable climate (Johnson and Simms, 2007).

The NHS Environmental Assessment Tool (NEAT) has been developed based on a well-established approach (i.e. BREEAM) to help NHS Trusts to assess their environmental performance and also to provide criteria for the design process. It is the NHS response to delivering the government's objective of a more sustainable environment. However, due to the recent update of Health Technical Memoranda (HTM) and building regulations, commencing from July 2008 NEAT was replaced by bream: healthcare[2]. This tool is more recent than NEAT and can be applied to all healthcare building at different stages of their lifecycle.

While the economic and environmental issues dominate the sustainability agenda, the social dimension of sustainability started recently to get integrated into sustainability framework and has gained increased recognition within the sustainability debate (Colantonio, 2007). Although there is no general agreement on what social sustainability means, it is broadly accepted that meeting basic human needs is a key component (Sinner et al., 2004). One of these basic needs is privacy (Altman, 1975). While responding to the economic and environmental dimensions of sustainability in hospital design does not seem to be related to the issue of privacy, the integration of the social aspects of sustainability within NHS agenda will result, most probably, in increasing the demand for hospitals that are responsive to patients' privacy.

2.6.5 IT and medical advances

The continuous development in information technology has a direct effect on healthcare facilities. This includes data handling and its applications on patient record systems (Francis et al., 1999). More importantly, new information technologies such as video conferencing may result in changing the way of communication between patients, primary healthcare and specialist healthcare staff. Notions like Tele-medicine and E-health are expected to be the norm in the future hospitals (MARU, 2001).

Advances in medicine and biomedical engineering may change the way by which healthcare buildings, particularly hospitals, are designed and managed. New technologies such as the robotic laboratories; surgical suites operated through satellites;

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[2] http://www.breeam.org/page.jsp?id=105

and minimally invasive techniques in real time with diagnostic procedures may result in a shift in hospital planning, standards and nature of work (Francis et al., 1999).

2.7 Summary and Conclusions

General hospitals are one of the largest healthcare buildings within the healthcare system. In spite of the demand for delivering healthcare services in more local-based settings, hospitals will continue to be built and used but perhaps on a smaller scale (e.g. community and specialist hospitals).

Wards seem to occupy a significantly larger floor area than any other individual departments in a hospital. Moreover, patients spend most of their time during their hospital-stay in wards. Consequently, more attention needs to be given to the different aspects of ward design.

Patients’ privacy has been seen as a cornerstone of ward design. The evolution of recent trends and demands in the field of hospital design such as the healing environment and patient-centred care has re-emphasised the concept of patients’ privacy and its importance for patients’ well-being. This puts pressure on hospital designers to offer a better level of privacy for individuals especially in multi-bed wards where there is more potential for a breach of privacy. Figure 2.10 summarizes this chapter.

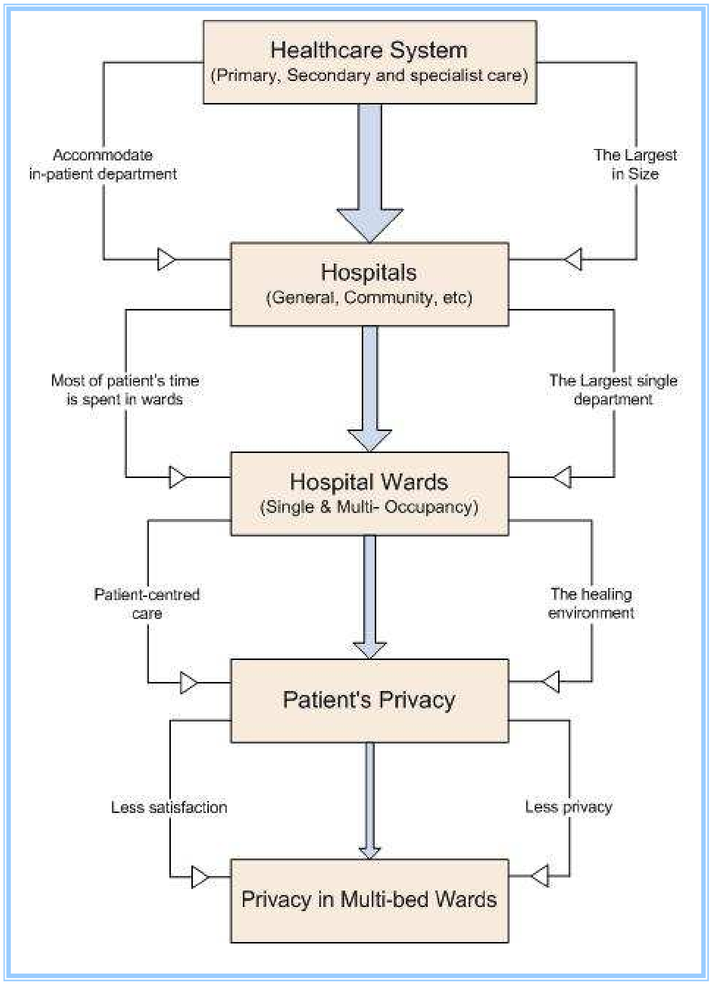


Figure 2.10 – Summary of chapter two

Most of the Department of Health reports and guidelines which address issues related to the internal environment of hospitals emphasise the importance of achieving a better level of patients' privacy especially in wards. However it seems that there is no framework to assess people's privacy preferences in this situation nor information to guide designers.

Before the concept of patients' privacy and its associated meanings can be explored, the wider notion of privacy needs to be examined. An attempt is made in the next chapter to address these issues.

Chapter Three:

Privacy

3.1 Introduction

In the previous chapter hospital wards were presented as one of the most important areas in hospital settings in terms of the space they occupy and the time that patients spend in a single department during their stay in a hospital. Within hospital wards, patients' privacy has been identified as essential for the well-being of patients, especially in multi-bed wards, where the opportunity for violation of patients' privacy is amplified. Meeting the level of privacy that patients require and expect is therefore a demanding need in contemporary hospitals.

Because of the complex nature of the concept of privacy, it needs to be understood before any attempt to address it is made by researchers. This is particularly important in hospital wards, given the fact that patients are usually weak, in a vulnerable state experiencing less control over their environment, and as consequence more sensitive towards their psychological needs, one of which is privacy.

This chapter reviews the general concept of privacy in terms of its meaning, functions, types and properties. Particular attention is paid to the relationship between the physical environment and privacy, a concept that is widely discussed in the environmental psychology literature. This chapter links this discussion to patients' privacy by covering the importance of privacy for patients and patients' right to privacy in hospital settings.

3.2 Understanding Privacy

> *'Privacy is addressed not only by psychologists, but also by political scientists, sociologist, anthropologists and lawyers reflecting its social, cultural and legal aspects. Privacy is manifested in our behaviour, preferences, values, needs and expectations. It is facilitated or eroded by the physical design of our homes, workplace, schools, public places and institutions.'* (Gifford, 2002, page 211).

The concept of privacy is wide ranging. It has been addressed in many disciplines (e.g. zoology, sociology, anthropology, environmental psychology, architecture and computer science). Each has its own definition, language and purpose. For example, Rawnsley (1980) identified three sources of the modern concept of privacy: privacy as a legal right; social privilege; and psychological function. In this chapter the review is limited to the concept of privacy in environmental psychology with particular focus on its relation to architectural design.

The importance of privacy is that it is a basic human need which relates to effective individual and group functioning and its converse, lack of privacy can result in a range of problems (Altman, 1975; Vinsel et al., 1980). Some authors have gone further, for example, Newell stated that *'…privacy remains a most vital component of healthful functioning.'* (Newell, 1995, page 88).

The complexity of the concept of privacy comes from the fact that privacy means different things to different people; and different people may need different kinds and levels of privacy according to many factors (e.g. age, gender, the physical environment they were located in, etc). In addition, privacy is related to other psychological concepts (e.g. territoriality and personal space) and part of people's psychological development. Consequently, formulating a universal definition of privacy has been acknowledged to be a difficult task. Because of the different facets of privacy, Gifford (2002) believes that any attempt to define privacy involves a risk of excluding one or more of these facets.

However, several definitions of privacy have been proposed by different authors. Newell (1995) found 17 different definition of privacy in the literature. She categorized them in three groups: privacy as a phenomenal state or condition of the person; privacy as a quality of place; and refuge. Amongst these definitions, Altman's (1975; 1977) and Westin's (1967) theories of privacy have been seen as the foundation upon which later studies on privacy have been established (Gifford, 2002; Margulis, 2003). Their theories have been quoted far and wide with significant contributions to the field of privacy research. This was reviewed, analysed and compared by Margulis (2003).

Alan Westin's theory sees privacy as a means rather than an end in itself. For Westin, privacy is a need which has been used by people to achieve the overall end of self-realization. He defined privacy as *'the claim of individual, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others. Viewed in terms of the relation of the individual to social participation, privacy is the voluntary and temporary withdrawal of a person from the general society through physical or psychological means*' (Westin, 1967, page 7). His theory of privacy is based mainly on classifications. To explain, he described '*hows*' and '*whys*' of privacy (i.e. types and functions of privacy) rather than processes (these two classifications are described in more details in the following sections in this chapter). He considered the differences between these classifications as a function of political systems because of their underlying socio-political values (Margulis, 2003).

Irwin Altman's definition of privacy has been used widely and probably seen as the best formulated one by many authors (Pedersen, 1997; Gifford, 2002). Altman defined privacy as *'the selective control of access to the self or to one's group'* (Altman, 1975, page 18). According to this definition, privacy can be perceived as a process by which individuals, or groups, attempt to regulate interaction with others by controlling the opened and the closed channels of information that lead to them. This includes access to senses-related information (these are as suggested by Hall (1969): accessibility, visibility, proximity, vocal and olfactory) and access to thoughts and interests. For Altman, privacy is a dynamic process which has three conditions: ideal, desired and achieved. The optimum condition of privacy can be achieved when the desired and achieved privacy are balanced, but if the desired privacy is less than the achieved one, that can cause social isolation. Conversely, crowding can happen if the desired privacy is more than the achieved one. Altman's approach to privacy focused on the mechanisms of obtaining privacy (Margulis, 2003) which he described as culturally unique (Altman, 1977). For Altman, these mechanisms are directly related to the physical environment. He emphasized the importance of the linkage between the physical environment and privacy regulations (Altman, 1990).

Although the literature describes commonality between Westin's and Altman's approaches for privacy, Westin's ideas seems to be narrower, focusing on information privacy (for full comparison between the two theories, which is beyond the scope of this thesis, see Margulis (2003)).

Leino-Kilpi et al. (2001), in their review found that privacy has been described in the literature through four main dimensions based on two earlier studies (Burgoon, 1982) and (Parrott et al., 1989): informational, psychological, social, and physical privacy. These dimensions were addressed earlier in Altman's and Westin's theory of privacy. According to this particular review, the informational dimension of privacy concerns the amount of control people have over the decision of when, what and how information can be released about themselves (e.g. using medical records for research); psychological privacy relates to the ability to reveal feelings and intimate information to a person and in a time that people choose; the social dimension of privacy describes the ability to control social interactions with others; and finally, physical privacy questions how the physical environment acts as a regulator for privacy. Although establishing a clear distinction between these dimensions is not an easy task (for example, physical privacy, which seems to be governed mainly by the physical environment, controls one's ability to determine a social opportunity and as a consequence react upon a social obligation), the issue of the relationship between the physical environment and privacy is discussed later in this chapter.

Due to its complex and multi-faceted nature, authors have approached privacy from different perspectives. It has been studied in terms of its types (Westin, 1967; Marshall, 1972; Pedersen, 1979; Pedersen, 1982; Hammitt and Madden, 1989; Pedersen, 1996), and functions (Westin, 1967; Altman, 1975; Hammitt, 1994; Pedersen, 1997). In addition, attention has been given to the influence of background factors on privacy (Altman, 1977; Pedersen, 1987; Newell, 1998). These issues are reviewed in the following sections.

3.2.1 Privacy and Maslow's hierarchy of needs

Psychologist Abraham Maslow presented a hierarchical structure of basic human needs (Maslow, 1943). In his model, he has not only classified human needs into five hierarchical levels but also determined the manner in which these needs can be satisfied. He argued that the demands of lower-level needs should be fairly well gratified before a higher-level need emerges. That is, needs in level two, for instance, will keep silent till needs in level one are fulfilled and so on.

These basic needs, in the order from the most demanding needs (the lowest-level) to the least demanding needs (the highest-level), are as follows: physiological needs, which are the biological needs required by the body to function such as water, food, oxygen, etc; safety needs such as security and protection from the different kind of unwanted influences (i.e. physical and psychological); belongingness and love needs, which help to avoid loneliness by receiving and giving love and belonging to a group; esteem needs by which people try to achieve better self-respect and respect from others. Maslow at this point explained that the satisfaction of the previous four needs creates '*satisfied people*' from which one can expect creativeness by satisfying the highest-level needs in his model, which he called self-actualization needs. This is related to being one's self or, in other words, '*become everything that one is capable of becoming*' (Maslow, 1943, page 10) in order to be ultimately happy, which one may call nonfunctional pleasure. Maslow's hierarchy of needs is often arranged in a pyramid shape as shown in Figure 3.1.

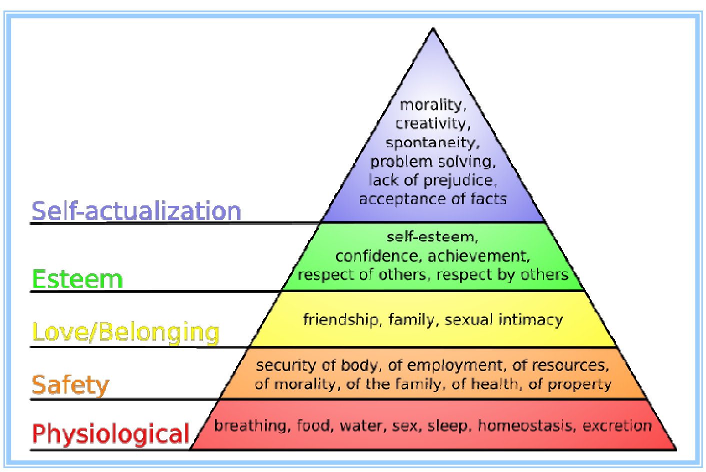


Figure 3.1-Maslow's hierarchy of needs

(Source: http://en.wikipedia.org/wiki/Image:Maslow%27s_hierarchy_of_needs.svg/ Retrieves: 08/01/08)

When considering a complex psychological construct such as privacy, it does not seem accurate to limit its effect to respond to a single level in Maslow's framework. Moleski and Lang (1986) showed how privacy requirements can be assessed using the top four levels of needs in Maslow's model: safety, belongingness and love, esteem and self-actualization. They stated, in page 16, that privacy '*may be a need for security from unwanted intrusion, or for belonging in terms of intimacy, or for the esteem of holding private territory, or actualization for pursuing one's own creative goals*'. Although such understanding of the role of privacy in satisfying people's needs is crucial, other authors provided a more detailed grasp of the function of privacy for the physical and psychological well-being of people. This is discussed in the next section.

3.2.2 The function of privacy

In spite of the wide recognition of the importance of privacy as a basic human need, it seems that few studies have investigated functions of privacy in detail. This may be related to the difficulties associated with such proposals due to the multi-faceted nature of privacy. However, there have been some attempts to determine functions of privacy and link them to the different types of privacy. This issue was reviewed by Pedersen (1997) and later by Gifford (2002). The following is a summary of their review.

The earliest classification was provided by Westin (1967), who described four functions of privacy: personal autonomy; emotional release; self-evaluation; and limited and protected communication. This, however, was seen later as a goal or need served by privacy and not as actual functions of privacy (Pedersen, 1997).

Personal autonomy: Westin did not only consider the sense of autonomy or control as one of the main functions of privacy but also regarded privacy as a central aspect of the sense of autonomy. People who control their environment have the ability to regulate others' access to themselves and their access to others (e.g. a company manager). As a consequence, they seem to meet their desired privacy to a higher level than those without this ability.

Emotional release: Societies tend to discourage public emotional release. Hence, privacy allows a room for people to relax from this pressure. People usually feel more emotion than which they can really display to the society, so privacy serves as a '*vehicle for emotional release'* (Gifford, 2002). In other words, privacy provides protection to disobedient emotional release against society's norms.

Self-evaluation: Privacy enables people to intensively understand information gained from daily dealings with others, and it is important for self evaluation. Privacy allows time and place for people to rethink, evaluate and gauge events, in order to produce a response by which the images they want to their selves can be achieved. Westin related this to sense of one's self, or identity. According to Gifford (2002) some theorists rely on the idea of privacy as a facilitator for identification as a central approach to understand privacy.

Communication: In Westin's approach, people required privacy to limit or protect their communication with others from intruders. To explain, Kaldenberg (1999) found that patients who were accommodated in single-bed rooms are more satisfied with their communication with staff members than those in multi-bed rooms where auditory privacy is less. In another study, the main reason for dissatisfaction of employees who were moved from offices with solid walls to open-plan offices appeared to be the loss of the communication privacy (Sundstrom et al., 1982a).

Westin's (1967) functions of privacy were tested empirically later by Pedersen (1997), who suggested nine functions of privacy: contemplation (to contemplate who you are and what you want to be), autonomy (experimenting new behaviour without fear of social rejection), rejuvenation (recovery from social hurt which led to social withdrawal and plan for future social interaction), confiding (confiding in others), creativity, disapproved consumption (to eat or drink socially-unacceptable substance) , recovery (like rejuvenation but with greater sense of relaxation) , catharsis (to be free from having to comply with the expectations of others) and concealment.

Newell (1994) provided a wider scope of privacy functions. In her approach, each individual is regarded as a '*stationary open system*' which is exposed to different influences. Hence maintenance and development is needed for the system's well-being. Privacy functions as a facilitator for both needs: maintenance of the system by providing relief from stressors and providing opportunities for system development.

The issue of privacy functions has not as yet been completely uncovered. With the few studies available, the generalization of the results seems to be unreasonable. In addition, different types of privacy may serve different functions. An insight into the different types of privacy may provide a better understanding of the concept.

3.2.3 Types (states) of privacy

Types of privacy were investigated originally by Westin (1967), who delineated four types of privacy: solitude, intimacy, anonymity and reserve. Solitude means being alone (not to be observed by others); intimacy refers to group privacy; anonymity is the privacy desired when someone wants to stay within a group but without personal identification or interaction; and finally reserve, which refers to creating psychological barriers against others (unwillingness to disclose personal aspects of self to others).

Solitude was investigated further by Marshall (1972), who suggested two types of solitude: seclusion, which refers to being away from the visual and audio observation of others, and not neighbouring, which refers to not welcoming the visits and the contacts with neighbours. In later studies, intimacy was split into intimacy with friends and intimacy with family; and a distinction was made between solitude and isolation (Pedersen, 1979; Pedersen, 1982). The difference between these two types of privacy is that isolation is seeking solitude but away from people, like living on a desert island (Gifford, 2002). Westin's types of privacy were confirmed empirically but found to be not comprehensive (Margulis, 2003). As a consequence, some refinements for Westin's original proposal were suggested.

Some of these types of privacy were investigated in terms of the psychological needs they serve (Pedersen, 1997). These types of privacy are: solitude, isolation, anonymity, reserve, intimacy with friends, and intimacy with family. He found that: solitude and isolation serve contemplation, autonomy, rejuvenation and confiding; solitude serves creativity; isolation serves disapproved consumption; anonymity and reserve serve recovery; anonymity serves catharsis and autonomy; reserve serves concealment; and finally intimacy with friends and family were described as '*multifunction*' types because they were found to serve almost all privacy needs except concealment.

3.2.4 Universals versus differences

Privacy has been acknowledged to be a universal need (Altman, 1975; Altman, 1977; Harris et al., 1995; Newell, 1998; Gifford, 2002) which accrues across cultures, age groups and gender. However, the complexity of privacy seems to be the driver for the cumulative body of research which investigates the differences across a number of variables which may affect regulations of privacy. On the other hand, there is a more recent trend in the privacy literature with focuses on the universals rather than the differences (Newell, 1994; Harris et al., 1995; Newell, 1998). Arguably, the learned social and environmental factors may contribute to differences between cultures, whereas the commonalities may have a more biological or physiological nature (Poortinga, 1990).

Cultural difference in privacy regulation has its origin in the anthropological studies by Altman (1977). He suggested that the process and mechanisms by which privacy is regulated is culturally unique while the desire for privacy is universal. Later research showed that the variability within culture includes age (Laufer and Wolfe, 1977; Wolfe, 1978); gender (Walden et al., 1981; Pedersen, 1987; Pedersen, 1988; Parrott et al., 1989; Newell, 1994) and in some cultures income (Newell, 1998). In addition the effect of previous experience of space has been found to be significant (Back and Wikblad, 1998).

On the other side of the coin, Newell, pursuing her system model of privacy stated that "*from the point of view of both research and design, it would seem appropriate to first find the psychological commonalities, or universals, than to find areas where groups react differently but predictably, and after that to identify areas of strong individual differences*'' (Newell, 1998, page 358). As a consequence, several universals have been identified which support the proposition of a system-based model for privacy. For instance, Newell (1998) found commonalities in the reasons for privacy, the emotional state associated with the need for privacy, the definition of privacy and the average duration of privacy experience. In another study, the relationship between the effective privacy regulation and place attachment has been proposed as a possible universal (Harris et al., 1995). Furthermore, the therapeutic effect of privacy has been perceived to be universal. Accepting the systems approach to privacy which sees the individual as a '*stationary open system*' (Newell, 1994), the importance of privacy for system-maintenance and system-development has been acknowledged by both theory and research (Newell, 1994; Newell, 1998). In a broader context, universals have been found in the choice of favourite places (Newell, 1997) and in the relationship between place attachment and subjective well-being (Harris et al., 1995).

3.3 Privacy and the Physical Environment

> '*The way in which we present ourselves to others is a function of our position relative to the organization of our physical surroundings. And how we present ourselves to others is the essence of privacy.*' (Archea, 1977, page 130).

The role of the physical environment in providing opportunities for privacy has been acknowledged in Altman's theory of privacy and emphasised in later studies (Altman, 1975; Archea, 1977; Sundstrom et al., 1980; Archea, 1984). In particular, the interplay between individuals, social relationships and the physical environment has been seen as one facet of privacy (Altman, 1990). This has been acknowledged by other authors' definition of privacy as well. For example, Kupritz defined privacy as '*the regulation of interaction between the self and others and/or environmental stimuli*' (Kupritz, 1998, page 341).

Georgiou (2006) in his dissertation developed a topological method for analyzing and synthesizing spaces in terms of privacy they provide using the five factors that affect it as described by Hall (1969). These factors are: visibility, vocals, olfactory, accessibility and proximity. He approached privacy from its architectural facet which he defined as '*the capacity of space to regulate the information which is communicated to its immediate environment.*' (Georgiou, 2006, page 15).

Physical privacy, as Burgoon (1982) defined, is the degree to which one is physically accessible to others. Hence, it is a function of how much the physical environment allows individuals to regulate access to themselves (Gifford, 2002) . Loss of physical privacy has been shown to lead to feelings of stress (Altman, 1975) and the allowed degree of physical enclosure has been shown to affect the level of privacy satisfaction particularly in work settings (Sundstrom et al., 1982b; Kupritz, 1998). Moreover, some studies acknowledged the effect of the physical environment on the communication of intimate information. In other words, the effect of the physical setting on self-related information one chooses to tell another (Chaikin et al., 1976; Gifford, 1988).

The role of the physical environment in the presentation of information about one's self, and as a consequence the experience of privacy, seems to be unavoidable in most privacy studies. This was clearly demonstrated in Newell's (1995) article 'perspectives on privacy'. In this article 72 privacy-related studies were reviewed and classified into person-centred, place-centred and interactional perspectives. In 92% of the articles, privacy has an environmental component (Margulis, 2003). Out of these, Altman's theory of privacy regulation (Altman, 1975; Altman, 1990) and Archea's Visual Access and Exposure Model (Archea, 1977; Archea, 1984) seem to be not only the most relevant to the current study but also to have the most influential ideas within this context.

3.3.1 Altman's privacy regulation theory

As explained earlier, Altman's approach to privacy focused on the mechanisms of obtaining privacy which is utilized usually within a physical environment. Hence, a better use of space management processes (i.e. personal space and territory) leads to achieving a better level of desired privacy. He considered crowding as the failure to achieve privacy and a lot of privacy as loneliness (Altman, 1975).

It seems, however, that there is no cut-off line between what is personal space, territoriality, crowding and privacy (Gifford, 2002). According to the review by Leino-Kilpi et al (2001), personal space refers to an area with invisible boundaries surrounding a person's body into which intruders may not come (Sommer, 1969), whereas territoriality seems to be more difficult to define in spite of the fact that it is a widespread phenomenon. Gifford (2002, page 150) defined it, based on Edney's (1974) article, as '*a pattern of behaviour and attitudes held by an individual or group that is based on perceived, attempted or actual control of a definable physical space, object or idea that may involve habitual occupation, defence, personalization and marking of it*'.

In Altman's model of privacy, personal space and territoriality are mechanisms to regulate privacy, so privacy is the central concept among other space management processes as shown in Figure 3.2.

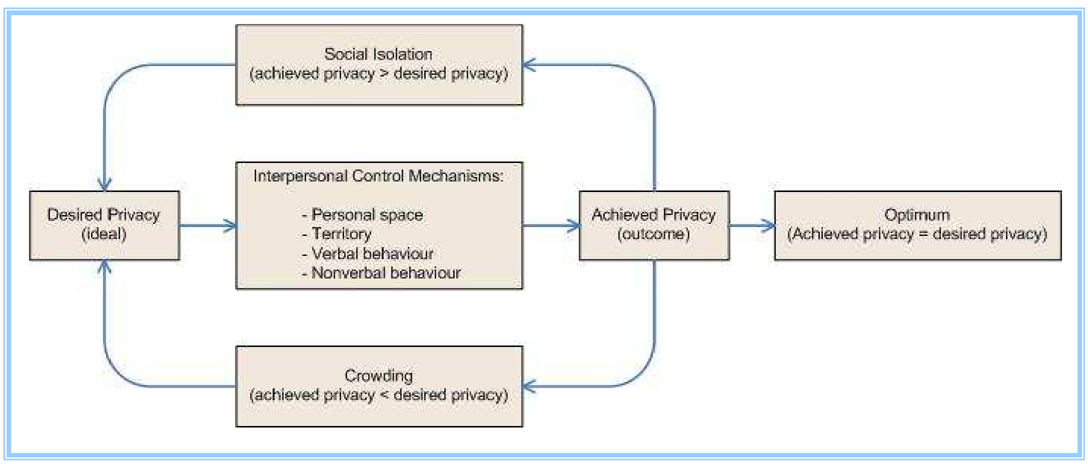


Figure 3.2 – Altman's model of privacy, (adapted from Gifford (2002))

Altman's model of privacy and its relationship to the physical environment focuses on space management processes which occur within that environment rather than describing the relationship between the arrangements of the physical environment and the amount of control over the distribution of information about the self that individuals have as a consequence of these arrangements. This may be related to the lack of clear definition or description of the physical environment in Altman's theory and how its components facilitate or impede privacy (Margulis, 2003). Conversely, this was dealt with in detail as a central approach in Archea's Visual and Exposure Model.

3.3.2 Archea's visual access and exposure model

Archea (1977; 1984) viewed privacy as an *information distribution process* that people utilize to regulate their behaviour in a physical environment. Although the literature suggests that the five senses are involved in this process (Hall, 1969), Archea hypothesized that visually conveyed information is the crucial one in monitoring one's surrounding activities and as a consequence the distributed and received information about social opportunities. Then he recognized that the human visual system is significantly restricted by the organization of physical environments.

Relying on this understanding he posited that in physically bounded environments, visual access and exposure regulate the flow of privacy-related information. And this in turn is governed by the placement (i.e. spatial location and orientation) and/or properties (e.g. reflection and transparency) of the physical environment's components such as edges (e.g. corners) and surfaces (e.g. walls and doors). Hence, he believed that the physical environment is the key player in concentrating, diffusing, segregating or localizing the information that individuals want to regulate in order to control their reactions to a social situation. He described the crux of his model as '*the arrangement of the physical environment regulates the distribution of the information upon which all interpersonal behaviour depends*' (Archea, 1977, page 121).

Visual access is the amount of visual control that individuals have from a specific location over one's spatial surroundings. Different locations provide different ranges of visual access which in turn create opportunities for obtaining information that help to synchronize one's behaviour with others within a physical environment. Accordingly, locations can be classified according to the visual access they provide. Archea pointed out that visual access is a function of one's spatial location and orientation; and properties of the physical environment components (e.g. wall, mirrors, doors, etc).

Visual exposure is the amount of visual monitoring that others in the spatial surroundings have over one's behaviours as a result of one's location within the physical environment. This is related to the amount of accountability and acknowledgment that one's behaviour receives by others. It is also related to others' spatial location and orientation in the spatial settings. People may seek low-exposure locations when they require a higher level of privacy as these locations potentially will conceal information from society. As Archea described, visual exposure is a function of the combination of physical environment arrangements and properties relative to one's position and others' position.

In fact, Archea's visual access and exposure model of isolation and concealment properties of a given location within spatial settings based on the visual information that is allowed by the physical environment components, brings to mind the isovist (Benedikt, 1979) and space syntax (Hillier and Hanson, 1984) approaches to analysis of architectural environments in relation to human behaviour. While the isovist idea seems to be similar to Archea's model in terms of describing the local properties of a location in a physical setting, space syntax is more concerned with the spatial organization as a whole and its relation to human behaviour within this organization. Isovist, space syntax and Visibility Graph Analysis (one of the space syntax techniques) are explained and described in more detail in chapter five.

Archea emphasized that people selectively position themselves in a physical setting according to their *capabilities*, *expectations* and *intentions*, the phenomenon he called *selective conspicuousness.* He explained that *inconspicuousness* occurs when the location and orientation of a person provide either too little exposure or too much access. Although extra conspicuousness is a major problem for privacy regulation because overexposure means communicating more information than what one desires to be communicated to others, less conspicuousness than what one desires can also cause difficulties as it leads to one's behaviour not being recognized by others. Archea's visual access and exposure model is shown in Figure 3.3.

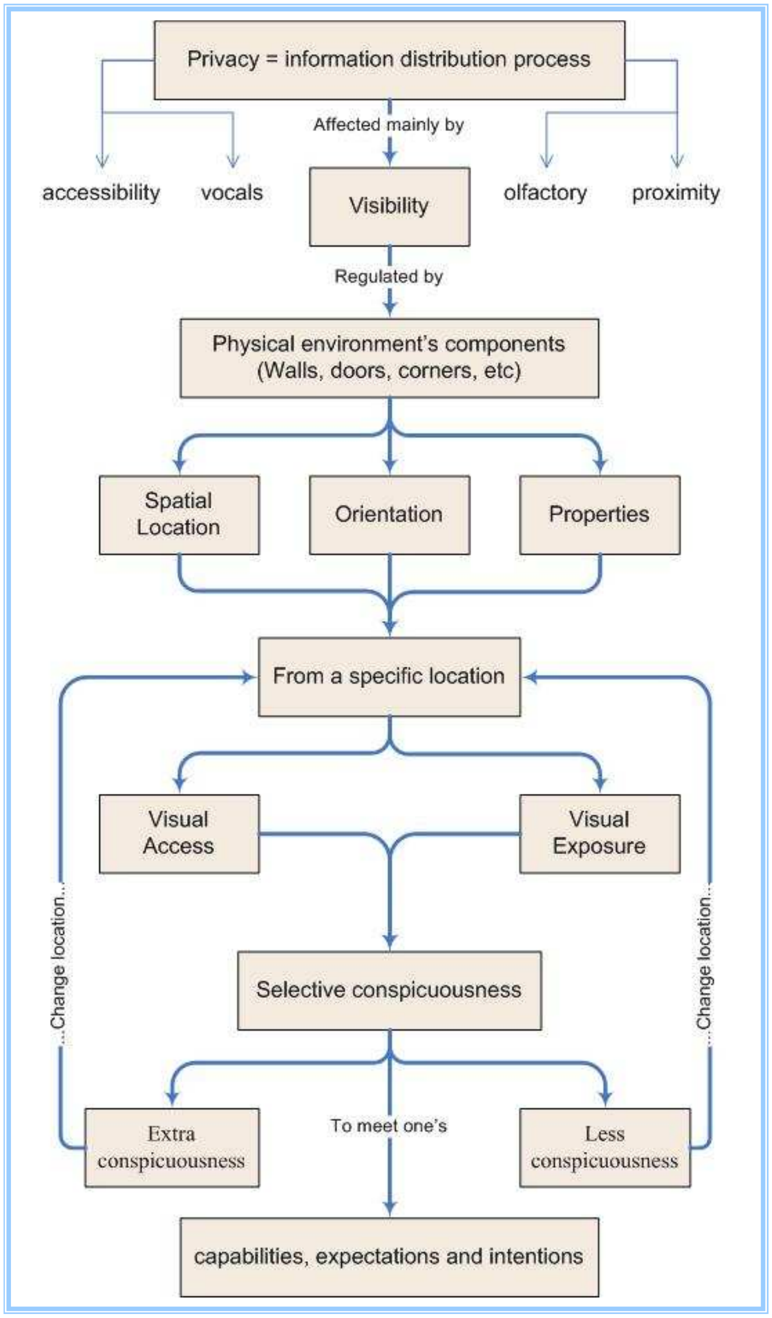


Figure 3.3 - Archea's Visual Access and Exposure Model

(Source: the author based on Hall (1969) and Archea (1977; 1984))

Putting it another way, people adjust their position, relative to the physical environment components, according to their *locational preference for privacy.* This allows them to control the information that they obtain about a social opportunity which may propose a social obligation or reveal information about them which may cause a violation of their privacy.

3.4 Patients' Privacy

As was reviewed in the previous chapter, respect for patients' privacy is known to be important for patients' physical, mental, emotional and spiritual well-being (Woogara, 2001). In spite of this, the frequent loss of privacy in the hospital setting is widely recognized (Annas, 1981; Matiti and Trorey, 2004) because patients in hospitals find difficulties to control the environment (Leino-Kilpi et al., 2001).

Many types of patients have viewed privacy as an important issue during their stay in hospitals (Schultz, 1977; Back and Wikblad, 1998). In addition, and as reviewed by Leino-Kilpi et al (2001), privacy has been recognized as one of the important concepts in nursing and health care ethics (Yura and Walsh, 1988; Thompson et al., 1994; Leino-Kilpi et al., 2000). In fact, privacy has been seen as a key concept in the hospital setting which has implications for nursing and staff (Glen and Jownally, 1995). In addition, patients' privacy and dignity has been seen as one of the fundamentals of healthcare provision (Department of Health, 2003).

Patients' privacy can be affected by many factors. For example, Back and Wikblad (1998) found that patients in long-term care have higher privacy preferences than those in acute care. In another study, Schopp et al (2003) investigated the perception of elderly people regarding privacy in five European countries (i.e. UK-Scotland, Finland, Germany, Spain and Greece). They found that the perception of privacy is strongest in the UK (Scotland) and weakest in Greece.

According to the review by Leino-Kilpi et al. (2001), most of the studies in the field of patients' privacy investigate physical privacy with emphasis on the hospital environment. Loss of physical privacy has been shown to lead to feelings of stress (Altman, 1975), and stress has been associated with an inability to process information (Buck, 1979). Hence the violation of patients' privacy may generate a feeling of stress which may lead to failure in understanding physicians' instructions or recommendations. This failure to understand is likely to lead to failure to comply, which may be associated with lower recovery rates and less patient satisfaction (Parrott et al., 1989). In a more recent study, Lawson (2002) investigated the effect of good architectural design of the internal environment of the ward on patients' well-being. Two main groups of environmental factors were investigated: the first related to the direct relationship between people and their environment such as colours, lighting and room temperature. The second group related to the way in which the environment mediates the relationships between people, for example in terms of privacy, community and personal space. The study concluded that the second group of factors matters more for patients. And more importantly, the most commonly raised issue among all patients was privacy.

In addition, a link has been established between privacy and maintaining dignity (Watson, 1988). This is consistent with Matiti and Trorey (2004) study in which they identified patients' privacy as a main factor that helps patients to maintain their dignity in hospital settings. In fact, privacy is directly related to the concept of control over one's environment (Westin, 1967). See section 2.2.4.

3.4.1 Control and patients' privacy

As reviewed earlier (see section 3.2), privacy is always associated with the concept of control. This is reflected in the different definitions of privacy including Altman's and Westin's. In addition, achieving control over the environment was described as main function of privacy by (Westin, 1967), who described the relationship between privacy and control as '*intimately connected*'.

Control theories are a set of theories in environmental psychology concentrating on how much control people have over environmental stimulations. According to Gifford (2002), people who have much control over the amount and kind of stimulations in the environment feel better than those who have little control. According to Brehm (1966) lack of control may cause a psychological reaction by which people try to maintain the freedom they lost. Control also affects people's satisfaction with their environments and the activities carried out in that environment. Lee and Brand (2005) provided evidence that the more personal control over the physical workplace, the higher level of job satisfaction is achieved. Some authors viewed privacy as the ability to control which personal information is communicated to whom (Maclorowski, 1991)

In health care environments, Shumaker and Reizenstein (1982) found that patients who have better control over the information related to their health cooperated more with staff and experienced less stress. In another study, Shumaker and Pequegnat (1989) identified lack of control and lack of privacy as sources of patient stress. Similarly, the respect of patients' autonomy by nursing staff, which offers more control for patients, has been seen to enhance the sense of safety and reduce anxiety among patients which in turn may help in the healing process (Hayter, 1981). Ulrich (1992) found that lack of control is a major problem in hospital settings which can amplify stress and affect the wellness of patients negatively. He suggested lack of privacy as a major factor that contributes to the loss of sense of control in hospital, and as a consequence, affect negatively the healing process of the patients and increases patients' anxiety. Later, and in two separate studies, positive patient outcomes were linked to patients' ability to control the environment (Murphy, 2000; Stichler, 2001). Moreover, two main conclusions which resulted from Lawson's (2002) study on the effect of architectural design of the ward's environment on patients' well-being are: firstly, being able to decide what levels of privacy and community patients want is extremely important to the patient, secondly, being able to control the environment is also very important. Meeting these needs may lead to higher level of patients' satisfaction and improves patients' general feeling about their treatments.

As a consequence of the increasing interest in the importance of giving patients control over the environment in hospital wards, a patient-centred care approach was proposed in health care environments. This trend was reviewed in the previous chapter. This approach promotes a homelike environment that is functionally efficient by giving patients a greater deal of control. It treats patients as individuals and defines quality of care from the patient's perspective (Martin et al., 1998). In the context of this approach, wards need to be designed in a way that corresponds to human scale, needs and preference; and provide the patients with privacy, dignity, security and cleanliness (Miller and Swensson, 1995).

3.4.2 Patients' identity

Patients' privacy is linked in the literature to so-called patients' identity. According to Woogara (2005), privacy allows individuals to uphold their autonomy and identity. NHS Estates (2005) reviewed a report which was prepared as a result of research carried out in Netherlands (Hoekstra and Liempd, 2001). This research investigated the relationship between patients' behaviour and their physical environment. The research suggested that if patients can retain their sense of identity, this enables them to resist negative aspects of hospital stay such as stress and assists their ability to recover more quickly.

According to this research, eight themes formulate the concept of patient's identity: privacy, safety, autonomy, independence, territory, social contact, orientation and freedom of choice, as shown in Figure 3.4. These themes interact with each other to form the concept of patients' identity.

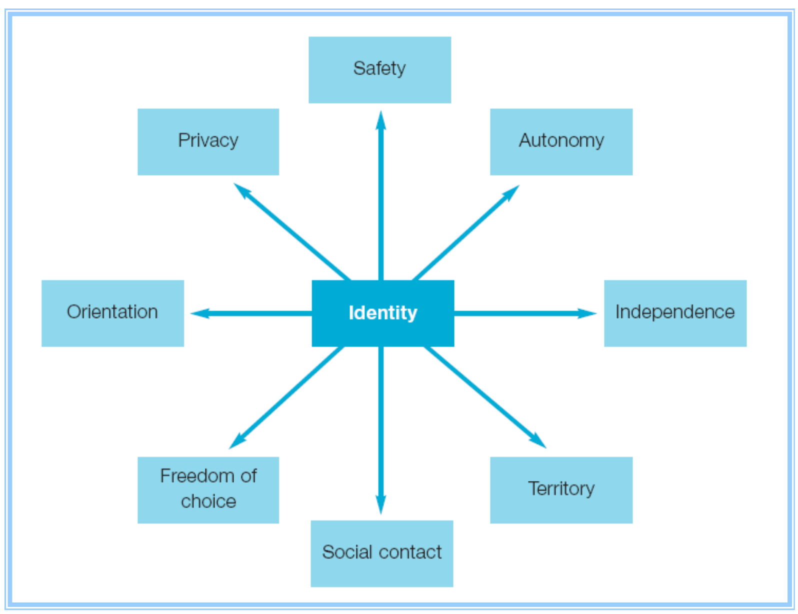


Figure 3.4- Patient's identity (Source: (NHS Estates, 2005))

In a hospital environment a patient is likely to lose his/her identity to an extent because he/she experience usually less control over the themes of identity. This probably happens in multi-bed rooms more than in single-bed rooms. The report suggested that if multi-bed rooms are included in the design, more attention needs to be paid to how of these themes are addressed.

3.4.3 Patients' right to privacy

Patients' rights encompass legal and ethical issues in the provider-patient relationship, including: patients' right to privacy, the right to quality medical care without prejudice, the right to make decisions about treatment options and the right to refuse treatment. Patients' rights have been recognised around the globe since the Human Right Act was published by the United Nation in 1948 and emphasized in the Human Right Act 1998 (Woogara, 2005).

The emphasis here is on privacy as a basic human right. The respect of this right by health professionals is vital for patients' physical, mental, emotional and spiritual well-being (Woogara, 2001). According to FIGO Committee for the Ethical Aspects of Human Reproduction and Women's Health[3], patients' rights to privacy include decisional, physical and informational privacy (Serour, 2006).

Patients' right to privacy has been addressed in many declarations of patients' rights, for example, World Medical Association Declaration of Helsinki[4] in 1964 (WMA, 1964) and World Health organization declaration on the promoting of the patients' rights in Europe (WHO, 1994). Moreover, the Health Insurance Portability and Accountability (HIPAA) act of 1996 emphasised the importance of providing reasonable safeguards to protect the confidentiality of staff conversations with and about patients in order to protect patients' privacy (OCR, 2003) [5].

In the UK, patients admitted to NHS hospitals have legal, ethical and human rights (Woogara, 2001). The Department of Health, which provides strategic leadership to the NHS, and social care organizations in England, has addressed the importance of respecting the patients' right to privacy in many publications. For example, NHS plan 2000 has emphasised the importance of respecting the privacy, autonomy and dignity of

[3] The FIGO Committee for the Ethical Aspects of Human Reproduction and Women's Health is part of the International Federation of Gynecology and Obstetrics (FIGO) and aims to identify and study the important ethical problems confronting health care practitioners in human reproduction.
[4] World Medical Association (WMA) is an international organization created to ensure the independence of physicians and the highest possible standards of ethical behaviour by physicians.
[5] OCR is the Office of the Civil Right. One of the secretary offices in The Department of Health and Human Services which is the United States government's principal agency for protecting the health of all Americans and providing essential human services.

the older patients (Department of Health, 2000). In addition, The Department of Health published two reports in which the importance of respecting the patients' right to privacy was emphasised (Department of Health, 2001a; Department of Health, 2001b).

3.5 Summary and Conclusions

In this chapter the concept of privacy and its associated issues that have been discussed in the literature have been investigated. This included the definition, functions, types and the universal versus difference aspects of privacy. Particular attention was paid to the role of the spatial arrangements of the physical environment in facilitating privacy requirements as has been debated in the human-environment relations literature. Then this was linked to patients' privacy by demonstrating the importance of privacy for the well-being of patients in terms of maintaining dignity, control and identity; and the wide recognition of patients' right to privacy.

Privacy has been characterized as a function of the spatial arrangements of the physical environment or, in other words, the design of architecturally bounded settings, which is how privacy is approached in this study. The architectural design of a space (in this case hospital open-ward) should act as facilitator for privacy by responding to its occupants' needs and preferences (in this case patients' needs and preferences).

Following Archea's visual and exposure model of privacy, this chapter illustrated that spatial arrangements of the physical environment is crucially linked to the visual aspects of privacy (no claim is made that it is not linked to the other senses-related aspects of privacy such as acoustic privacy, but however this is out of the scope of the current study). As a consequence, visual privacy is defined in this thesis as the amount of visually communicated information as a function of one's position in relation to the immediate spatial arrangements of the physical environment and the wider surrounding spatial configuration. Hence, locational preference for privacy is the location within the spatial configuration which facilitates the achievement of the desired level of visual privacy.

According to this well-established relationship between spatial arrangements of architectural elements which bound a space and visual aspects of privacy, people adjust their spatial locations according to their privacy preference. Hence, there is a need to assess people's preferences for locational privacy using a well-established framework that quantifies the spatial environment in terms of the visibility it offers from different locations relative to the whole spatial configuration. According to Gifford (2002) no comprehensive measure of privacy has been developed yet and privacy has been investigated mostly with surveys, questionnaires and interviews. This is particularly relevant to open-wards where patients experience a higher level of visual privacy violation. It is here where this thesis makes use of space syntax theory for the analysis of the spatial structure of architectural configurations as a tool to assess people's locational preference for privacy in hospital open-wards.

Chapter Four:

Space Syntax and Visibility Graph Analysis (VGA)

4.1 Introduction

The aim of the current study is to investigate the relationships between layout spatial attributes and people's preferences for privacy in open wards. The investigation requires a tool with which the impact of the spatial structure of a layout on people preferences and behaviour in architectural environments can be captured. (Peponis and Wineman, 2002, page 276) stated that '*The origins of examining the essential function of the spatial layout are deeply rooted in studies of environment and behaviour'*. Thus, a syntactic approach for the analysis of spatial environments could be helpful to understand the logic of people's preferences and dislikes for privacy according to measurable spatial attributes of bed locations within planned hospital wards, and therefore, making use of one of the existing analytical approaches for spatial environments.

In this chapter three theories, or ways of thinking, about aspects of spatial structure and the way that structure functions to influence the behaviour of its users are reviewed and compared, to allow better understanding of these approaches and selection of the most appropriate one to this research.

Isovist, space syntax (convex and axial representation) and visibility graph analysis are reviewed, their analytical techniques studied and their limitations determined. Then a comparison between them is carried out to determine the appropriate one by which objectives 1 and 2 of this study can be addressed in a later chapter.

After determining the technique to be used, this technique is applied to analyse the spatial environments of the six case studies. The results are shown in this chapter in two formats: visibility graphs (visual representation) and tables (numeric representation). After this the chapter finishes with a summary. This chapter provides an insight into the spatial structure of the wards examined in a quantitative format which allows the statistical investigation in chapter six.

4.2 Isovist and Isovist Field

An Isovist is a way to analyse space, frequently architectural space. It has been used in architecture, geography and mathematics. As reviewed by Turner et al (2001), the concept of isovist was first introduced using this name by Tandy (1967), who used it as a method to analyse the landscape. Later, different terms were used to describe the concept of the isovist e.g. 'intervisibility' in computer topographical models (Gallagher, 1972) and 'viewshed' in landscape architecture and planning (Lynch, 1976).

The importance of the concept in architecture seems to be first recognized by Benedikt (1979), who defines the isovist as '*the set of all points visible from a vantage point in space with respect to an environment*'. This way of thinking allows him to quantify the size and the shape of the isovist using geometric measures. As a consequence, the isovist becomes an effective way to describe spatial environments as people perceive and interact with them which allows a number of spatial behaviours to be explained.

Benedikt tried to combine the interest of psychologists and architects in space by producing a tool to integrate psychological concepts of space from an architectural point of view. He built his assumption on Gibson's (1966) conceptualization of the visual environment as the light rays received by the eye from a surrounding environment. Thus the perception of the visual environment is related to an individual point, which could be the observer, who will face changes in the visual information he/she is receiving during any movement in the space, because the light rays he/she receives will change according to his/her position in the space. Therefore, Benedikt defines the visual environment as '*the field light-borne information*' in which the observer is involved. According to this definition, a strong interplay between space, light and visibility can be noticed. The isovist is formulated as a means to look at this interplay.

Benedikt noted that the position of the generating point and its surrounding environment control the shape and the size of the generated isovist. Therefore, measuring the properties of the shape and the size of an isovist can be useful to explain and predict spatial behaviour. Benedikt considered the isovist as a volume, and then he simplified it into a 2D horizontal slice taken at the level of the observer's eye. Therefore, the isovist is a closed polygon parallel to the ground plan in a defined environment.

4.2.1 Isovist geometric measures

In order to produce numerical measures which quantify the size and the shape of an isovist, Benedikt relied on the boundary of the isovist and the distribution of what he called the radial of length.

According to Benedikt (1979), the boundary of an isovist splits into three types: real surfaces which are the surfaces that close the field of sight (scatter the light), occluding radial surfaces which are the surfaces of the radials which define the occluded area and finally, the region-boundary surfaces, that is the surfaces resulted from the intersection between the field of sight and the boundary of the environment. These three types of isovist's boundaries were used then to measure the size of isovists.

In addition, Benedikt calculates the radial of length, which is the length of the straight line (light travels in straight lines) connecting the generating point with another point on the boundary surfaces of the isovist according to an angle. Radial of length indicates how much the isovist is distributed. Hence, the radial of length has a distribution function, and can be used to measure some features of the shape of an isovist. Figure 4.1 illustrates the boundaries and radial of length for an isovist.

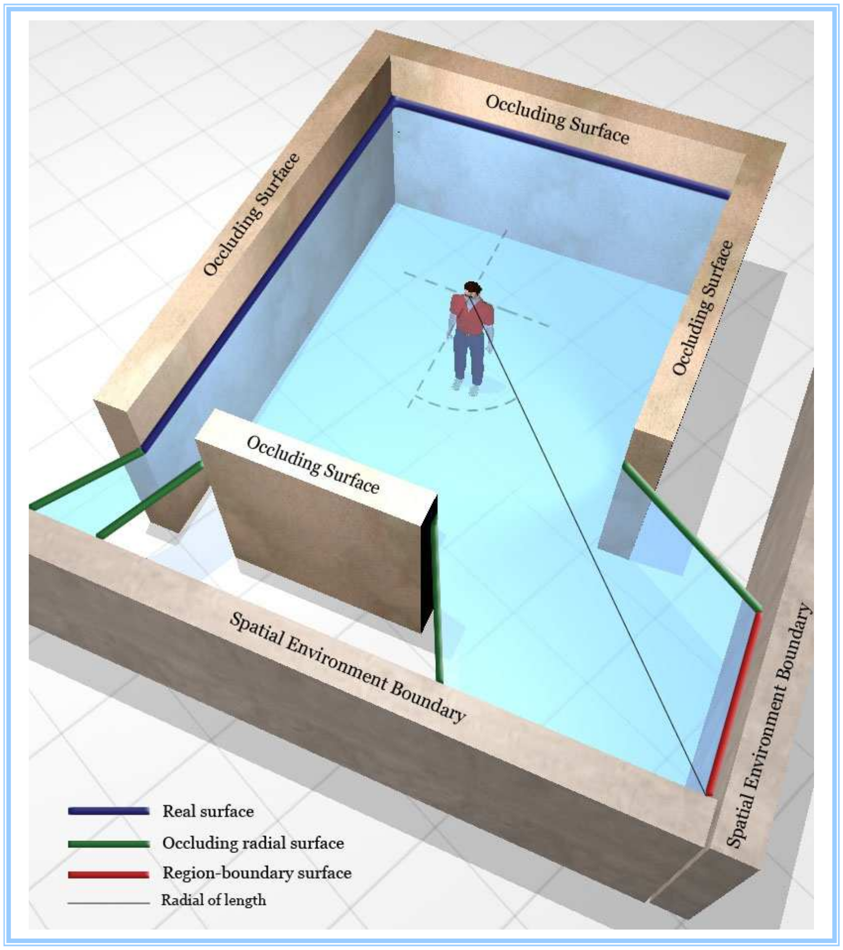


Figure 4.1 – Benedikt's Isovist boundaries and radial of length (Source: the author)

As a consequence, Benedikt developed several geometric measures to quantify isovists. These measures are: area, perimeter, occlusivity, variance, skewness and circularity. The area and the perimeter measure the size of the isovist, whereas the occlusivity, variance, skewness and the circularity measure the shape of the isovist.

The area of the isovist is simply the area of the isovist polygon measured in square metres. In other words, it measures how much space can be seen from the generating point, and conversely how much space can see the generating point. Benedikt's perimeter of the isovist measures how much 'real-surface' can be seen from the generating point (Figure 4.1). For this measure, the other two kinds of boundaries of the isovist (occluding radial surfaces, and region boundary surfaces) do not count. On the other hand, the occlusivity of the isovist measures the length of the occluding radial boundary of the isovist. In other words, it is the sum of the length of all occluding radials. If the occlusivity equal zero that means there are no occluding areas and the isovist equivalent to the configuration, while an increase in the value of the occlusivity indicates more doubt about the configuration. There are two measures which depend on the distribution of the radial of length of an isovist, the variance and the skewness. The variance of the radial measures the diffusion of the perimeter of the isovist polygon. On the other hand, the skewness of the isovist is measures the asymmetry of the perimeter of the isovist polygon. The last measure is the circularity of the isovist which is a measure of how close the isovist is to a circle. In other words, it is a measure of centrality of the generating point with respect to its isovist. These six measures presented by Benedikt (1979) quantify numerically the size and shape of an isovist in an attempt to describe spatial configuration and explain some behaviour in space such as privacy, visual control and way finding.

In spite of the importance of Benedikt's approach for describing architectural space and urban configuration, only a few studies aimed to develop the concept and its measurements in architectural literature (Turner et al., 2001) and urban studies (Batty and Rana, 2004). For instance, Conroy (2001) developed a computer application called 'Omni Vista'[6] to investigate the visual properties of the stopping patterns of subjects in different environments. This particular application generates the isovists according to Benedikt's concept and calculates the measures that he described. In addition, 'Omni Vista' calculates extra geometric properties such as: area/perimeter, dispersion, drift, maximum radial length, mean radial length, minimum radial length and standard deviation of the radial (Dalton and Dalton, 2001). Omni Vista runs on Apple Macintosh platform, which may be the reason it has not been widely used. On the other hand, the recent versions of widely used software called Depthmap, can produce point isovists along with their measures. Depthmap runs on a Windows platform. More explanation about this particular software will follow in this chapter.

4.2.2 Isovist Field

Benedikt observed that each single isovist in a particular environment is unique in shape and size, and this isovist will change according to the movement of the generating point. Hence, he assumes that in order to quantify the spatial environment and understand how people perceive it, move through it and use it, the interplay between the isovists in the

[6] Omni Vista is an Apple Macintosh programme to perform isovist analysis, developed by Ruth Conroy and Nick Dalton especially for the PhD of Ruth Conroy (Conroy, 2001).

configuration need to be considered. As a consequence, he formulates the “isovist field” for each of his measurements. The Isovist field, as explained by Turner et al (2001), traces the changes happened to a single property (such as area, diameter…etc) of an isovist according to the movement of its generating point in the configuration and presents these changes by plotting contours lines which shows visually how this property varies through the space.

4.2.3 Isovist limitations

Although the isovist as formulated by Benedikt seems to be an effective tool to analyse spatial environments aiming to explain some behaviours in space, it has not been used widely in architectural research. On the other hand, more studies in landscape have used the concept under the name of ‘viewshed’ (Fisher, 1995; Wang et al., 1996). Turner et al (2001) on page 104 stated that ‘…, *despite the elegance of Benedikt’s isovist methodology and its close relationship to theories of visual perception and spatial description, applications of the isovist in architectural analysis have been limited to a small number of studies’*.

This limitation in using the isovist in the field of architecture may relate to the following reasons: firstly, the computing time required to produce the isovist, the geometric measures and isovist field (Turner and Penn, 1999). However, the time required for these tasks has significantly reduced after the rapid development of the computer industry and information technology. Secondly, there is no clear way of how to interpret the results of the isovist measures under the umbrella of social issues. In other words, there is no clear ‘*theoretical framework*’ to do so (Turner et al., 2001). And finally and most importantly, Benedikt’s geometric measures are all local and describe the visual field of a point in the configuration. That means these measures can not describe the visual relation between a given location and its spatial environment (Turner and Penn, 1999; Turner et al., 2001).

4.3 Space Syntax Theory

Space Syntax is a set of theories and techniques developed by Bill Hillier and his colleagues at the Bartlett School of Architecture in University College London (UCL), as a new approach for the representation, quantification and interpretation of spatial environments in settlements and buildings in terms of their social relationships. Space syntax deals with spaces as a social product embedded within a social logic, not as neutral physical entities (Hillier and Hanson, 1984).

Space syntax was presented by Hillier and Hanson (1984) and further developed by Hillier (1996a). The theory and its analytical techniques have been widely applied in the fields of architecture, urban design, planning and interior design. The use of these techniques has been extended to involve a variety of other fields such as archaeology, information technology, geography and anthropology. In addition to the initial focus of space syntax, which was mainly on the pattern of predestination movements, the use of these techniques has been extended to include modelling of urban traffic, predicting air pollution levels, estimating the potential of retail development and many other aspects (Ratti, 2004a).

It seems that there are two factors which have significant consequences for the way in which people think of the relation between themselves and spaces. Firstly, people are active in buildings, hence a building offers a picture of how a group of people organise their interaction, separation and activities in space. Generally speaking, people with power have bigger rooms, better carpets and more expensive desks. Those without power have much less. Moreover, people with power are often at the heart of a building, deep in the centre and not at its borders. So, buildings are not neutral physical objects but reflect the priorities of the society they are located in. Secondly, when exploring whether architecture affects behaviour or not, it is important to remember that people are not related to a neutral physical object, but to human values embedded in space. Human behaviour is already part of the built environment (Aspinall, 2002).

With this understanding in mind, the significance of a quantitative tool which can capture the relationship between human behaviour and the spatial environment is widely recognized. And this was, and has been, the driver of the continuous development of space syntax theory. Hanson and Zako (2005), page 117, stated that *‘’Space syntax techniques for the analysis of spatial layouts were the first to demonstrate, in a numerical way, clear and systematic relations between spatial design and observed functioning across a range of buildings and urban types’’*.

Space syntax’s central empirical claim is that relatively simple spatial relations could be the prime determinant of how people occupy and move through a building or urban environment. The visual relations between spaces allow investigation into how a particular spatial environment functions socially. Hillier and colleagues have produced evidence showing high correlations between what space syntax predicts and the way in which architectural space is used. Examples are, pedestrian movements in urban areas (Hillier et al., 1987; Peponis et al., 1989; Hillier et al., 1993; Ozer and Kubat, 2007), traffic flow (Penn et al., 1998; Barros et al., 2007), commercial land value (Desyllas, 2000; Min et al., 2007) and crime patterns (Hillier and Shu, 2000; Nubani and Wineman, 2005; Sahbaz and Hillier, 2007). Hillier and Hanson (1984) argued that highly accessible and visible spaces in the network are likely to be most inviting to social interaction, whereas segregated spaces are less inviting. A remarkable finding of space syntax is that global properties of a spatial configuration, such as integration, are important in predicting the behaviour in the space and determining the functional consequences of the design. A number of studies, in different cultures, environments and scales, reported noticeable correlations between global measures of space (i.e. integration) and average number of people found in the space (Peponis et al., 1989; Min, 1993; Peponis et al., 1997; Read, 1999).

4.3.1 Space syntax analytical techniques

The approach of space syntax is to develop strategies and techniques by which inhabited spaces, either of buildings or urban scale, can be analysed in a way that allows the researcher to understand the social logic embedded in these spaces. This, in turn, can be integrated in sophisticated computer programmes to perform the spatial analysis (Ratti, 2004a). The results of this analysis, which are usually numerical, may develop a good grasp of interrelationships between the spatial configuration and a social, cultural or behavioural phenomenon under question. In order to do so, the space needs to be configured. Configuration , in the words of Hillier et al (1987), page 363, *"is defined in general as, at least, the relation between two spaces taking into account a third, and, at most, as the relations among spaces in a complex taking into account all other spaces in the complex. Spatial configuration is thus a more complex idea than spatial relation, which need invoke no more than a pair of related spaces."* In other words, defining a set of discrete spaces, which are connected to all other spaces in the environment, rather than seeing the space as a continuous single entity. This way of thinking allows the space to be represented by its topology, which is non-metric representation, in an abstracted way. And this, in turn, allows several analytical techniques to be developed.

Space Syntax techniques may be best explained by Bafna (2003) who presents them in a simple and practical way based on a plan of an office corridor as an example. In this thesis, his logic in describing space syntax analytical techniques is employed. A hypothetical simple hospital ward is used to illustrate the analytical techniques associated with space syntax, Figure 4.2(1). This hypothetical ward consists of two single-bed rooms and one multi-bed room monitored by one space in which the nurses' station is located, and this space is connected to the hospital street. For simplicity, only the main spaces are considered, Figure 4.2(2).

It can be noticed that the relationship of the patient (P2) to the nurse (N) is not symmetric with respect to common space (C), which is the hospital street. That means that (P1) is not accessible directly from (C), but it is accessible from (C) via (N), whilst (N) is accessible directly from (C). On the other hand, the relationships between (P1) and (C), on one side, and (P2) and (C) on the other are symmetric. Space syntax represents each room with a node and each direct access between two rooms as an edge (line) linking their representative nodes.

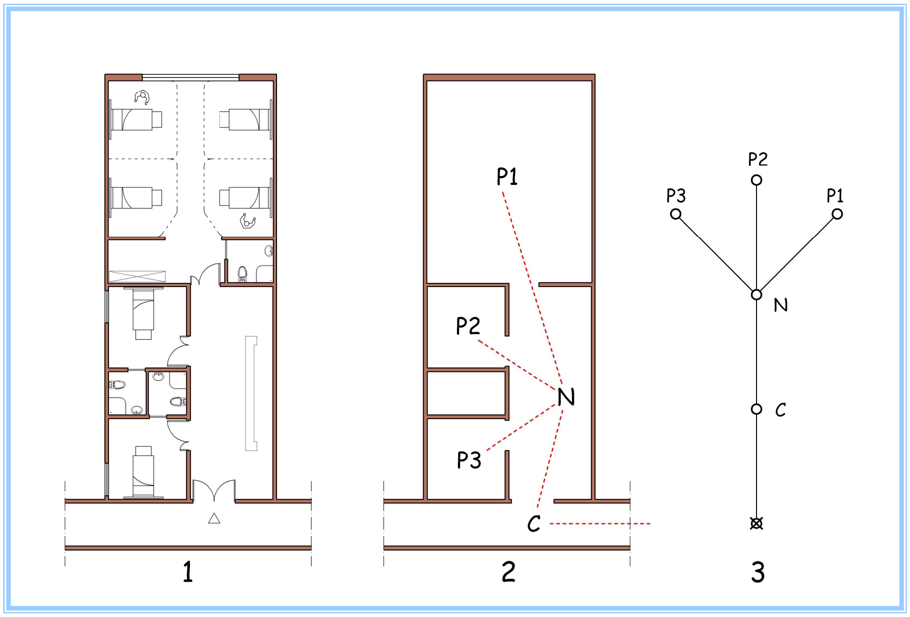


Figure 4.2 - Hypothetical simple ward and its justified map.

This way of representing the plan allows a map of nodes and links to be drawn which represents the topology of the original plan, as shown in Figure 4.2(3). In this map, which is called a *justified map*, patients are located in the upper level and nurses in the lower level, and that gives a clear idea about the social and functional hierarchy in this plan. The point in this kind of representing is independent from the physical attributes of the plan such as the size of the room, furniture or windows. The only things that count are accessibility and visibility, which are related to the social and functional logic. It is not acceptable that the only access to the nurse's space is via the patient's space. In contrast, it is recommended that the only access to the patient's space be via the nurse's space. This justified map reflects the importance of patients in hospital wards who should have more privacy than others (similar to the relation between the patient and the nurse is the relation between the manager and his secretary). Moreover, the nurse can control the access to the patients and monitor their movements.

Suppose the patient has another access to his/her room, Figure 4.3. In this case the control of the nurse over access to the patients would be reduced because of the alternative route created and the privacy of the patients would be reduced as well. This alternative route, which reduces nurse's control over the patients, is called a *ring*. Rings can be captured by the nodes and edges presented in the justified map.

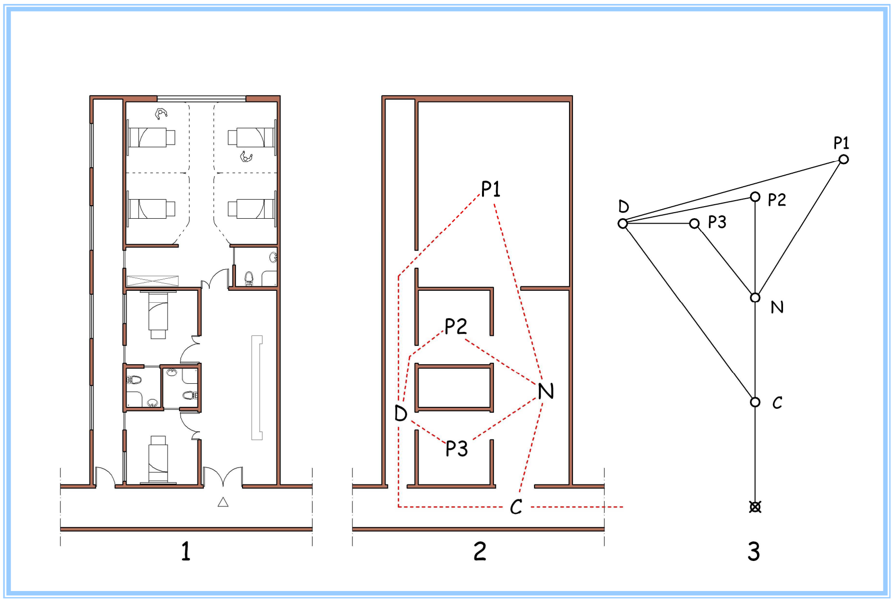


Figure 4.3 - hypothetical simple ward with rings.

Then, the combination between the concepts of justified maps and configured spaces, which are usually defined by boundaries, has led to a simple technique by which the spatial configuration can be represented. This can be done by assigning each node to a space label which can be distilled from the original plan. However, it has been noticed that this way of representing is limited in capturing the properties of the spatial structure (Bafna, 2003). This limitation can be illustrated by the same example of the hypothetical ward, but by modifying its plan slightly, Figure 4.4(1). In this case the nurse will not be able to control visually the movement from and to (P3). But the justified map of this representation of spatial configuration assumes that the nurse controls (P3), which is not accurate. As a consequence, the spatial configuration can be represented by convex polygons, Figure 4.4(2), by which the properties of the spatial configuration can be captured. This representation produces another map which is called *convex map*. The rules for generating a convex map are to take a spatial configuration and divide it into a set of the 'fewest and fattest' convex spaces in which all points are directly visible and accessible from all other points, as suggested by Hillier and Hanson (1984). Then each convex space can be represented by a node and each accessible relationship between the convex spaces can be represented as an edge to produce a justified map from the convex map, Figure 4.4(3).

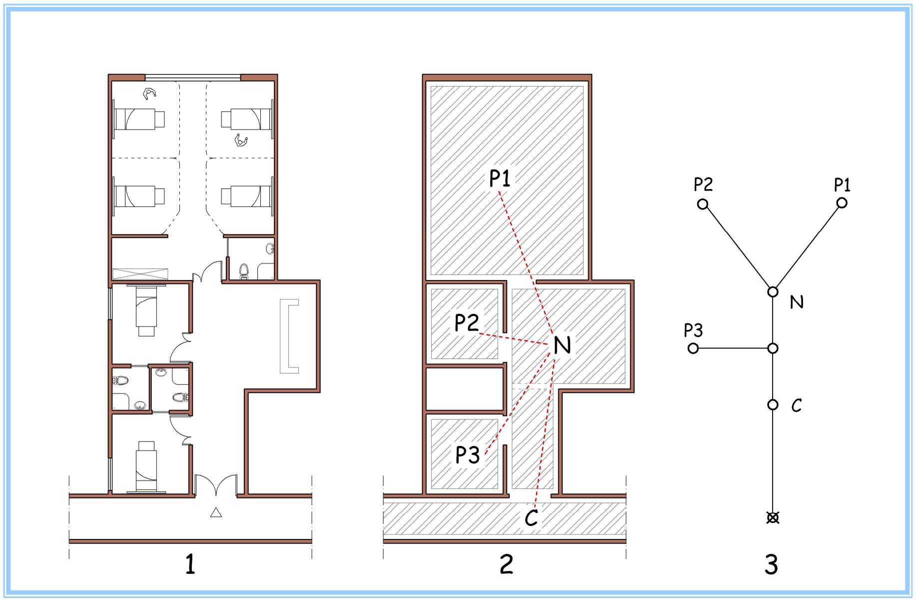


Figure 4.4 – The convex map of the hypothetical ward.

This two-dimensional way of describing the spatial configuration gives a static description of the spatial configuration, whereas space syntax aims to capture the dynamism of the social life in space (Bafna, 2003). As a solution to this conflict, a one-dimensional description of the spatial configuration is presented to capture the movement structure within a given configuration by overlaying another map called *axial map* on the top on the convex map. Hillier and Hanson (1984) found that, while strangers are more likely to move through space in the settlement, inhabitants collectively have a more static relationship to various parts of the local system. They argued that axial lines give access to strangers to enter the system. While convex spaces create a more static zone to the inhabitants to control the system.

According to Hillier and Hanson (1984), axial maps are constructed from the minimal set of the longest straight lines that covers the spatial configuration through its convex spaces. To a large extent these correspond to the longest sight lines through the space. However, an axial map relates the spatial experience to the depth between two spaces. In other words, the number of turns to get from one space to another is the important feature rather than the metric distance between the spaces. Axial maps have been developed as a technique to describe and analyse urban areas by considering their street network as configured spaces. Axial maps seem to be the most used space syntax technique at the urban level (Ratti, 2004a).

Therefore, configuration in space syntax can be represented as convex spaces or axial lines. In order to explain the relation between the convex spaces and axial lines, figure 4.5 shows two diagrams. Diagram (a) is a convex space where all points within the space are accessible and visible from all other points without passing outside the boundary of the space, whereas the axial line from X to Y in diagram (b) passes outside the space, and that makes the space a non-convex space. Hence, space in diagram (b) needs to be configured into convex spaces, and then axial lines can be constructed.

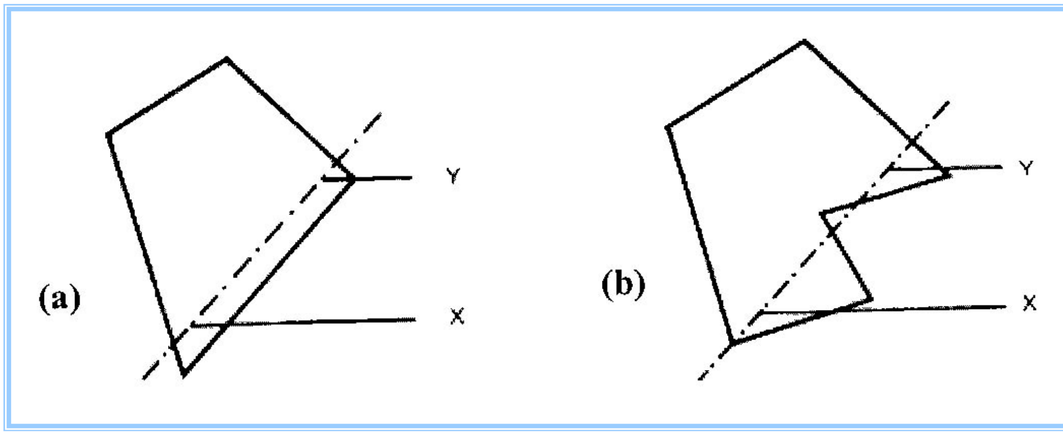


Figure 4.5 – Convex and non-convex space (Hillier, 1988)

4.3.2 Space syntax measures

Space syntax has produced some numerical measures to quantify spatial configuration. Some of these measures are local and some are global measures. Local measures are those which take into account the relationship between the space and the spaces that are immediate accessible from it. Global measures are those which describe the relationships between a space and all other spaces in the configuration (Hillier and Hanson, 1984).

The first developed measure presented by space syntax is the depth. Depth is the consequence of the accessibility of any space to another. To explain, the greater the number of spaces an individual has to access in order to reach another space, the deeper the configuration. Conversely, the fewer intermediate spaces an individual has to pass through to get to another space, the shallower the configuration. The number of spaces passed through to reach a particular space is taken as its depth value. Mean depth is simply the mean of the depth values of all spaces in the configuration (either convex spaces or axial lines) and it represents the shallowness or the depth of the whole configuration.

Then, mean depth is used to calculate the Relative Asymmetry (RA) by which the depth of the spatial configuration from a particular point is compared with how deep it could be theoretically (Hillier and Hanson, 1984). It is a measure of how integrated a particular space is with respect to the rest of spaces in the system. In other words, relative asymmetry is a normalized version of the mean depth where (1) corresponds to all spaces in the system being in a linear sequence from a particular space (low integration) and (0) when they are all directly connected to the space (high integration).

This method of normalization raised an issue. It is acceptable to compare the values of the relative asymmetry of spaces within the same system or spaces in different systems in case where these systems have the same size (number of spaces). But relative asymmetry is not appropriate when comparing systems with different sizes. In order to compare systems with different sizes, Hillier and Hanson (1984) developed what they called Real Relative Asymmetry (RRA). They divided the normal relative asymmetry value by the D-value which is calculated as a relative asymmetry of the level 0 in the justified map of the diamond-shape pattern. Current space syntax studies report integration values which are the inverse of RRA value (1/RRA). The higher the integration of the space (lower RRA), the less depth the space has in the system. In addition, integration can be calculated to various radii. In this case, the calculations of the integration of a space will be limited to the spaces that are accessible up to a given number (radius) of steps from that space. Mean depth and integration are global measures as they consider the relationship with all spaces in the spatial environment.

One of the local measures of space syntax based on the axial map and convex map is connectivity, which can be defined as the number of spaces at a depth of one (directly connected) from a particular space, and simply measures how well connected a space (axial line or convex space) is locally. On the other hand, control is another local measure and it measures the amount of choice a space presents to its neighbours as a possible first step in a journey. The larger the control value, the larger the chance of the space to be visited when moving from a neighbouring space (Hillier and Hanson, 1984).

Space syntax methods have been used in numerous studies in many fields, mainly in the field of architecture in both urban and building design. It has been found that integration values correlate with pedestrians' movement. Hillier (1985) reported a correlation between the integration and the density of pedestrian movement in a residential area in London. Similarly, Hillier et al (1987) investigated the relationship between integration and pedestrian movement in four areas in London, and found high correlation. Hillier et al (1993) reported that integration correlates noticeably with the distribution of population within an urban setting. The same correlation has been found in different cultures and different cities, such as in six Greek cities (Peponis et al., 1989), in ten neighbourhoods in Sweden and China (Min, 1993) and in Dutch cities (Read, 1999). Moreover, a strong correlation has been found between integration radius-3 and vehicular distribution in streets in six areas in London (Penn et al., 1998).

At the building level, for instance, Grajewski (1993) reported strong correlations between the interaction (the ratio between people engaged in conversation to the total number of people) and integration values in six offices in three different countries. Whereas Peatross and Peponis (1995) found noticeable correlations between integration values and movement densities in two institutions for design education. In addition, space syntax has contributed to wayfinding research (Peponis and Zimring, 1990; Haq and Zimring, 2001).

Space syntax techniques have been used widely in the field of environmental psychology. For example, Rashid et al (2005) investigated the direct and indirect effects of spatial behaviours and layout attributes on individuals' perception of six psychological constructs, which are: privacy, communality, communication, control, territoriality and safety in open plan offices. They used axial lines to analyse the accessibility and the visibility in four US federal office settings. The analysis involved integration, connectivity and axial lines' length. The results of statistical analysis revealed that the three spatial behaviours considered in the study (movement, face to face interaction and visible-copresence) and the three layout attributes (integration, connectivity and axial lines' length) are important for individuals' perception of psychological constructs in open offices. Moreover, regression analysis suggested that there is a negative correlation between the sense of privacy and two layout attributes: integration and the length of the axial lines. The results showed that higher integration had amplified the negative effect of some spatial behaviour (i.e. visible co-presence) on individuals' perception of privacy. In other words, the higher the integration value of the space next to a workstation, the less privacy people working in this station feel with respect to the associated effect of visible co-presence.

In another study, the relationships between the main physical features of residential care homes for older people and quality of life for residents and staff were investigated by Hanson and Zako (2005). The study involved thirty-six care buildings which were analysed twice, firstly using convex space method and secondly using axial lines method. The results suggested that building layout has clear effects on aspects of quality of life of the residents in care home buildings.

There is one more concept which has been discussed in the space syntax literature. It is the extent to which the local attributes of a configuration indicate its global ones, which known as the *intelligibility* of the spatial configuration. In other words, intelligibility is the property of a spatial configuration by which the observer can perceive its spatial structure and move through it correctly by gleaning the global structure of the environment through its local structure (Hillier, 1996a). The intelligibility of a spatial environment can be measured by the degree of correlation between the local measures (i.e. connectivity) and global measures (i.e. integration).The greater the correlation between the connectivity and the integration of a spatial environment is, the higher the intelligibility of this spatial environment will be. It has been found that in highly intelligible environment the degree of the correlation between the global measures, such as integration, and people behaviour (i.e. movement within this environment) is greater than in low intelligible environments (Hillier, 1996a). Another study showed that the correlation between spatial configuration and spatial cognition is significantly higher in highly intelligible environments (Kim, 2001).

In summary, *''the ability of space syntax to describe global configuration properties as well as relationships of part to whole and the association between these properties and patterns of space use has made it a fruitful method used in a variety of broader fields…''* (Peponis and Wineman, 2002, page 279).

4.3.3 Space syntax criticisms and limitations

In spite of the elegance of Space syntax theory, and its analytical techniques, being one (if not the only one) of the successful attempts to quantify the relationships between spaces and human behaviour, it has been criticised. Several limitations were identified by Ratti (2004a). In his paper entitled -*Space syntax: some inconsistencies*- he argued that there is a number of what he called *inconsistencies* in space syntax. Some of the points he raised were noticed previously by other authors and other points were new. Hillier and Penn (2004) replied to these criticisms, and Ratti (2004b) came back with a rejoinder. This debate focused on axial maps as the most used space syntax technique. The following paragraphs summarize this debate briefly in six points.

First, space syntax discards the metric attributes of the spatial environments and relies on the topological representation only, which raises the fundamental problem in linking the metric and the topological attributes in one model. This particular problem had been discussed earlier (Chang and Penn, 1998; Hillier, 2003). Hillier and Penn (2004) explained in two points why space syntax research deals with metric information in the regression model rather than the spatial model. Firstly, the metric factors may change significantly, and sometime contrary, to the integration of some spaces. Secondly, they may have an impact on the choice of boundaries which in turn may affect the location of the centre of integration. Steadman (2004) argued that it is unquestionable in traditional transport models that travellers follow the shortest routes in terms of the metric distance or travel time rather than shortest topological turns as space syntax argues.

Secondly, space syntax ignores the 3D information (e.g. building height), which seems to play a role in the density of pedestrian movements (higher buildings generate more movements). The reply to this criticism is based on the basic assumption of space syntax ,which was emphasised by Hillier et al. (1993), that the spatial configuration is the driver for pedestrian movement while other attractions function as *multipliers*. In addition, Hillier and Penn (2004) explained that such factors can be dealt with in the regression model rather than in the spatial model. For example, Penn et al (1998) found that although variables like building height and pavement width were significant in predicting pedestrian movement at particular scales, the effects of the spatial variables, however, were significantly higher.

Third, Ratti (2004a) argued that the disregard of land use in axial maps is another limitation associated with space syntax techniques which has been reported previously by Batty et al. (1998). Hillier and Penn (2004) seemed to have a different approach to this particular issue. They believe, based on previous studies (Hillier, 1996b; Hillier, 1999), that rather than investigating the impact of the land use on the movements and spatial configuration, it would be more appropriate to investigate the influence of the spatial configuration, and as consequence the movements, on land use.

Fourth, what seems to be a well-known limitation of space syntax, with particular reference to axial lines, is the process by which the axial map is drawn which has been seen as an arbitrary, or subjective, process (Batty and Rana, 2004; Ratti, 2004a). Different researchers may produce non-unique axial maps for the same spatial environment as no logarithm has been developed to create axial lines automatically (Desyllas and Duxbury, 2001; Batty and Rana, 2004). Hillier and Penn (2004) argue that there are set of questions, which correspond to the definition of the axial lines, by which the process of creating axial line is governed. Examples of these questions are: *"Can a line be extended to make further connections? Can two lines be simplified into one? Are all parts of space covered? Are all 'rings' around built forms represented? "* (Hillier and Penn, 2004, page 507).

As a reaction to this particular limitation, two noticeable attempts to automate the process of creating axial maps have been developed. The first approach is based on approximating isovist's geometric properties, such as diameters, in order to produce an axial map which corresponds to the degree of the intersection and accessibility between the isovists. This allows a generic algorithm to be developed (Batty and Rana, 2004). The second approach uses an *all-line map* as presented by Penn et al (1997), in which all the possible axial lines are drawn. Then Peponis et al (1998) suggested minimising these lines to the fewest set of axial lines. This approach has been taken further by Turner et al (2005) who wrote an algorithm to reduce the all-lines map to its correct *least-line map*. Newer versions of some space syntax software (i.e. Depthmap) can create both All-line maps and Fewest-line maps in a reasonable time. This significant development has happened after this research had been started.

Fifth, Ratti (2004a) illustrated in an example that a small transformation in the geometry may change significantly the integration values of axial lines, and as a consequence the movement pattern, the phenomenon he called "*the discontinuous nature of axial map transformation*". Hillier and Penn (2004) explained that although Ratti’s examples look geometrically similar, they are "*syntactically different*" and small changes in the geometry are important as it has been evidenced that these small changes affect the morphology of the urban areas (Hillier, 1996a; Hillier, 2002) and the behaviours within spaces (Conroy, 2001). Ratti (2004b) seemed to be unconvinced and he argued back that small geometrical variations, which can not be captured by the eye and at the same time change the integration values significantly, should not affect movement patterns significantly.

And finally, space syntax does not seem to be clear about how to define the boundaries of spatial configurations. According to Ratti’s example (2004a), extending or shrinking the boundaries will alter the integration pattern of the spatial configuration under study. This is associated with the claim that space syntax has limitations when dealing with regular grids: a regular grid of axial lines has the same integration value, but as soon as it is connected to its outside (by an axial line or a street in case of cities), different integration values may be obtained. This limitation has not been addressed, as far as it could be asserted, satisfactorily in space syntax literature. There had been some attempts to reduce what is known as *axial map edge-effect.* Ratti (2004a) recommended using local integration (i.e. integration radios 3) rather than the global one.

4.4 Visibility Graph Analysis (VGA)

Visibility Graph Analysis was introduced as a result of the combination between two ways of thought: isovists and space syntax. However, it is usually entitled under the wider umbrella of space syntax. It is a graph-based technique in which each isovist in the configuration is represented as a node, and as consequence the graph consists of a grid of points. These nodes are connected by edges if they are mutually visible.

It is a method to analyze space using several measures which could be calculated from this graph. Some of these measures are syntactic to achieve the overlapping between the isovist field and the space syntax finding which reported noticeable correlations between global measures of space (i.e. integration) and some aspects of behaviour (i.e. pedestrian movement) (Hillier and Hanson, 1984; Hillier et al., 1993). This overlapping produced the "*integrating isovist*", which was first introduced by Turner and Penn (1999). The concept of the integrating isovist has been developed after that to form visibility graph analysis by Turner et al. (2001).

In visibility graph analysis a set of points in the configuration forms the grid of points from which the isovists can be generated. Then, the relationships between the points are established by edges. The selection of these points should, as much as possible, describe the configuration, hence the grid resolution should be adequate to cover all the spaces under question. Turner et al (2001) pointed out that the reasonable resolution when the human scale is considered is one metre. However, a finer resolution may be required to capture meaningful features of the configuration.

The edges between the grid points, which represent the relationship between the isovists, are formed following one of two rules as described by Turner et al (2001). Firstly, between each two points if there is an intersection between the isovists generated at these points and if the points are mutually visible, this relationship is called the *first-order visibility relationship*. Simply, this relationship is formed between each point and all other point visible from it. Secondly, *second-order visibility relationship* is formed between each two points if their isovists are intersected and the points themselves are not mutually visible- in other word, taking one step from a generating point into the intersection area, then taking second step to another generating point. Figure 4.6 illustrates these relationships.

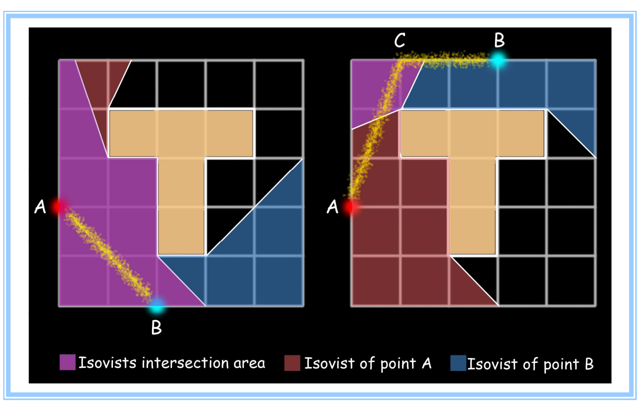


Figure 4.6 – First and second order relationships (Source: The author based on Turner et al. (2001))

These rules of establishing relationships between the grid points allowed them to describe the relationships between isovists (integrating isovists) and to formulate syntactic measures of isovist fields in order to combine the isovist fields with space syntax to get a better description of the spatial configuration and the function consequences of the design. Turner and Penn (1999) considered each isovist as a node and each relationship of intervisibility and accessibility as a link. This allowed them to develop global measures of isovist fields which can determine the accessibility and the visibility between nodes in the configuration even if these nodes are not directly visible. This methodology has been formalized later as Visibility Graph Analyses (VGA) by (Turner et al., 2001).

Visibility graph analysis can be used not only in terms of visibility (what you can see), but also in terms of accessibility (where you can go) by taking the visibility graph at floor level, instead of eye level. In this case the furniture will cause changes in the analysis (Turner et al., 2001).

4.4.1 VGA measures

The way in which visibility graphs is conducted, and then analysed, allows several numerical measures to be calculated. The first two measures associated with VGA are connectivity and mean depth, which were presented by Turner and Penn (1999). Connectivity is a local measure, whilst mean depth is a global measure. Turner et al (2001) named connectivity as a neighbourhood size which can be defined as all points that are visually directly connected to a generating point. In other words, the connectivity of a point is the total number of points that are mutually visible with that point which corresponds to the isovist size generated at that point. Mean depth (or mean shortest path length) is the total number of shortest paths from each point in the configuration to the generating point, divided by the total number of points in the configuration. This measure represents the number of fewest edges (the number of turns plus one) which connect the generating point to all other point in the configuration.

These two measures were developed under the title of visibility graph analysis by Turner et al (2001), who presented the clustering coefficient as well. The clustering coefficient is a local measure which was previously developed by Watts and Strogatz (1998). In VGA it can be defined as the number of connections between the points which are mutually visible with the generating point (the neighbourhood size), divided by the number of edges that could possibly be formed. Therefore, it depends on how spiky the isovist we consider is. The spikier it is, the higher the number of points which are not visible from each other will be and that means the lower value of clustering coefficient. In other word, the clustering coefficient value will increase if many points in the neighbourhood of the isovist are mutually visible (related to the convexity of the isovist). A high clustering coefficient value indicates lower loss of visual information during the movement from the generating point to any other location in any direction. For example, in a multidirectional junction the value of the clustering coefficient is low because the isovist polygon generated at that point is spiky and moving from that point to any direction will cause loss in the visual information (Turner et al., 2001).

In order to generate visibility graphs and to perform their analysis, many computer-based programmes have been developed. Again, the pioneer in this field is University College London, Bartlett School of Graduate Studies, in which VGA was introduced under the umbrella of space syntax. In the 3rd International space syntax symposium in Atlanta, Turner (2001) presented the first software to perform visibility graph analysis called Depthmap.

Depthmap has been rapidly developed and many newer versions have been produced. These developments involved many other measures of spatial configuration including integration and control, which were presented by Hillier and Hanson (1984). In addition to the VGA, the recent version of Depthmap is able to conduct axial maps, segment analysis, metric analysis and agent-based analysis.

4.4.2 Depthmap

Depthmap is computer software designed to conduct visibility graph analysis and perform various measures which quantify spatial environments numerically in order to give a good indicator of people's behaviours in space. Depth map has been designed to run on Windows platform.

The user may import 2D drawings as DXF[7] files into Depthmap. To perform VGA, a grid of points needs to be set up, and then the spaces under consideration can be chosen. Depthmap analyses the centres of the grid squares. In other words, it analyses points' location, not grid squares (Turner, 2001). After performing VGA various spatial measures and analyses can be conducted. These spatial measures split into two main categories: local measures which depend on the relationships between each node and the nodes that are mutually visible with it, and global measures in which the relationships between each point and all other point in the configuration are considered. Depthmap, by default, displays the spatial measures as a colour scale. However, a numerical table can be constructed for each measure either for a single node, all nodes or for a set of nodes which are called *Gates* (Turner, 2004).

The local measures that can be conducted by Depthmap release 5.4 (which was used in this research) are connectivity, clustering coefficient, control and controllability. These measures are calculated according to the following definitions which were reported by Turner (2001) and the software handbook (Turner, 2004): Connectivity is the number of nodes each node can see, that is the immediate neighbourhood of a node. Clustering coefficient gives an idea of how much a location is a junction. It measures the spikiness (or conversely, the convexity) of the visual field from a node. The controlling point is that point which can see a large area while each point in that area can see relatively little, see section 6.11 for more details. And finally, controllability is a measure of how many points can be easily dominated by a node.

On the other hand, Depthmap performs four global measures of spatial environments which are mean depth, node count, integration and entropy. The way in which depth map calculates these measures depends on the following concept of each measure which, again, is explained in the software handbook: Mean depth is the average of the shortest path lengths from each node to all other nodes in the configuration. Node count is simply the total number of nodes in the configuration. Entropy is a measure of the distribution of points in terms of their visual depth from a node. Depthmap performs three kinds of integration; these are: integration HH, Integration P-value and integration Tekl. To explain, Integration HH is similar to the integration presented by Hillier and Hanson (1984) in which the normalized mean depth is compared to D-value, which is

[7] Drawing Exchange Format

the integration of the root of the diamond-shape. Whilst Integration P-value compares the normalized mean depth with the integration of the root of a pyramid-shape or half-diamond (Hillier and Hanson, 1984). And in both cases the shapes (the diamond-shape or the pyramid-shape) contain the same number of nodes that are contained in the original configuration. On the other hand, integration Tekl relies on a logarithmic transformation of the total depth of the configuration (Teklenburg et al., 1993; Livesey and Donegan, 2003).

The results of local and global measures can be exported from Depthmap in two main forms: graphs or tables. Depth Map, by default, displays spatial measures with a colour spectral which runs from indigo for the very lowest value through blue, cyan, green, yellow, orange and red to magenta for high values (Turner, 2001). The numeric results can be exported as tables which contain the numeric values of the spatial measures for each point or each group of points (gate).

VGA, and in particular its pioneering software Depthmap, has been seen as an effective tool to analyse and assess spatial environments and to get meaningful understanding of the configuration in order to explain different behaviours in different types of spaces (Turner and Penn, 1999; Desyllas and Duxbury, 2001; Doxa, 2001; O'Sullivan and Turner, 2001; Campos and Fong, 2003; Cutini, 2003; Alameddine, 2004; Fong, 2005; Guney, 2007).

4.4.3 VGA limitations

Similar to axial lines, VGA is based on the topological distance and not on metric distance. The difference is that VGA is a point analysis technique (isovists) whereas axial map is an area analysis technique (convex spaces). Thus, criticism such as the disregard of the metric attributes and the 3D information of the spatial environments can be applied not only to axial lines but also to VGA. However, in studies of the relationship between the spatial attributes and preferences, the effect of other factors rather than the spatial structure can be minimized by eliminating these factors from the graphic information used for data collection. For example, in hospitals, the location of and the distance from the nurses station may influence patients’ preferences of bed location for privacy. This effect can be minimized by not showing the location of nurses' station.

Another criticism to VGA reported by Hillier and Penn (2004) refers to the subjective judgment in the preparation of the spatial configuration to be analysed using VGA. To explain, although VGA is an automated method, the user needs to specify the resolution of the points grid, which may differ from one to another. In spite of the '*around one metre*' grid resolution recommended with regards to human scale (Turner et al., 2001), a finer grid resolution may be required to capture meaningful spatial properties.

Finally, the effect of the edges, or boundary selection, which has been a major limitation of axial maps, has less impact when using VGA for the analysis of building interiors. The reason for that is that building interiors have a well-defined spatial structure if we consider them as a *bounded spatial systems* (Desyllas and Duxbury, 2001).

4.5 Comparison

One of the main aims of this research is to explore the relationship between spatial attributes of buildings and subjective judgment on spatial location for privacy. That raises the need for an analytical technique which allows the researcher to analyse the space in a way in which people preferences for privacy can be captured and, as a consequence, understood. After reviewing three approaches for the analyses of spatial environments - isovist, space syntax (convex and axial representation) and visibility graph analysis - with regards to their relationships to human behaviour, a comparison between these techniques helped to distil the appropriate one by which the aim of this study can be addressed.

To begin with, the way in which Benedikt (1979) presented isovists allows him to produce non-syntactic measures of the size and shape of isovists. In addition, all of these measures are local measures, whereas the literature suggests that global measures are what matters in terms of using the spatial attributes to predict and explain some behaviour in space and understand people's perception and preferences with respect to their activities in space. However, Benedikt's concept of isovist, particularly isovist fields, has been developed and adapted to overcome this limitation. Batty and Rana (2004) suggested a shift in the way of creating axial lines from area analysis (convex spaces) to point analysis (isovist). In other word, allow axial lines to cross isovists rather than convex spaces. The difference is that isovists are usually spiky and therefore not convex spaces, a point made when visibility graph analysis was introduced by Turner et al (2001).

Hence, the important comparison here is between the ability of space syntax and visibility graph analysis to predict and explain behaviours in both urban and building spatial environments. With respect to this comparison, Turner and Penn (1999) in their study in the Tate Gallery found high correlations between room occupancy and a combination of their area and VGA mean depth. More importantly, they compared axial and convex maps with visibility graph analysis in models of movement flow in a department store. Their study showed higher correlations between integration values and movement flow when calculated by visibility graph than by axial map. In addition, they found clear visual similarities between the visibility graph and axial map at urban level (i.e. the area around Baltic House in central London). Similarly, a strong correlation was found between mean depth as calculated by VGA and shopper flows in another shopping store (Penn, 2005).

At the urban level, in spite of the accumulated studies which reported high correlations between movement flow and axial lines integration, Desyllas and Duxbury (2001) presented a comparative study between axial lines and visibility graph analysis at urban level. The results of their study indicate significantly higher correlations between visibility and pedestrian movement than between any axial lines measures and movement flow.

The question, therefore, is: Which method should be used, axial lines or VGA, and which would have a better ability to capture meaningful properties of space at building and urban level? This question was answered clearly by professor Bill Hillier in his email dated 29/03/2007 to the space syntax mailing list[8] in which he stated that:

[8] http://www.jiscmail.ac.uk/lists/spacesyntax.html

" In general, line based analysis, and in particular the segment angular analysis available in Depthmap is the best - and best tested - syntactic technique for urban pedestrian movement. VGA is much less good for urban movement because it conflates one and two dimensional analysis i.e. a space may be integrated either because it is well connected in the linear pattern or because it is wider, and the technique does not tell you which." He added *"Where we have found VGA, and in particular visual integration analysis, strong is in buildings like department stores, and we think it is because movement is less linear and more exploratory, and so movement used the breadth dimension of space to complement the linear dimension much more than in urban movement which is in general less exploratory and more linear."*

Moreover, the advantage of using VGA over axial lines is that VGA is able to capture space properties at a much finer scale. Being a point-based analysis, VGA can describe the spatial properties at each view point in each individual convex space, whereas axial lines can not analyse convex spaces. This was noted by Turner and Penn (1999) who found that the central region of an urban area is better captured by VGA integration. This seems to be related to the relationship between centrality and configuration at urban level. Cutini (2003) reported that the axial lines, being a one-dimensional representation, can not account for the presence of squares in cities nor capture their morphological locations. Thus, he argued that VGA can capture the characteristics of main squares in settlements (i.e. high value of neighbourhood size, clustering coefficient and integration). On the other hand on building level, VGA has been preferred over axial maps in open-plan buildings (Turner, 2000). For example, Doxa (2001) used VGA to analyse two open-plan public buildings, the National Theatre and the Royal Festival Hall, where convex spaces can not be defined clearly.

To sum up, the literature suggested two main reasons for employing VGA in building analysis rather than axial lines. First, in addition to its ability to capture the density of activities in urban spaces, VGA has shown better prediction of movement flow in buildings. Second, VGA is able to describe the space at a fine enough level to capture relationships between building spaces and behaviour within these buildings.

With this understanding in mind, the advantage of using VGA to research in the field of human behaviour (e.g. privacy regulations), particularly in building, is that it demonstrates the impact of the spatial structure on the behaviour under question in a quantified way. The importance of this approach comes from the fact that the spatial structure of a building is under the control of architects and designers. Hence, it can be manipulated to enhance, or weaken, a particular spatial property, or properties, in order to meet the requirements of that spatial behaviour. If a relationship is found, it must be borne that the spatial structure is not the only factor which may have an impact on the behaviour under question, but it can add a great value to the architectural design of buildings if it is considered from the early stages of the design. For instance, in modern hospitals the visual privacy is an up-to-date requirement which seems to be influenced directly by the spatial structure of hospital wards. This particular psychological construct may be enhanced by manipulating the spatial properties, or the design itself, that are related to people's privacy preferences in hospital wards. Turner et al (2001) stated that *"… visibility graph analysis may represent a step towards exploring the relationship between architects, as designer of spaces, and users, as architects of their own experience of space"*.

As a result of the previous discussion, VGA was used for the spatial analysis of the case studies chosen for this research. In particular, Depthmap software was employed to perform VGA and calculate the various spatial attributes. In the following paragraphs a description of the six case studies considered in this research is given. Then, each stage by which the case studies were adjusted to conduct VGA using Depthmap is explained. And finally, the results of VGA for each case study are shown numerically and visually.

4.6 Case Studies

Six different types of open ward in different hospitals in the UK were used to address the aim of this research. James and Tatton-Brown (1986) classified the type of wards into seven categories: nightingale, corridor or continental, duplex or nuffield, racetrack or double corridor, courtyard, cruciform and radial ward. A typical example for each category was included as a case study in this research based on the clarity and availability of ward layouts. However, the courtyard type was excluded from this study because, in general, this type of ward is larger than others. Including courtyard ward would have resulted in either a significant reduction in the scale of presenting ward layouts on the questionnaire or presenting them on separate pages, and in both cases participants' subjective judgments are likely to be affected negatively. In this part, a description of each of these six open wards is given and the layout of each ward is presented.

● *Ward A*

The first case study is an open ward in Larkfield Hospital. It consists of 32 beds distributed in multi-bed bays and single-bed rooms. Each multi-bed space contains four beds. The staff space is located in the middle of the ward splitting it into two sections (Duplex or Nuffield ward type). Figure 4.7 shows the original plan of ward A.

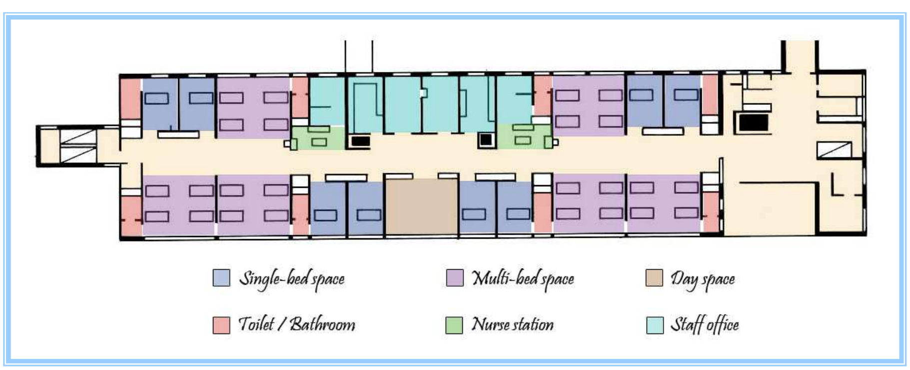


Figure 4.7 - Ward A: Larkfield Hospital, UK. (Original layout: James and Tatton-Brown, 1986)

● *Ward B*

The second case study is an open ward in the east wing of St Thomas' Hospital in London. It consists of 28 beds distributed in multi-bed spaces and single-bed spaces. Each multi-bed space contains four beds. This ward was designed as a corridor ward type. Figure 4.8 shows the original plan of ward B.

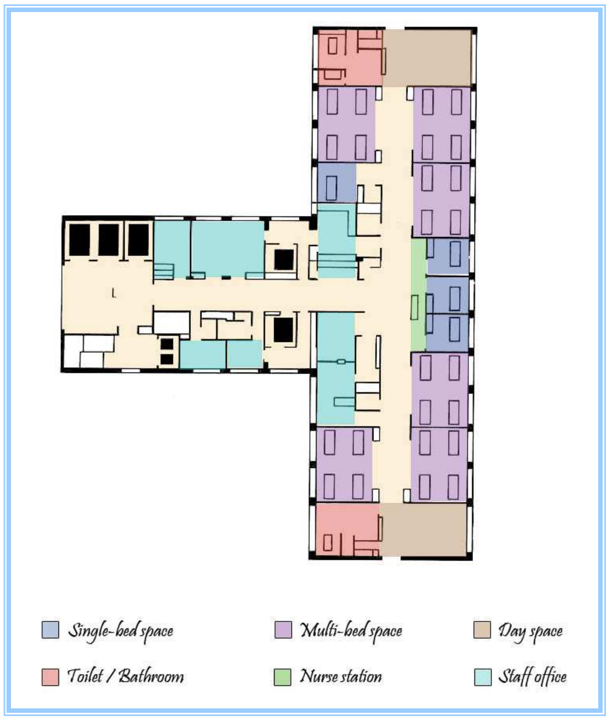


Figure 4.8 - Ward B: St Thomas' Hospital, London. (Original layout: James and Tatton-Brown, 1986)

● *Ward C*

The third case study in this research is probably the most famous example of the Nightingale ward type. It was designed in 1867 in St Thomas' Hospital in London. It consists of 30 beds distributed along both sides of long main space. Figure 4.9 shows the original plan of ward C.

Figure 4.9 - Ward C: Nightingale ward, St Thomas' Hospital, London.
(Original layout: James and Tatton-Brown, 1986)

● *Ward D*

The fourth case study is the open ward of Weston general hospital in Weston-super-Mare which designed by South Western Regional Health Authority as a cruciform ward type. The ward consists of 28 beds distributed in three multi-bed spaces, six beds for each bay, and four single-bed rooms. The nursing space is located in the centre of the ward for ease of supervision. Figure 4.10 shows the original plan of ward D.

Figure 4.10 - Ward D: Cruciform ward, Weston general hospital, Weston-super-Mare, UK.
(Original layout: James and Tatton-Brown, 1986)

● *Ward E*

The fifth case study is a day care open ward in Chesterfield Royal Hospital in Derbyshire. The ward consists of 24 beds distributed in three multi-bed bays, six beds for each space and 4 single bed rooms. The four multi-bed bays are located around the central space of the ward which contains the nursing zone. This ward is as an example of the radial ward type. Figure 4.11 shows the original plan of ward E.

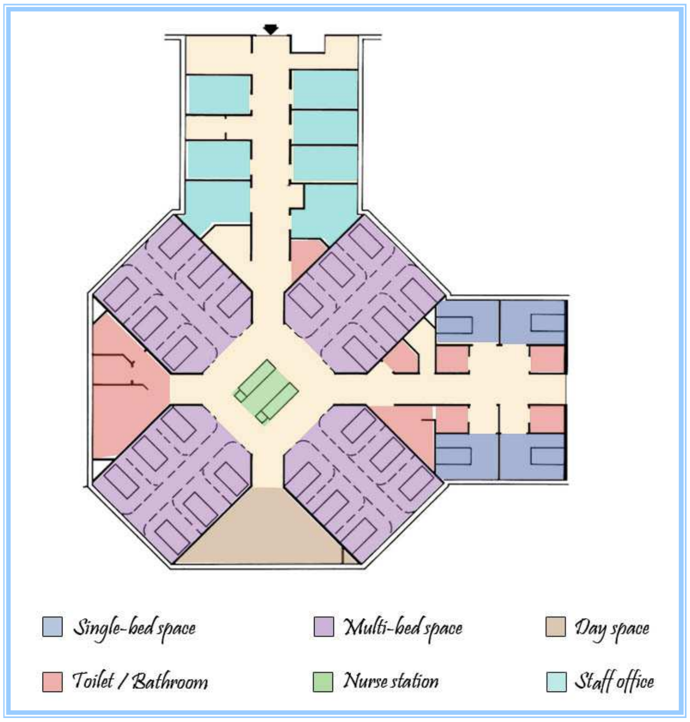


Figure 4.11 - Ward E: Chesterfield Royal Hospital in Derbyshire, UK.
(Original layout: James and Tatton-Brown, 1986)

● *Ward F*

The last case study is an open ward in High Wycombe Hospital in Buckinghamshire. The ward contained originally 40 beds distributed in multi-bed bays and single-bed rooms. Four multi-bed bays contain six beds each; two contain four beds each and eight are single-bed rooms. This ward is an example of racetrack ward type (or double corridor ward). Figure 4.12 shows the original plan of ward F.

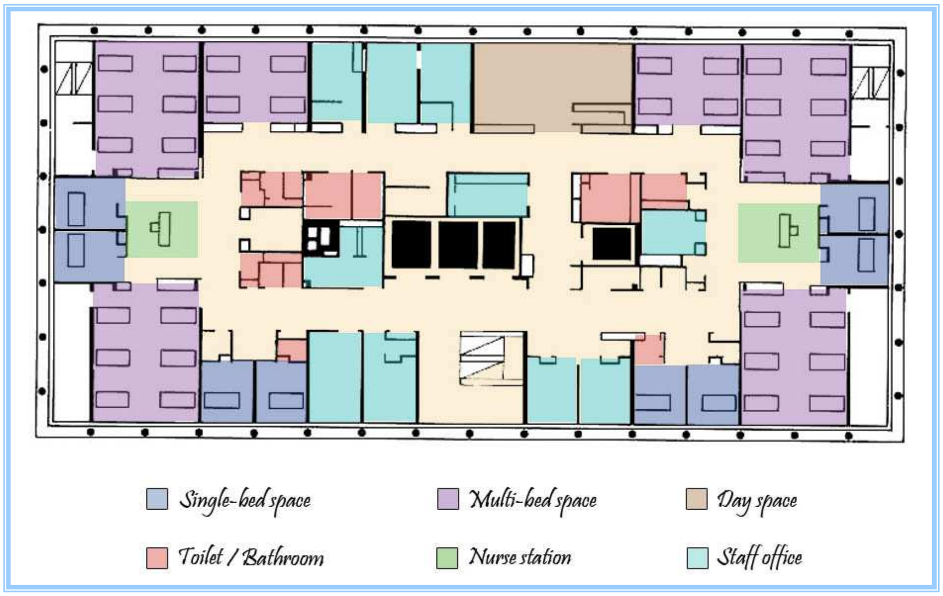


Figure 4.12 - Ward F: Racetrack ward, High Wycombe Hospital in Buckinghamshire, UK. (Original layout: James and Tatton-Brown, 1986)

To summarize, six different wards were considered as case studies to address the aims of this research. These wards vary in beds number (ranged between 24 and 40 bed) and ward type (Duplex, Corridor, Nightingale, Cruciform, Radial and Racetrack). Further reductions in the range of bed numbers were made in redrawing plans (see below). The layouts of these wards were subjected to necessary adjustments in order to render them a suitable version to be analysed using Depthmap. These adjustments are described in the section below.

4.7 Wards' Layout Adjustments and Analysis

In order to conduct Visibility Graph Analysis for the six open wards using Depthmap, a number of procedures are required to adapt the layout of the wards into an acceptance format which can be imported by Depthmap. Then, for the aim of this research, the spatial measures for each ward and each bed in all wards need to be calculated numerically. In this part, the adjustments curried out using Auto CAD for the wards' layouts are described and the steps in which the VGA for each ward and each bed (gates) is calculated are explained. In addition, the visual and numerical results obtained for Depthmap are presented.

4.7.1 AutoCAD adjustments

The original layouts of the wards were scanned from James and Tatton-Brown (1986) in JPEG format (Joint Photographic Experts Group). Then the scanned layouts of the wards were inserted into AutoCAD files in order to redraw them to perform 2D vector drawings which can be saved as DXF (Drawing Exchange Format), which is the recommended format to import layouts with only lines, polylines and polygons into Depthmap (Turner, 2004).

During the redrawing process, the original dimensions of each ward were preserved. However, a few changes in the dimensions of the wards were necessary to equate the area of each bed across all wards. As a result, a 5.28 m^2 rectangle was allowed for each bed in multi-bed bays across all words with dimensions of 2.4 X 2.2 m^2. For the purpose of this study, the beds in single-bed spaces were not included. The reason is that the concern here is locational privacy in multi-bed wards, where the literature suggested a frequent loss of privacy and patients' dissatisfaction (see chapter 3).

The wards were redrawn at the scale of 1:100 (each one metre in the reality represented as 100 units in AutoCAD). This scale allows higher resolution to the grid when performing VGA. The furniture in all wards was not included, except the beds which were gathered in one separate layer. The number of beds in multi-bed spaces is: 28 beds in ward A, 24 beds in ward B, 28 beds in ward C, 24 beds in ward D, 24 beds in ward E and 32 beds in ward F. The relationship between bed numbers and ward preferences are examined in the following chapter. The wards layouts after redrawing them using Auto CAD are shown in Figure 4.13.

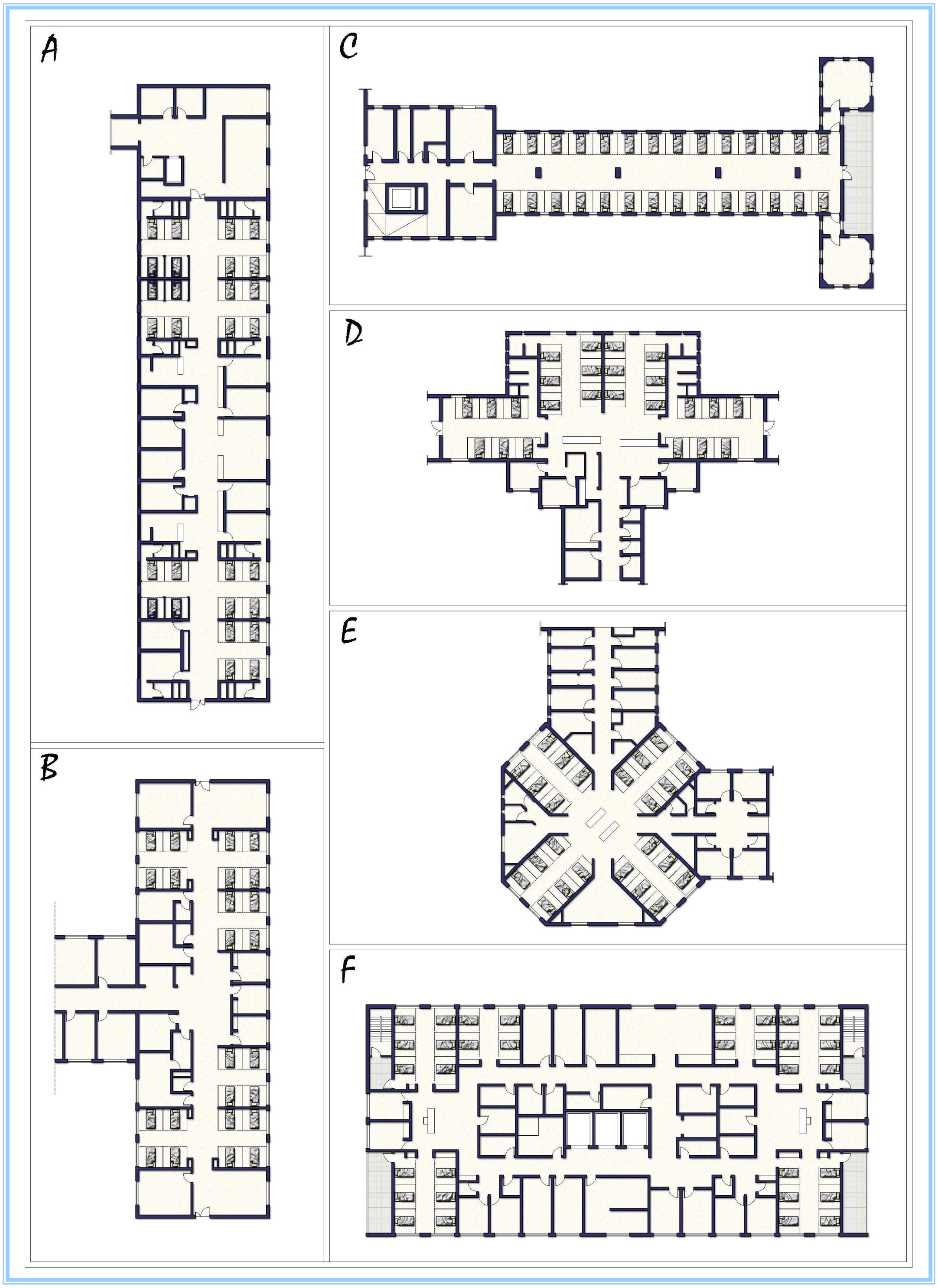


Figure 4.13 - Wards layout after redrawing them using Auto CAD.
(Original layouts: James and Tatton-Brown, 1986)

4.7.2 Conducting VGA and establishing gates

After redrawing ward layouts using Auto CAD, each ward was saved as a DXF file. Then each ward was imported into a separate Depthmap file. Depthmap has two sets of layers: the VGA layers and the line layers which are the original layers contained in the imported DXF file. The beds layer in line layers was turned off. By applying these steps, the ward layouts were ready for the spatial analysis.

Conducting VGA involves three main stages: setting up the grid, performing the visibility graph and analysing the visibility graph. In addition gates can be established to calculate the spatial attributes for a set of points.

The first stage is to make the grid of point locations for the analysis. Depthmap analyses point locations not grid squares, hence, the visibility analysis is performed from the very centre of the squares (Turner, 2004). Depthmap assumes a sensible resolution of the grid spacing which allows a fast analysis on most machines. However, this default resolution can be modified. In this research the grid spacing resolution used in analysing all wards was 20cm X 20cm. Although this resolution seems to be quite high, it was necessary to cover the narrowest spaces in bed locations and to allow performing gates which cover the accurate space of each bed (the bed space width is 2.4m, that is 12 grid squares X 0.2m for each square, and 2.2m length, that is 11 grid squares X 0.2m for each square). After setting up the grid, the spaces which needed to be analysed were filled using the fill tool and/or the pencil tool.

The second stage is to perform the visibility graph. Once the visibility graph is performed, Depthmap connects each point to all other points that are mutually visible with it. In this stage, three measures are calculated: Connectivity, Isovist maximum radial Isovist moment of inertia (Turner, 2004).

The last stage is to run the analysis of the visibility graph. This procedure gives the user the option to perform both local and global measures. The local measures that can be calculated by Depthmap are: Clustering coefficient, Control and Controllability. The global measures that Depthmap calculates are: Mean depth, entropy and Integration. Three integration measures are available in Depthmap: Integration HH in which the d-value is applied to normalize the mean depth, Integration p-value and Integration Takl. These two other measures of integration use other ways to normalize the mean depth (Turner, 2004).

After the VGA is conducted, a set of point can be selected and then converted into a shape. The aim of this is that each shape may represent a *Gate* (the name comes from pedestrian movement observation in space syntax literature; see (Hillier et al., 1993)) which is a set of points for which the average, minimum, maximum, total and point count of spatial measures can be obtained. For the aim of this research, each bed across all wards represented as a gate consists of 132 grid squares (12*11). In addition, each ward is represented as a gate to calculate the average of its spatial measures. The gates (bed locations) in each ward were given a number ranged from 1 to 32, depending on the number of beds in each ward. Wards names and gate (bed locations) numbers are shown in Figure 4.14.

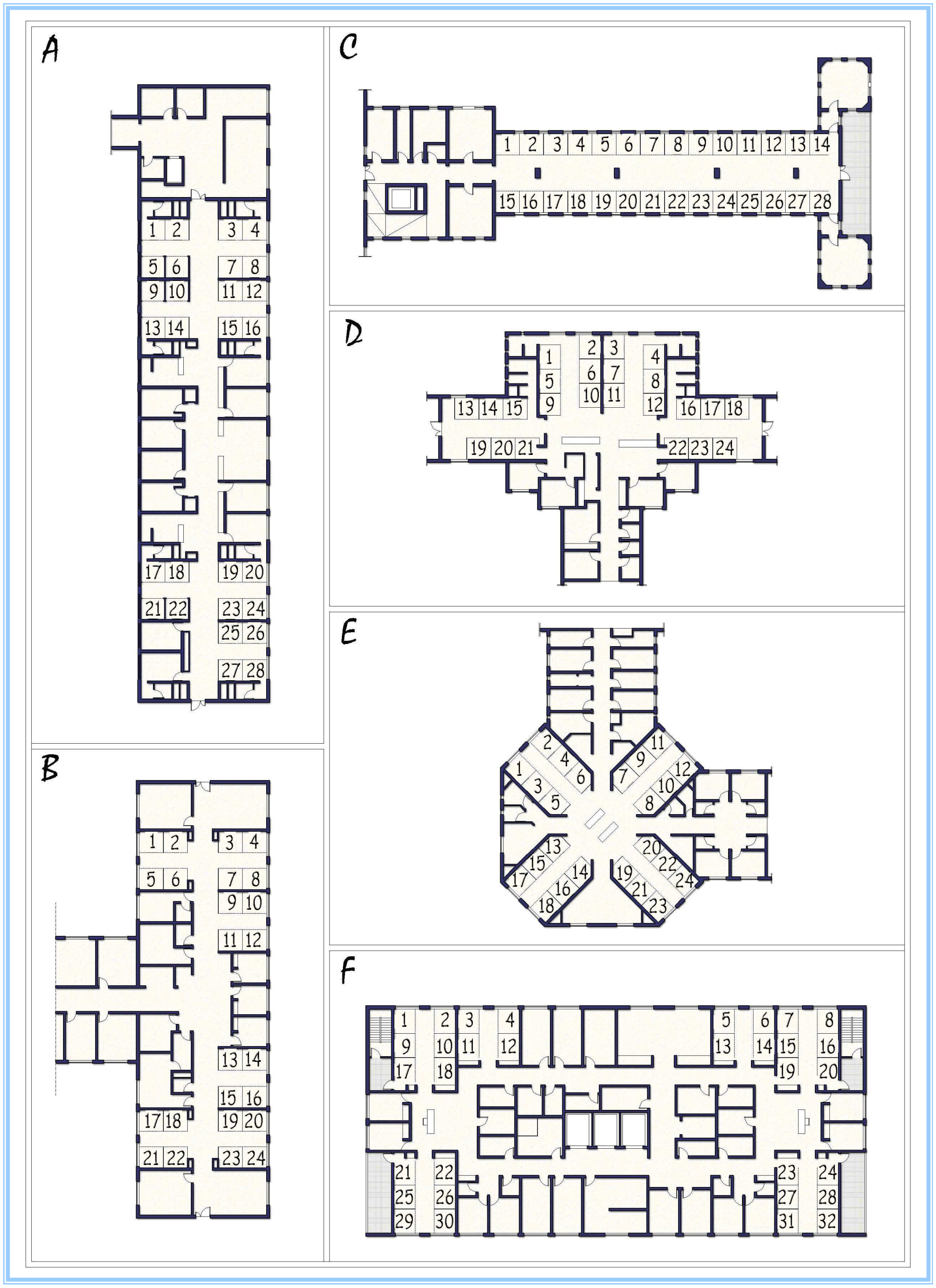


Figure 4.14 - Gates (bed locations) numbers in each ward

(Original layouts: James and Tatton-Brown, 1986).

4.7.3 Depthmap results

This section is a description in spatial language of the distribution of the spatial attributes across all wards. The results of the visibility graph analysis for each ward are presented in two forms: visual results and numeric results. Firstly, the visual result consists of graphs that represent the spatial measures as a colour scale. Secondly, the numeric results consist of a table containing the numeric values of the spatial measures for the ward and for each bed in this ward. These values are calculated as the average of the values contained in each bed location or gate. The spatial measures which were considered in this research are: Connectivity, Isovist maximum radial, Clustering coefficient, Control, Controllability, Entropy, Integration HH, Integration p-value and Mean depth. A glossary of VGA terms used in the graphs is provided below (see section 4.4.1 and 4.4.2 for details). The colour scale used in the following graphs in this section runs from a blue tinged magenta for the very lowest value, to blue (through cyan) to green (through yellow) to red, and up to a red tinged magenta, for the very highest value (this is the default colour scale used in Depthmap).

Glossary of VGA terms:

- Connectivity:	The number of nodes each node can see, that is the immediate neighbourhood of a node.
- Isovist maximum radial:	A measure of the length of the longest line of sight generated from a given point.
- Clustering coefficient:	Measures the spikiness of the visual field from a node (i.e. measures how much a location is a junction).
- Control:	The area of the current neighbourhood with respect to the total area of the immediately adjoining neighbourhood.
- Controllability:	A measure of how many points can be easily dominated by a node.
- Entropy:	A Measure of the distribution of points in terms of their visual depth from a node.
- Integration HH:	A measure of how deep the space is within its spatial structure.
- Integration p-value:	Similar to Integration HH, but with different normalization method.
- Mean depth:	The average of the shortest path lengths from each node to all other nodes in the configuration.

● *Ward A*

Ward A contains 28 gates (bed locations). The visibility graphs of the different spatial attributes are shown in Figures 4.15 and 4.16.

The locations of greatest connectivity in ward A are found at the circulation space (corridor) that connects spaces together. The gates near the outer boundary of the ward seem to have less connectivity than those near the internal corridor. Isovist maximum radial achieves the greatest values at the two ends of the main visual axis in the ward, and at the same time, the lowest values can be recognized in the gates near the outer boundary of the ward. The clustering coefficient is greater in the gates near to the outer boundary than the internal ones. Most of the gates have lower control values than the circulation space which have several highly controlling zones. On the other hand, the gates near to the outer boundary of the ward have higher controllability value than internal ones. Entropy has low values in the circulation space, with the entropy values increasing towards the outer boundary of the ward. The visualization of the values of Integration HH looks similar to those of Integration p-value. Locations of high Integration are located along the main visual axis. The gates near to the outer boundary of the ward seem to have lower integration values than those near to the main visual axis. On the other hand, Mean depth initially appear to reflect the integration.

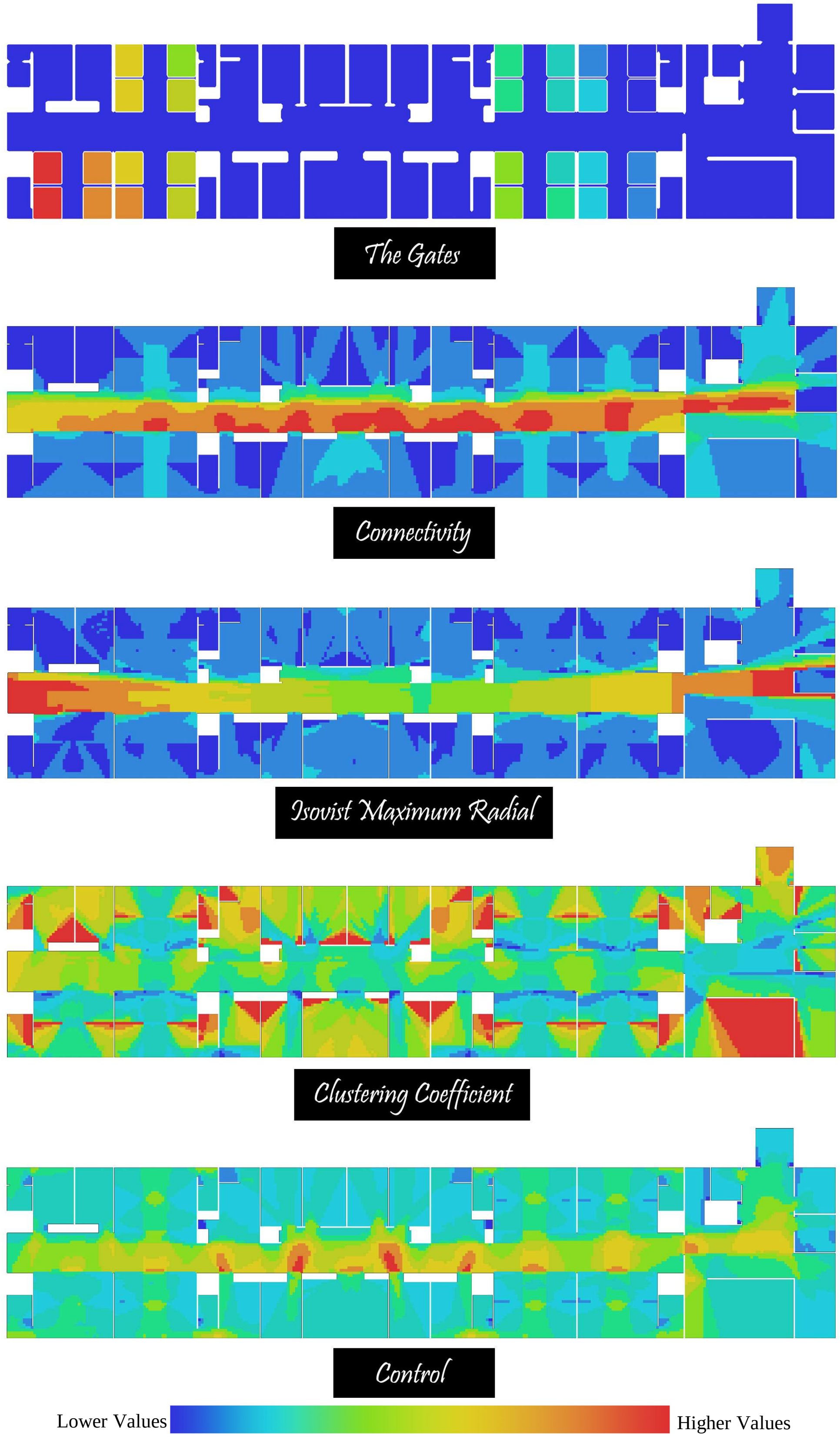


Figure 4.15 - The Gates [9]*, Connectivity, Isovist maximum radial, Clustering coefficient and Control of ward A.*

[9] Coloured squares denote bed location (gates). Colours of beds in this diagram have no meaning, as opposed to the following diagrams, where colour represents the value of each spatial measure.

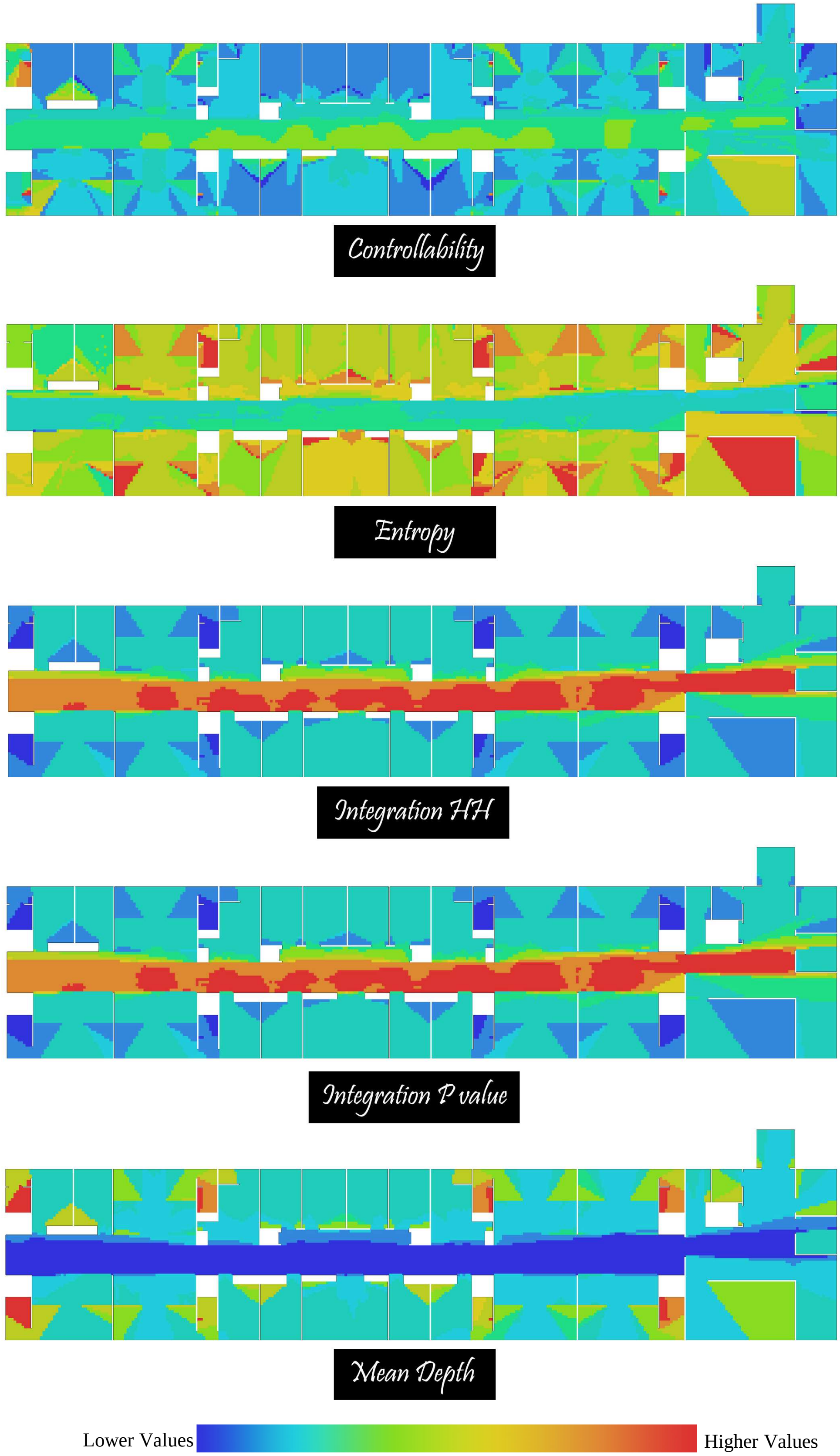


Figure 4.16 - Controllability, Entropy, Integration HH, Integration p-value and Mean depth of ward A.

For each spatial measure, the values of each spatial attribute across the whole ward were averaged to calculate the spatial attributes of the ward itself. Then, for each spatial attribute, the values of the points which represent each gate were averaged to calculate the spatial attributes for each gate. Table 4.1 shows the spatial values for ward A and for each gate (bed location) in this ward.

	Connectivity	Isovist Maximum Radial	Clustering Coefficient	Control	Controllability	Entropy	Integration [HH]	Integration [P-value]	Mean Depth
Ward A	1485.7950	1775.9030	0.7121	1.0000	0.1819	1.6613	7.2999	0.6281	2.7738
Bed 1	566.3864	754.4266	0.7510	0.8155	0.1825	1.7601	5.3629	0.4614	3.2327
Bed 2	907.1136	1470.1490	0.5641	0.7648	0.1205	1.6656	6.9086	0.5944	2.6894
Bed 3	906.9621	1593.0680	0.5524	0.7497	0.1196	1.6295	6.9985	0.6021	2.6707
Bed 4	598.1364	764.3842	0.7445	0.8559	0.1947	1.7603	5.4156	0.4659	3.2107
Bed 5	562.1970	816.3373	0.7497	0.8083	0.1688	1.7770	5.5072	0.4738	3.1560
Bed 6	832.5606	1217.0630	0.5772	0.7508	0.1227	1.6424	6.7168	0.5779	2.7318
Bed 7	817.3257	1310.2140	0.5796	0.7172	0.1152	1.6354	6.7967	0.5848	2.7111
Bed 8	594.3106	822.7659	0.7434	0.8461	0.1607	1.7284	5.6968	0.4901	3.0816
Bed 9	558.6970	790.8067	0.7557	0.8043	0.1755	1.8040	5.3334	0.4589	3.2316
Bed10	773.8712	1044.3180	0.6103	0.7326	0.1214	1.7196	6.4917	0.5585	2.8029
Bed11	872.5682	1537.8130	0.5547	0.7339	0.1156	1.6831	6.8698	0.5910	2.6999
Bed12	619.1212	938.2905	0.7185	0.8511	0.1557	1.8429	5.5059	0.4737	3.1556
Bed13	544.4621	730.2375	0.7667	0.8061	0.2168	1.8061	5.1508	0.4431	3.3233
Bed14	871.6288	1452.7210	0.5550	0.7689	0.1217	1.6446	6.8366	0.5882	2.7007
Bed15	874.3182	1471.9080	0.5623	0.7158	0.1159	1.6452	6.9240	0.5957	2.6807
Bed16	597.5757	736.9385	0.7399	0.8364	0.1615	1.8062	5.5961	0.4815	3.1228
Bed17	551.8182	736.9999	0.7628	0.8106	0.2194	1.8065	5.1252	0.4409	3.3331
Bed18	846.3636	1226.6710	0.5690	0.7769	0.1373	1.6627	6.5200	0.5610	2.7836
Bed19	806.5000	1179.0150	0.5739	0.7127	0.1250	1.6523	6.5999	0.5678	2.7600
Bed20	604.3712	746.4776	0.7355	0.8397	0.1576	1.7128	5.7561	0.4952	3.0615
Bed21	551.7879	784.5183	0.7610	0.8027	0.1968	1.8031	5.0989	0.4387	3.3461
Bed22	766.4318	1048.5280	0.6127	0.7385	0.1307	1.7109	6.3721	0.5482	2.8446
Bed23	878.6515	1631.6430	0.5574	0.7451	0.1195	1.6594	6.8914	0.5929	2.7061
Bed24	612.7879	934.3638	0.7240	0.8538	0.1716	1.8480	5.2551	0.4521	3.2738
Bed25	704.8409	783.7363	0.6292	0.7285	0.1319	1.6066	6.3244	0.5441	2.8365
Bed26	585.6818	819.6891	0.7398	0.8883	0.1737	1.6296	5.7218	0.4923	3.0717
Bed27	886.4091	1647.1220	0.5666	0.7922	0.1288	1.6206	6.8544	0.5897	2.7182
Bed28	574.3561	743.3165	0.7504	0.9007	0.2673	1.7123	5.0650	0.4358	3.3793

Table 4.1– The spatial values in ward A.

● *Ward B*

There are 24 gates (bed locations) in ward B. The visibility graphs of the different spatial attributes are shown in Figures 4.17 and 4.18 while Table 4.2 shows the spatial values for ward B and for each gate (bed location) in this ward.

The points that generate the greatest connectivity values in this ward are those located at its centre, where the two main visual axes are intersected. The gates generate less connectivity than the main visual axes. The longest line of sight is generated from both ends of the circulation space that connects the bays together. The gates that are close to the circulation space seem to have shorter lines of sight than those far from it.

The central space has the lowest clustering coefficient values, which indicate a good junction point. At the same time, the gates near the outer boundary of the ward generate greater values of clustering coefficient than other gates. The control in this ward varies. The greater control values are distributed along the two main visual axes. Similarly, the two main visual axes have greater controllability than the gates itself. Entropy values of gates seem to be greater than entropy values of the circulation spaces.

The integration HH and the Integration p-value are very similar. The greatest integration values occur in the central space in the ward as a result of the interaction between the two main visual axes. However, the integration of the gates far from the circulation space seems to be slightly lower than the integration of the gates close to this space. On the other hand, the mean depth of the gates near the outer boundary of the ward is likely to be greater than the mean depth of the internal gates, whereas the lowest mean depth values occur in the central space of the ward.

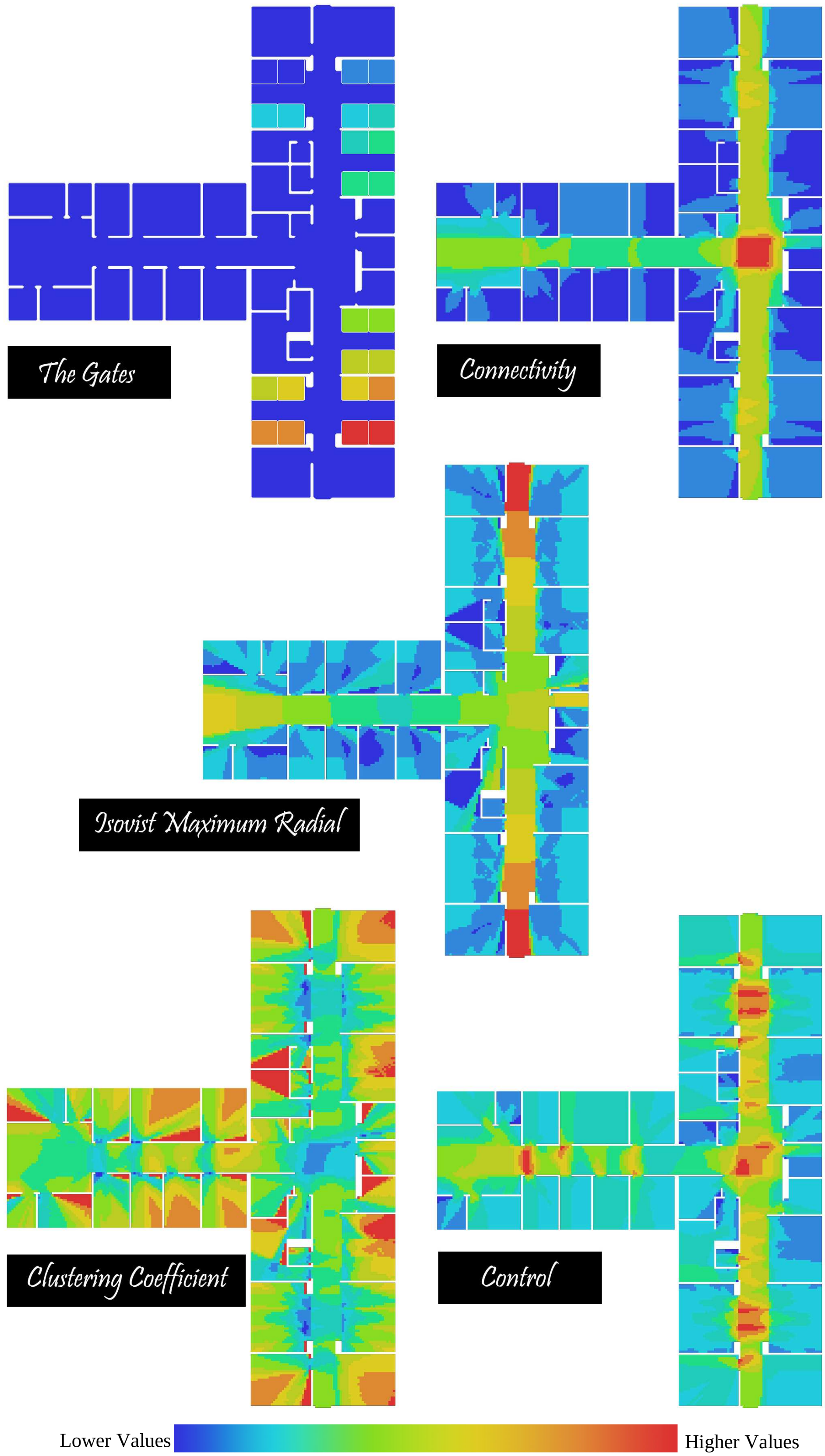


Figure 4.17 - The Gates[10], Connectivity, Isovist maximum radial, Clustering coefficient and Control of ward B.

[10] Coloured squares denote bed location (gates). Colours of beds in this diagram have no meaning, as opposed to the following diagrams, where colour represents the value of each spatial measure.

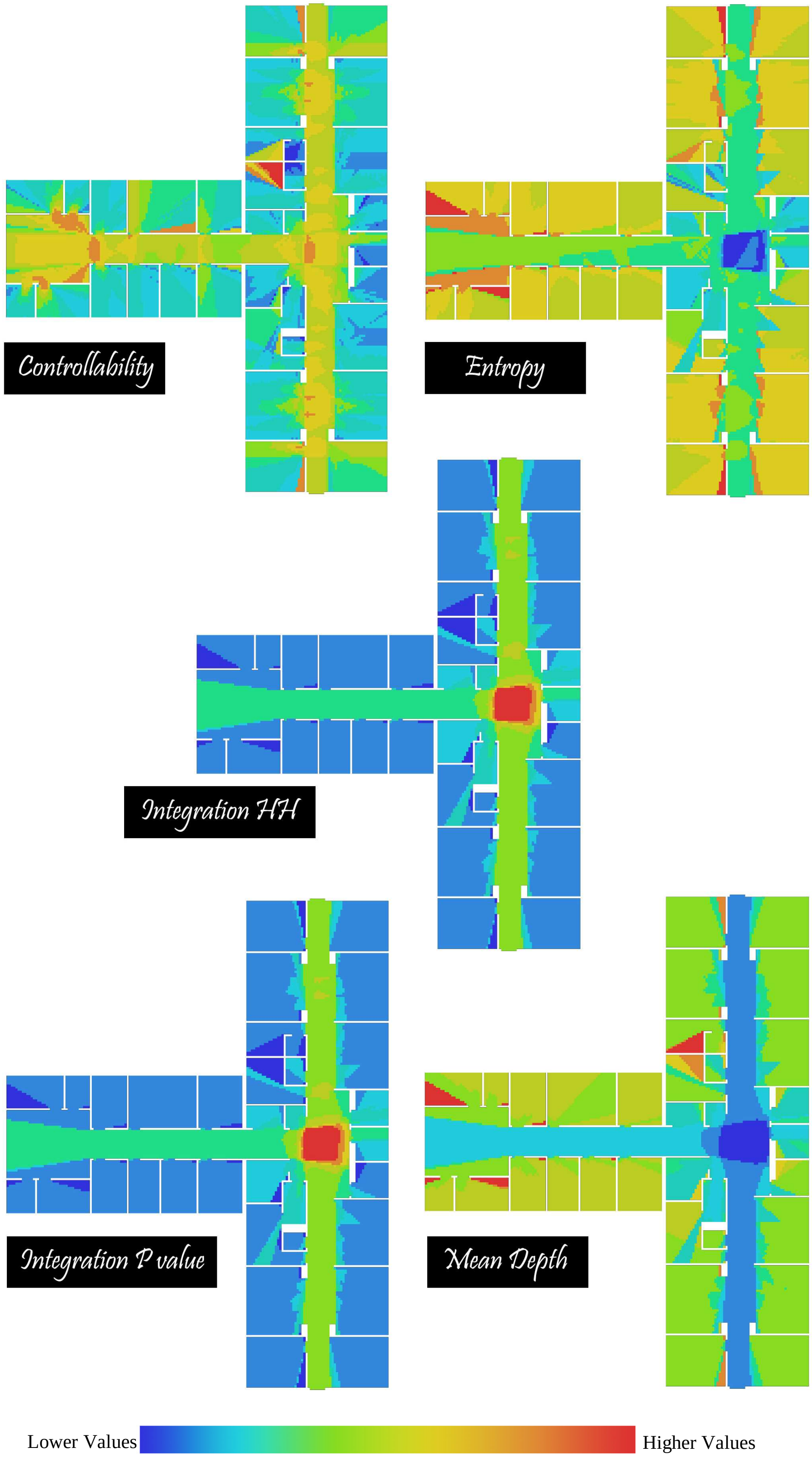


Figure 4.18 - Controllability, Entropy, Integration HH, Integration p-value and Mean depth of ward B.

	Connectivity	Isovist Maximum Radial	Clustering Coefficient	Control	Controllability	Entropy	Integration [HH]	Integration [P-value]	Mean Depth
Ward B	1508.5870	1594.6730	0.7233	1.0000	0.1766	1.6357	7.1122	0.6066	2.7776
Bed 1	634.0985	1204.3220	0.7458	0.7007	0.1105	1.7348	6.0146	0.5130	2.9481
Bed 2	809.9924	1135.3580	0.6333	0.7774	0.1264	1.7134	6.3038	0.5376	2.8732
Bed 3	761.0076	1112.2800	0.6461	0.7758	0.1236	1.7288	6.1887	0.5278	2.9054
Bed 4	628.4091	1203.6210	0.7516	0.7930	0.1107	1.7372	5.9839	0.5104	2.9580
Bed 5	668.6667	1205.5050	0.7422	0.7001	0.1187	1.7334	6.0080	0.5124	2.9502
Bed 6	821.1288	1038.4060	0.6289	0.8025	0.1387	1.7650	6.0687	0.5176	2.9310
Bed 7	1082.4550	1143.4230	0.6053	0.9025	0.1561	1.7766	6.4114	0.5468	2.8439
Bed 8	815.9849	1226.1380	0.7002	0.7521	0.1339	1.7725	6.1049	0.5207	2.9192
Bed 9	839.8257	1165.4410	0.7178	0.7209	0.1195	1.6970	6.4800	0.5527	2.8348
Bed10	580.1061	1170.6700	0.8753	0.6200	0.1086	1.7022	5.9661	0.5088	2.9639
Bed11	905.7576	1236.0030	0.6830	0.7516	0.1228	1.5318	6.8911	0.5877	2.7315
Bed12	633.6667	1185.9130	0.8049	0.6601	0.1201	1.7023	5.9753	0.5096	2.9609
Bed13	797.0985	1103.8620	0.7447	0.6792	0.1106	1.5402	6.7383	0.5747	2.7691
Bed14	459.3788	733.7668	0.9582	0.5358	0.0945	1.6636	5.8514	0.4991	3.0024
Bed15	913.4243	1113.1660	0.6865	0.7530	0.1299	1.7254	6.4447	0.5497	2.8412
Bed16	666.4621	1177.6650	0.8202	0.6595	0.1201	1.7379	5.9682	0.5090	2.9632
Bed17	658.4773	1205.4980	0.7436	0.6982	0.1200	1.7370	5.9437	0.5069	2.9713
Bed18	805.9470	1036.6920	0.6314	0.7951	0.1395	1.7687	6.0018	0.5119	2.9525
Bed19	1059.7500	1121.3480	0.6154	0.8474	0.1512	1.7859	6.3763	0.5438	2.8519
Bed20	794.3636	1230.4430	0.7166	0.7044	0.1277	1.7827	6.0865	0.5191	2.9252
Bed21	642.0303	1204.3450	0.7439	0.7089	0.1149	1.7433	5.9438	0.5069	2.9713
Bed22	822.2045	1134.9190	0.6309	0.7912	0.1317	1.7278	6.2203	0.5305	2.8975
Bed23	765.3182	1077.4550	0.6475	0.7729	0.1279	1.7377	6.1144	0.5215	2.9273
Bed24	636.2879	1204.5450	0.7495	0.7014	0.1147	1.7449	5.9198	0.5049	2.9792

Table 4.2 – The spatial values of ward B

● *Ward C*

The number of the gates contained in this ward is 28. The visibility graphs of the different spatial attributes are shown in Figures 4.19 and 4.20. Table 4.3 shows the spatial values for ward C and for each gate (bed location) in this ward.

The red points which represent the highest connectivity can be recognized in the middle of the circulation space from both sides, whereas the connectivity of the gates located in the middle of the ward seems to have greater connectivity than the gates located at both ends. The longest sights lines are generated from the points located in the far ends of the circulation space and isovist maximum radial of the gates varies.

Clustering coefficient of the gates located at the ends of the circulation space seems to generate more convex visual field than those in the middle, and as a result greater clustering coefficient. The gates differ in their control values. However, the control values of the gates seem to be less than the control values of the points in other spaces in the ward. Controllability of the gates appears to be less than the controllability of the circulation space. The gates located in the middle are likely to have greater entropy values than other gates, but it can be noticed that the entropy decreases when moving from the middle gates towards the ends of the ward. However, the gates in the right end have lower values than those in the left end.

Again, the integration HH and the integration p-value seem to be similar visually. The greatest integration occurs in the points located in the middle of the circulation space. On the other hand, the mean depth of the main space appears to generate low values comparing with the gates.

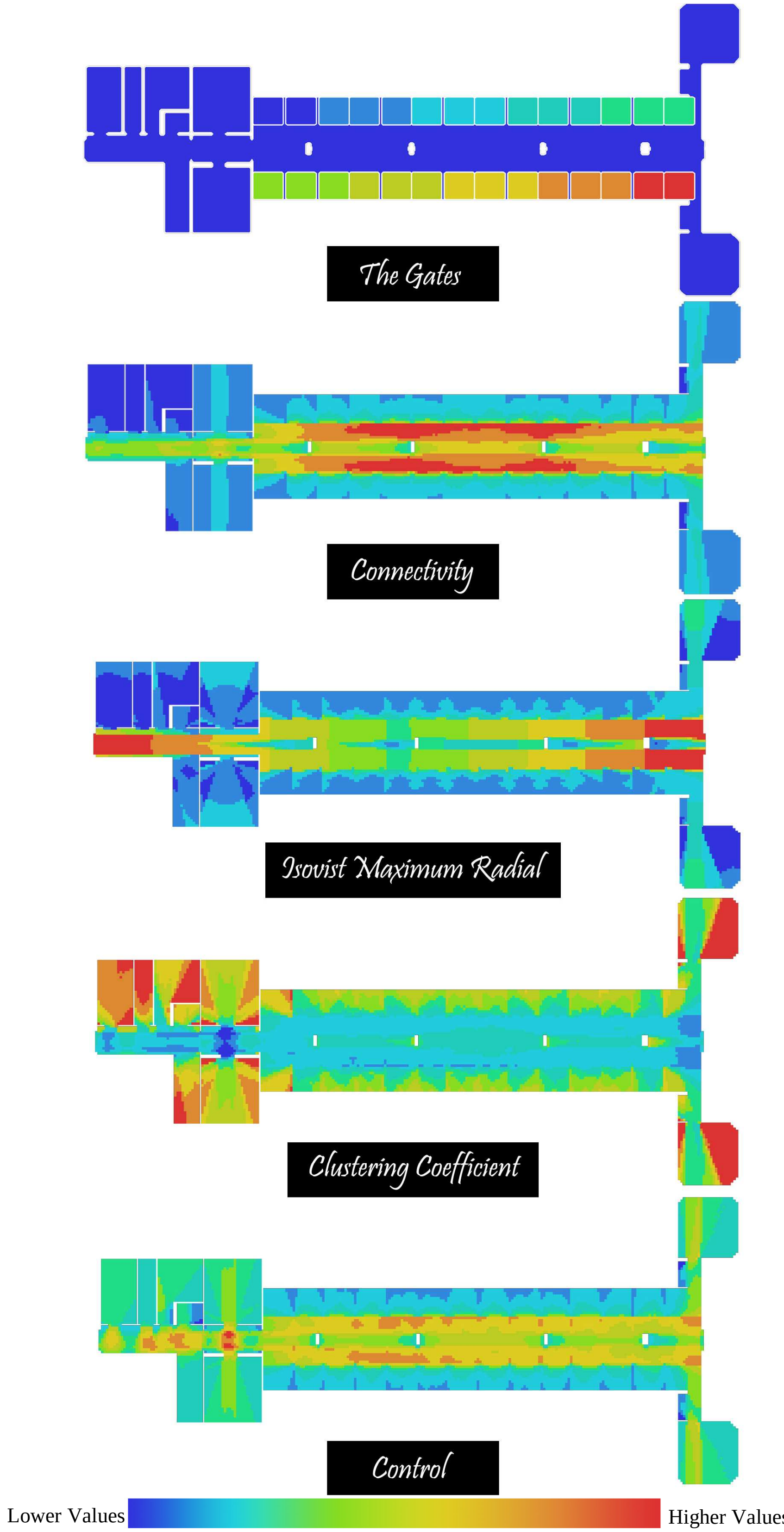


Figure 4.19 - The Gates[11]*, Connectivity, Isovist maximum radial, Clustering coefficient and Control of ward C.*

[11] Coloured squares denote bed location (gates). Colours of beds in this diagram have no meaning, as opposed to the following diagrams, where colour represents the value of each spatial measure.

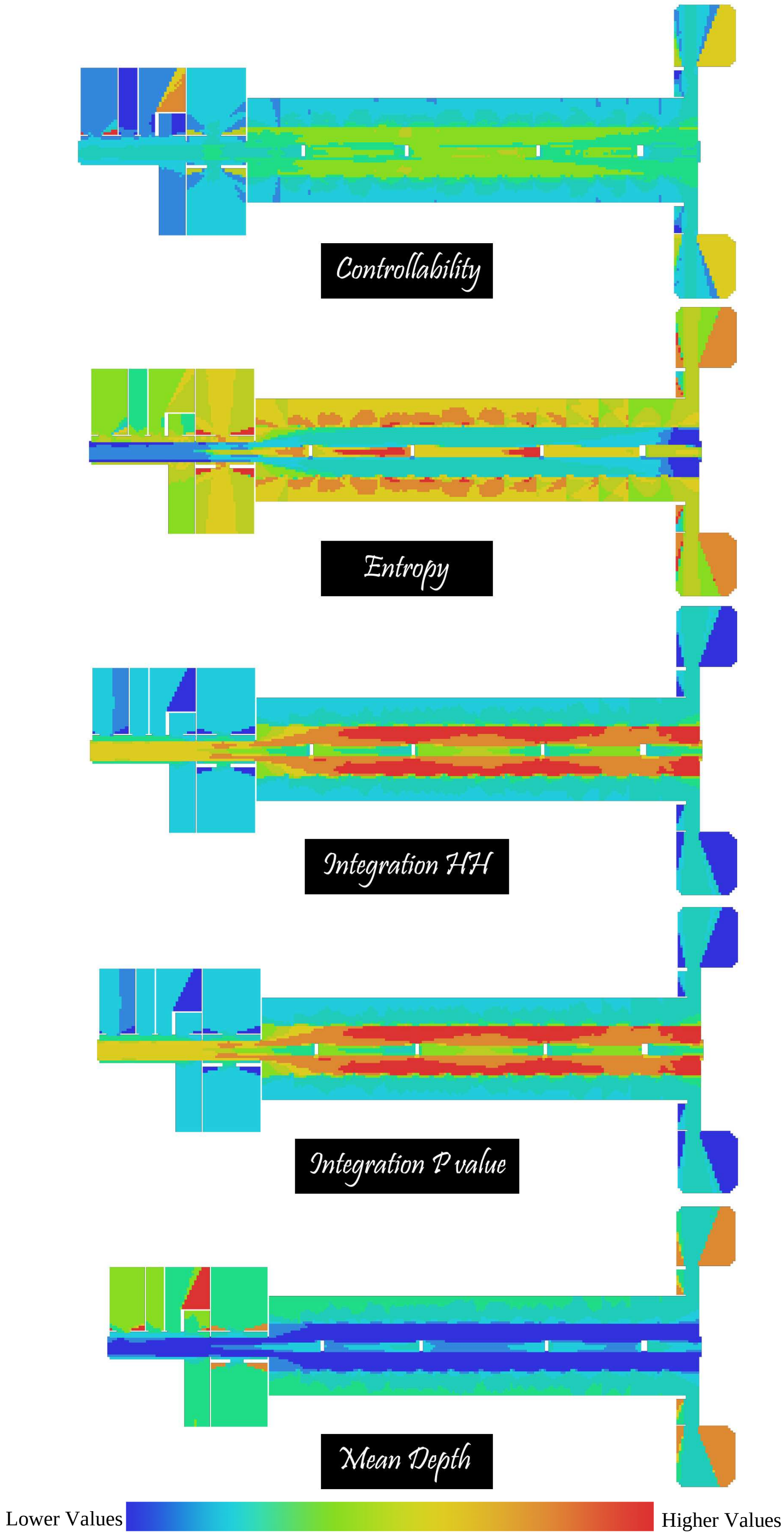


Figure 4.20 - Controllability, Entropy, Integration HH, Integration p-value and Mean depth of ward C.

	Connectivity	Isovist Maximum Radial	Clustering Coefficient	Control	Controllability	Entropy	Integration [HH]	Integration [P-value]	Mean Depth
Ward C	1619.0500	1877.1630	0.6672	0.9985	0.2174	1.4201	9.1556	0.8353	2.3233
Bed 1	911.1818	1158.5800	0.7803	0.5813	0.1550	1.5553	7.3677	0.6722	2.4930
Bed 2	1099.1590	1186.5990	0.6370	0.6674	0.1720	1.5825	7.6942	0.7020	2.4339
Bed 3	1169.9390	1211.6090	0.6734	0.6722	0.1798	1.5969	7.7709	0.7089	2.4193
Bed 4	1243.4390	1231.5800	0.6896	0.6880	0.1887	1.6142	7.8317	0.7145	2.4083
Bed 5	1241.0300	1275.8800	0.6548	0.6719	0.1845	1.6168	7.8648	0.7175	2.4023
Bed 6	1229.7950	1284.8390	0.6506	0.6462	0.1816	1.6103	7.8900	0.7198	2.3991
Bed 7	1299.3940	1283.3610	0.6828	0.6896	0.1929	1.6157	7.9453	0.7249	2.3906
Bed 8	1286.3640	1257.6100	0.6889	0.6754	0.1925	1.6086	7.9248	0.7230	2.3927
Bed 9	1253.0830	1262.8580	0.6635	0.6669	0.1868	1.5968	7.9143	0.7220	2.3940
Bed10	1229.2950	1240.5770	0.6256	0.6602	0.1843	1.5760	7.9116	0.7218	2.3941
Bed11	1243.9850	1230.5110	0.6876	0.6988	0.1892	1.5500	7.9385	0.7242	2.3881
Bed12	1152.0610	1153.2420	0.7004	0.6608	0.1792	1.4993	7.8840	0.7193	2.3959
Bed13	1158.8180	1308.1530	0.6256	0.6867	0.1768	1.4483	8.0132	0.7311	2.3719
Bed14	1221.9090	1596.3410	0.6988	0.8058	0.1834	1.4571	8.0991	0.7389	2.3588
Bed15	1050.6140	1361.6090	0.7443	0.6948	0.1663	1.5536	7.6469	0.6976	2.4521
Bed16	1267.0080	1355.1250	0.6129	0.7430	0.1844	1.5749	8.0559	0.7349	2.3871
Bed17	1350.9170	1365.7700	0.6412	0.7570	0.1929	1.5784	8.1972	0.7478	2.3694
Bed18	1441.1510	1378.0660	0.6564	0.7833	0.2021	1.5849	8.3398	0.7608	2.3528
Bed19	1449.5000	1397.2120	0.6261	0.7653	0.1998	1.5912	8.3680	0.7634	2.3490
Bed20	1446.2880	1418.3640	0.6232	0.7410	0.1985	1.5852	8.3919	0.7656	2.3467
Bed21	1507.1360	1434.0430	0.6512	0.7861	0.2091	1.5928	8.4231	0.7685	2.3412
Bed22	1491.9010	1417.9070	0.6586	0.7689	0.2086	1.5821	8.4132	0.7675	2.3433
Bed23	1461.7650	1451.6590	0.6340	0.7580	0.2028	1.5728	8.4063	0.7669	2.3430
Bed24	1434.0910	1458.0040	0.6035	0.7465	0.1993	1.5480	8.4156	0.7678	2.3404
Bed25	1437.6440	1462.0810	0.6559	0.7871	0.2026	1.5216	8.4306	0.7691	2.3348
Bed26	1329.7120	1389.3810	0.6682	0.7399	0.1919	1.4779	8.3256	0.7596	2.3465
Bed27	1331.3560	1551.8860	0.6040	0.7571	0.1885	1.4303	8.4550	0.7714	2.3248
Bed28	1367.4550	1821.2240	0.6710	0.8667	0.1914	1.4256	8.5483	0.7799	2.3141

Table 4.3 – The spatial values of ward C.

● *Ward D*

In ward D, there are 24 gates (bed locations). The visibility graphs of the different spatial attributes are shown in Figures 4.21 and 4.22 while Table 4.4 shows the spatial values for ward D and for each gate (bed location) in this ward.

The connectivity of ward D is quite predictable; the connectivity of the greatest values is found at the central space of the ward. The longest sight lines occur in the far ends of the wards.

The junction points can be found mainly in the central space of the ward. Conversely, the central space of ward D contains the points that generate the greatest control values while gates are likely to have less control than other spaces. It can be visualised that the points in the central space of the ward contribute highly to the controllability of the ward, whereas the gates contribute less to the controllability of the ward. The lowest level of entropy points appear to be in the central space of the ward. However, the gates appear to have greater entropy values than the other spaces in the ward.

The visualization of the Integration HH appears to be similar to the Integration p-value. The greatest integration can be found in the central space, where the two visual axes are intersected. On the other hand, the lowest mean depth appears in the points located in the central space, whereas the gates contribute more than the central space to the mean depth of the ward.

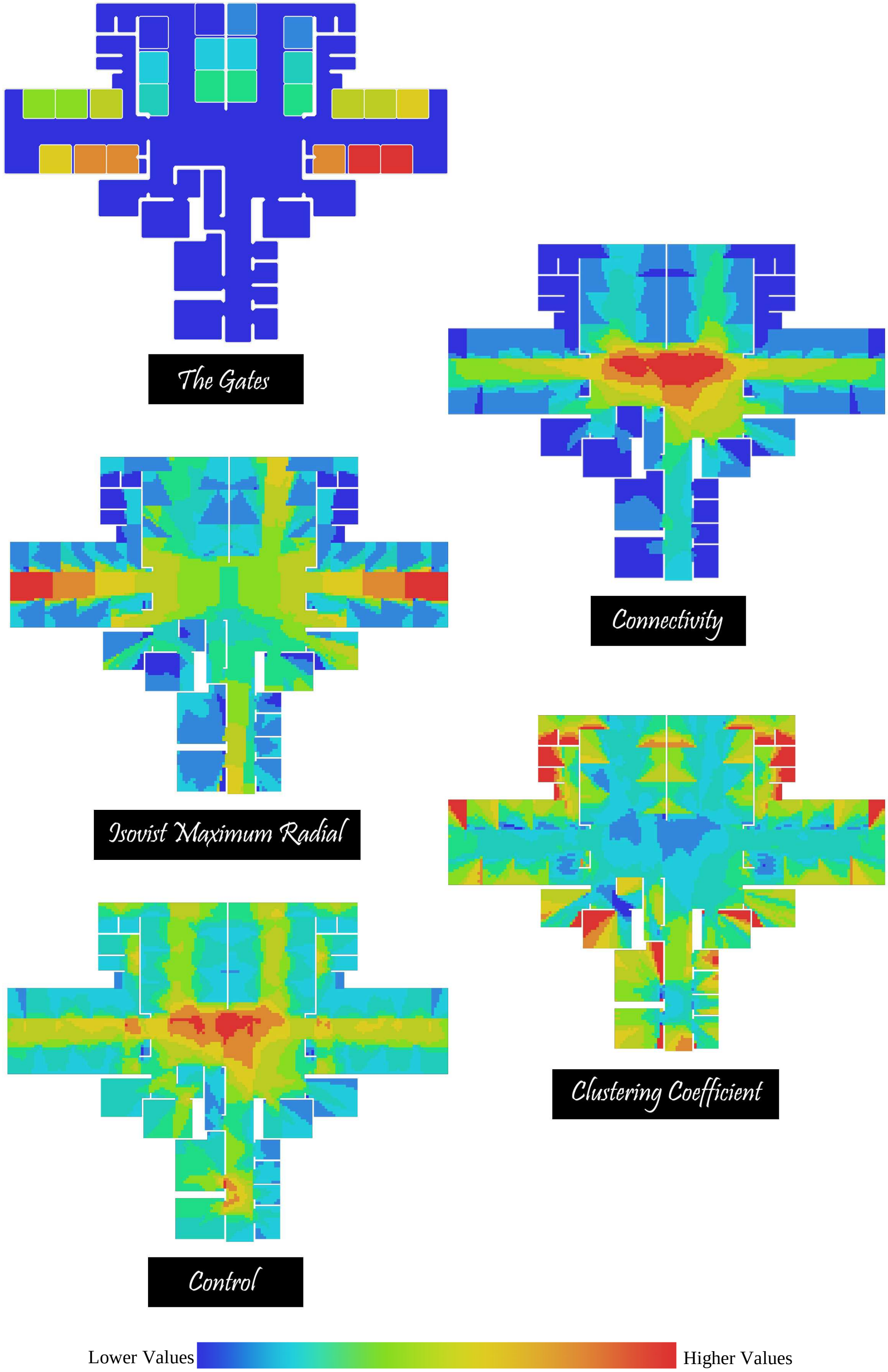


Figure 4.21 - The Gates[12], Connectivity, Isovist maximum radial, Clustering coefficient and Control of ward D.

[12] Coloured squares denote bed location (gates). Colours of beds in this diagram have no meaning, as opposed to the following diagrams, where colour represents the value of each spatial measure.

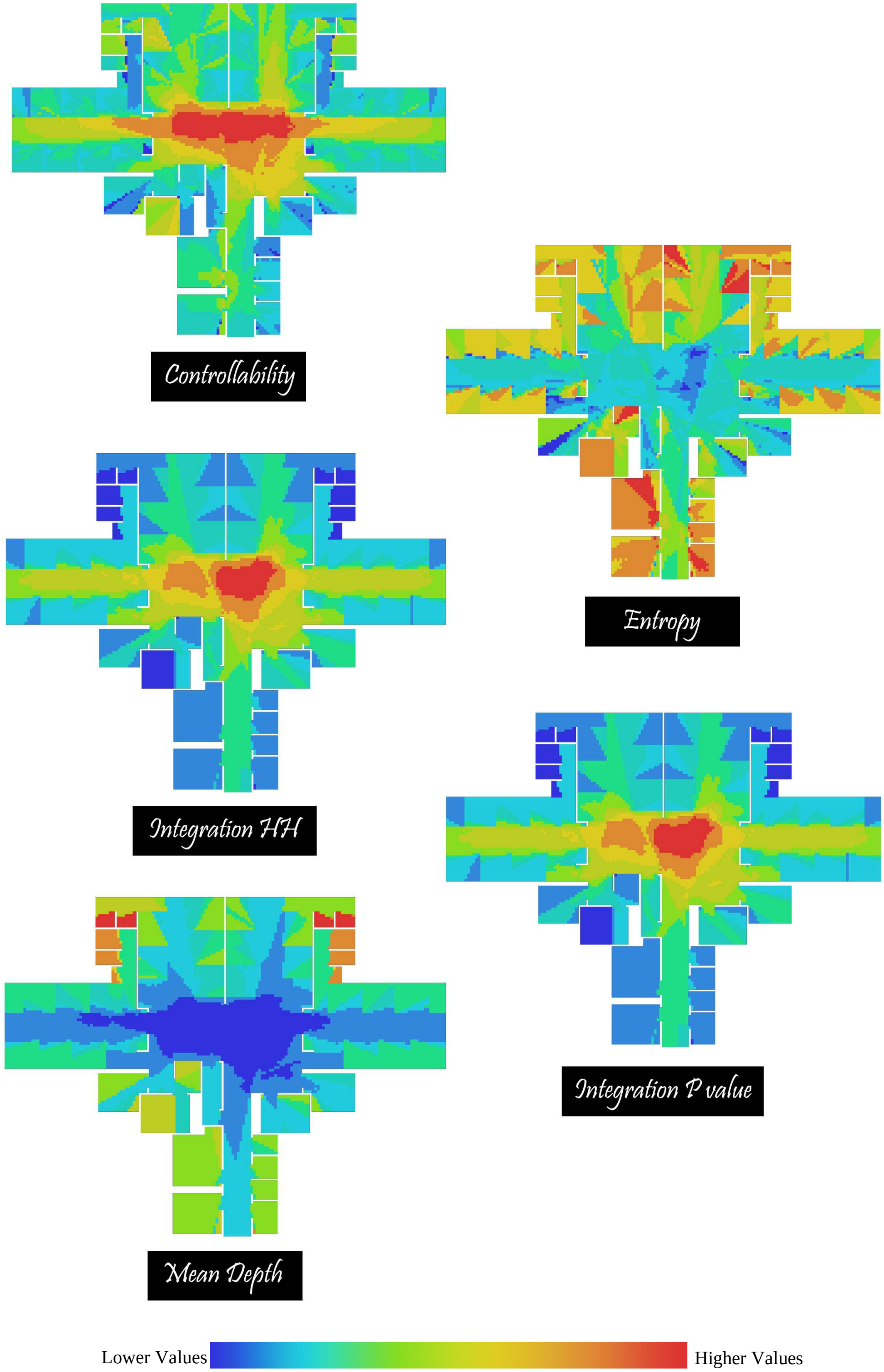


Figure 4.22 - Controllability, Entropy, Integration HH, Integration p-value and Mean depth of ward D.

	Connectivity	Isovist Maximum Radial	Clustering Coefficient	Control	Controllability	Entropy	Integration [HH]	Integration [P-value]	Mean Depth
Ward D	1310.9060	1369.8590	0.6678	1.0000	0.2119	1.6673	7.7744	0.7148	2.5567
Bed 1	708.1515	931.7944	0.7144	0.8381	0.2496	1.7385	5.8074	0.5340	2.9288
Bed 2	658.1667	912.3862	0.6992	0.9285	0.2137	1.8317	5.6196	0.5167	2.9649
Bed 3	646.5379	907.1394	0.7060	0.8774	0.1913	1.8515	5.7540	0.5290	2.9202
Bed 4	783.5530	1054.6410	0.7040	0.8251	0.2088	1.8197	6.1288	0.5635	2.8420
Bed 5	911.9243	1317.3710	0.5950	0.8308	0.1801	1.6572	7.1163	0.6543	2.5815
Bed 6	743.6288	818.4258	0.6968	0.7715	0.1858	1.8433	6.0684	0.5580	2.8119
Bed 7	731.0833	817.7820	0.7037	0.7220	0.1762	1.7736	6.2980	0.5791	2.7459
Bed 8	911.0151	1167.2500	0.6215	0.7945	0.1724	1.6438	7.2073	0.6627	2.5478
Bed 9	1765.4140	2018.8300	0.6145	0.9213	0.2359	1.5526	9.1062	0.8373	2.1968
Bed10	814.1288	983.1841	0.6195	0.6524	0.1502	1.7661	6.8249	0.6275	2.5964
Bed11	805.6061	1002.1250	0.6257	0.6206	0.1458	1.6547	7.1188	0.6545	2.5309
Bed12	1617.9770	2001.4680	0.6142	0.8233	0.2105	1.5156	9.1317	0.8396	2.1936
Bed13	684.0682	889.3105	0.7231	0.7524	0.1838	1.7617	6.0651	0.5577	2.8192
Bed14	813.6212	1160.0010	0.6406	0.7835	0.1616	1.7274	6.8013	0.6253	2.6313
Bed15	822.3333	1062.9740	0.6734	0.6875	0.1540	1.7183	6.9027	0.6347	2.6101
Bed16	801.2955	1035.9350	0.6757	0.6650	0.1496	1.7156	6.9063	0.6350	2.6072
Bed17	789.3333	1081.3050	0.6463	0.7470	0.1596	1.7694	6.6138	0.6081	2.6719
Bed18	692.8788	943.6860	0.7241	0.7670	0.1785	1.7448	6.2005	0.5701	2.7868
Bed19	793.6818	985.2407	0.6848	0.7624	0.1737	1.7562	6.5180	0.5993	2.7078
Bed20	812.2727	952.5053	0.6792	0.7427	0.1656	1.7449	6.6912	0.6152	2.6564
Bed21	1324.6030	1728.4620	0.5373	0.9877	0.1739	1.5083	8.8135	0.8104	2.2513
Bed22	1506.3280	1713.0990	0.5374	1.0330	0.2001	1.5482	8.8776	0.8162	2.2431
Bed23	823.6136	986.6144	0.6748	0.7501	0.1667	1.7511	6.6902	0.6151	2.6611
Bed24	788.5076	969.3221	0.6871	0.7616	0.1775	1.7786	6.3920	0.5877	2.7437

Table 4.4 – The spatial values of ward D.

● *Ward E*

The number of gates (bed locations) in ward E is 24. The visibility graphs of the different spatial attributes are shown in Figures 4.23 and 4.24 while Table 4.5 contains the spatial values for ward E and for each gate (bed location) in this ward.

The central space in ward E contains the points that generate the greatest connectivity, whereas the gates generate lower connectivity. However, the closer the gate to the central space is the higher connectivity it seems to generate. The points that can see the longest visual distance are located in both ends of the vertical visual axis and gates can see much shorter distance than those points. The gates close to the central space, however, can see longer distance than those far from it.

The points that can be considered as a junction are located in the central space as well. And the gates near the outer boundary of the ward generate less spiky isovists. Being a radial ward design type, the control in ward E is unsurprising. There is one central controlling zone in ward E, whereas gates have lower control values than the central space. The gates that are directly next to the central space have lower controllability than the other gates. The lowest entropy values are located in the central space of the ward and the gates have greater entropy.

The visual inspection shows that integration HH and integration p-value are very close. The greatest integration points are located, as expected, in the centre of the ward and the value of the integration mostly decreases when moving away in all directions from the central space. Therefore, the closer the gate is to the central space, the higher integration value it has. Contrary, the contribution of the central space to the mean depth of the ward is not significant.

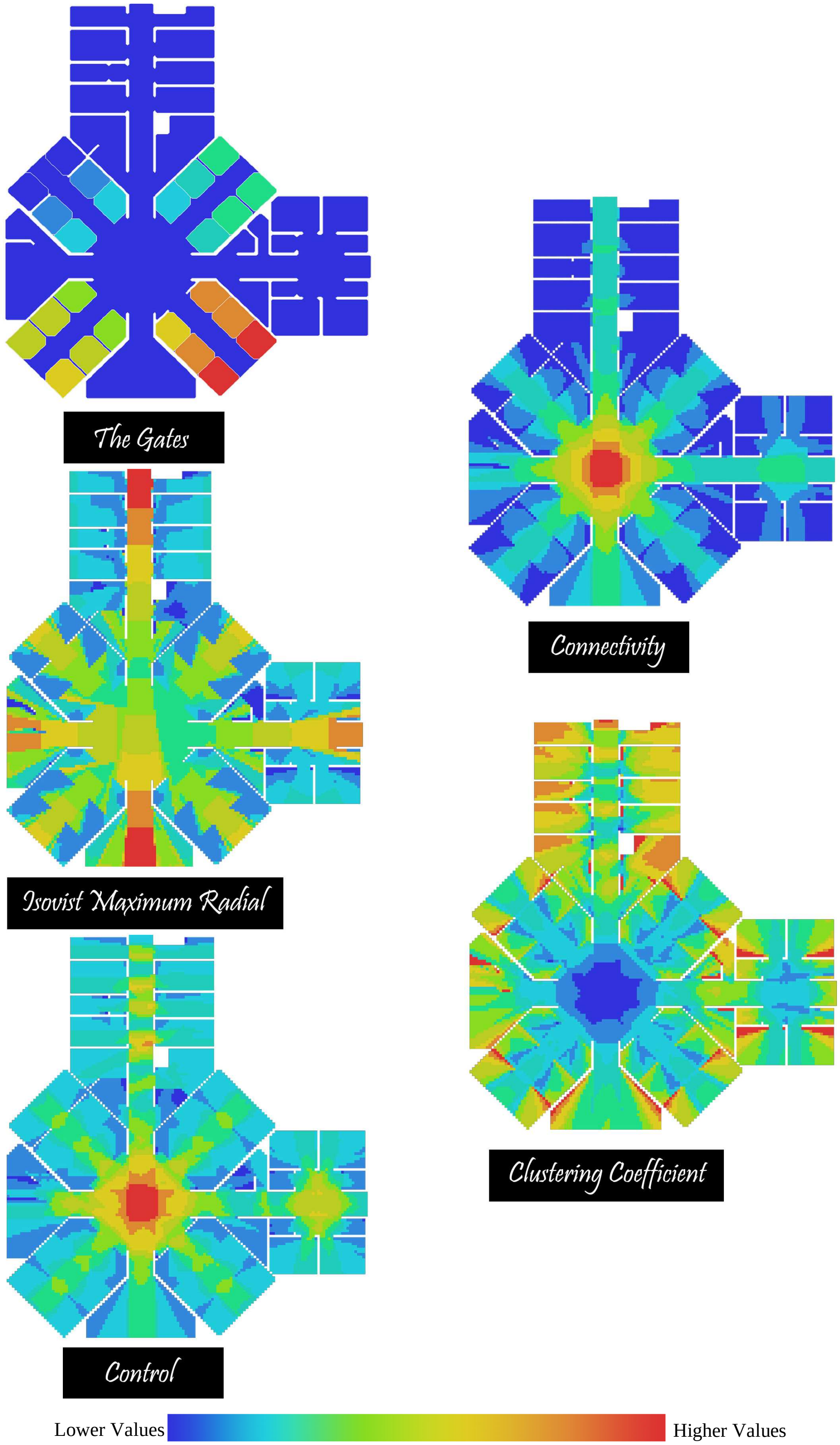


Figure 4.23 - The Gates[13], Connectivity, Isovist maximum radial, Clustering coefficient and Control of ward E.

[13] Coloured squares denote bed location (gates). Colours of beds in this diagram have no meaning, as opposed to the following diagrams, where colour represents the value of each spatial measure.

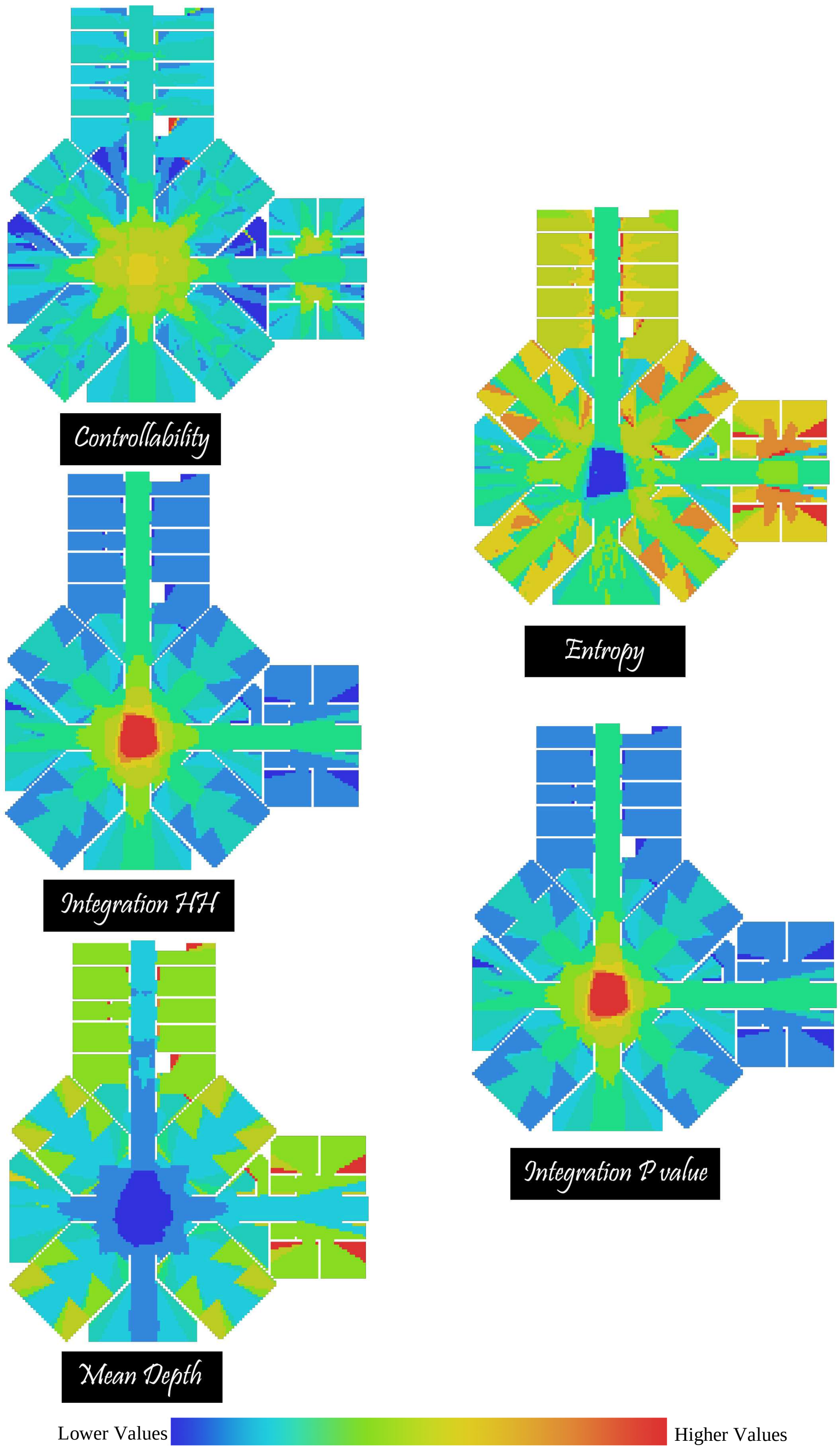


Figure 4.24 - Controllability, Entropy, Integration HH, Integration p-value and Mean depth of ward E.

	Connectivity	Isovist Maximum Radial	Clustering Coefficient	Control	Controllability	Entropy	Integration [HH]	Integration [P-value]	Mean Depth
Ward E	1211.3370	1374.4120	0.6731	1.0006	0.1854	1.5373	7.6692	0.6923	2.5810
Bed 1	596.3433	909.0914	0.7562	0.7705	0.1762	1.6669	5.8354	0.5268	2.9635
Bed 2	543.1567	850.1724	0.7697	0.7436	0.1744	1.6524	5.7401	0.5182	2.9794
Bed 3	764.6492	1011.9230	0.6414	0.8156	0.1661	1.6868	6.3824	0.5762	2.8042
Bed 4	715.6940	964.0653	0.6518	0.7851	0.1616	1.6144	6.4306	0.5805	2.7689
Bed 5	980.4963	1346.3060	0.5909	0.7449	0.1389	1.4371	7.8713	0.7106	2.4282
Bed 6	930.0154	1214.3820	0.5964	0.7028	0.1385	1.5653	7.4499	0.6725	2.5079
Bed 7	954.1691	1216.0220	0.5998	0.7163	0.1421	1.5731	7.4501	0.6725	2.5122
Bed 8	981.1617	1224.5470	0.5948	0.7405	0.1434	1.5324	7.6188	0.6878	2.4762
Bed 9	738.4926	999.2305	0.6461	0.7855	0.1629	1.6827	6.3197	0.5705	2.8194
Bed10	762.8657	1024.1820	0.6397	0.8082	0.1636	1.6768	6.3947	0.5773	2.8026
Bed11	576.1866	857.0750	0.7639	0.7698	0.1798	1.6836	5.7217	0.5165	2.9912
Bed12	596.4552	890.1424	0.7579	0.7819	0.1794	1.6808	5.7907	0.5227	2.9738
Bed13	914.6240	1339.1420	0.5924	0.7026	0.1295	1.3907	7.8930	0.7125	2.4174
Bed14	946.4240	1263.4490	0.5883	0.7171	0.1338	1.5396	7.6848	0.6937	2.4631
Bed15	728.0151	956.4512	0.6516	0.8000	0.1691	1.6535	6.4025	0.5780	2.7801
Bed16	752.5379	987.0145	0.6441	0.8156	0.1698	1.6186	6.4796	0.5849	2.7588
Bed17	575.2727	858.0860	0.7642	0.7682	0.1850	1.6572	5.7724	0.5211	2.9738
Bed18	595.3409	869.3857	0.7578	0.7799	0.1894	1.6466	5.8077	0.5243	2.9646
Bed19	921.7377	1270.5310	0.5932	0.7105	0.1332	1.5491	7.6014	0.6862	2.4803
Bed20	908.2927	1212.1020	0.5966	0.6993	0.1339	1.5139	7.5829	0.6845	2.4752
Bed21	717.8358	967.3059	0.6517	0.7971	0.1676	1.6854	6.2585	0.5650	2.8298
Bed22	725.3636	987.6989	0.6565	0.7979	0.1651	1.6410	6.4255	0.5800	2.7757
Bed23	539.0866	837.1024	0.7651	0.7492	0.1749	1.6687	5.6770	0.5125	3.0003
Bed24	535.9926	825.4086	0.7724	0.7432	0.1741	1.6584	5.7115	0.5156	2.9843

Table 4.5 – The spatial values of ward E.

● *Ward F*

Ward F contains the largest number of gates: 32. The visibility graphs of the different spatial attributes are shown in Figures 4.25, 4.26, 4.27 and 4.28. Table 4.6 contains the spatial values for ward F and for each gate (bed location) in this ward.

The greatest connectivity in this ward is located in the intersection points between the visual axes. In addition, the gates which are close to any visual axis seem to have greater connectivity than other gates. The points located in the ends of the two main visual axes are likely to have the longest sight lines.

The gates which are located near the outer boundary of the ward (far from the main visual axes) have more convex visual fields. The gates located in a six-gate space seem to have less control than those located in a four-gate space. Likewise, the gates located in a four-gate space seem to have more controllability than those in a six-gate space. The gates located in the four-gate space in the left wing of the ward appear to have less entropy than other gates.

The visualization of the integration HH and integration p-value in ward F seems to be similar. The greatest integration values are likely to be in the left ends of the two main visual axes and in the intersection points which resulted from the overlapping between these two horizontal visual axes and the vertical visual axes which pass through the six-gate spaces in the right wing of the ward. On the other hand, mean depth appears to reflect the integration, as the integration is a normalized version of the mean depth.

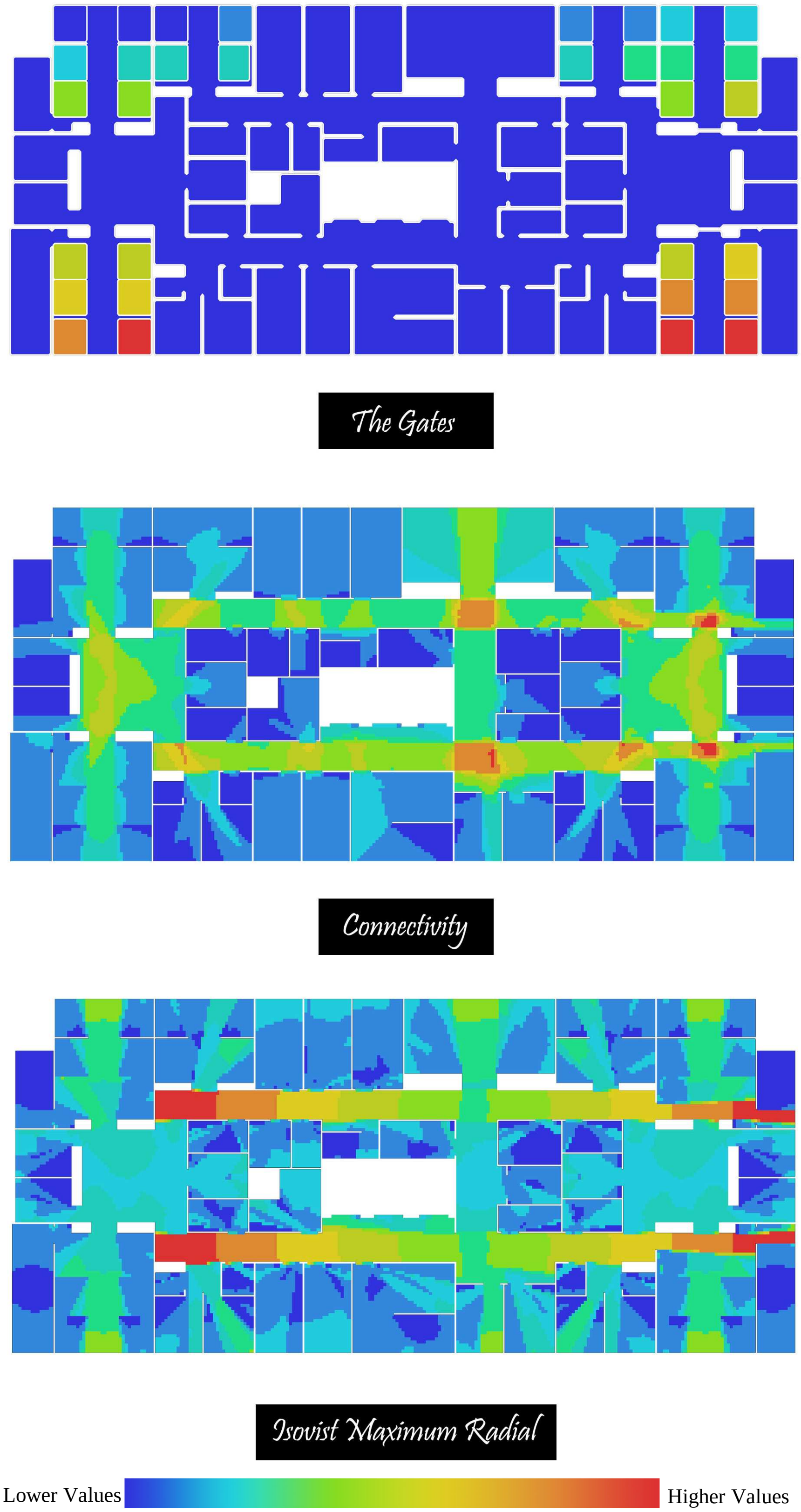


Figure 4.25 - The Gates[14], Connectivity and Isovist maximum radial of ward F.

[14] Coloured squares denote bed location (gates). Colours of beds in this diagram have no meaning, as opposed to the following diagrams, where colour represents the value of each spatial measure.

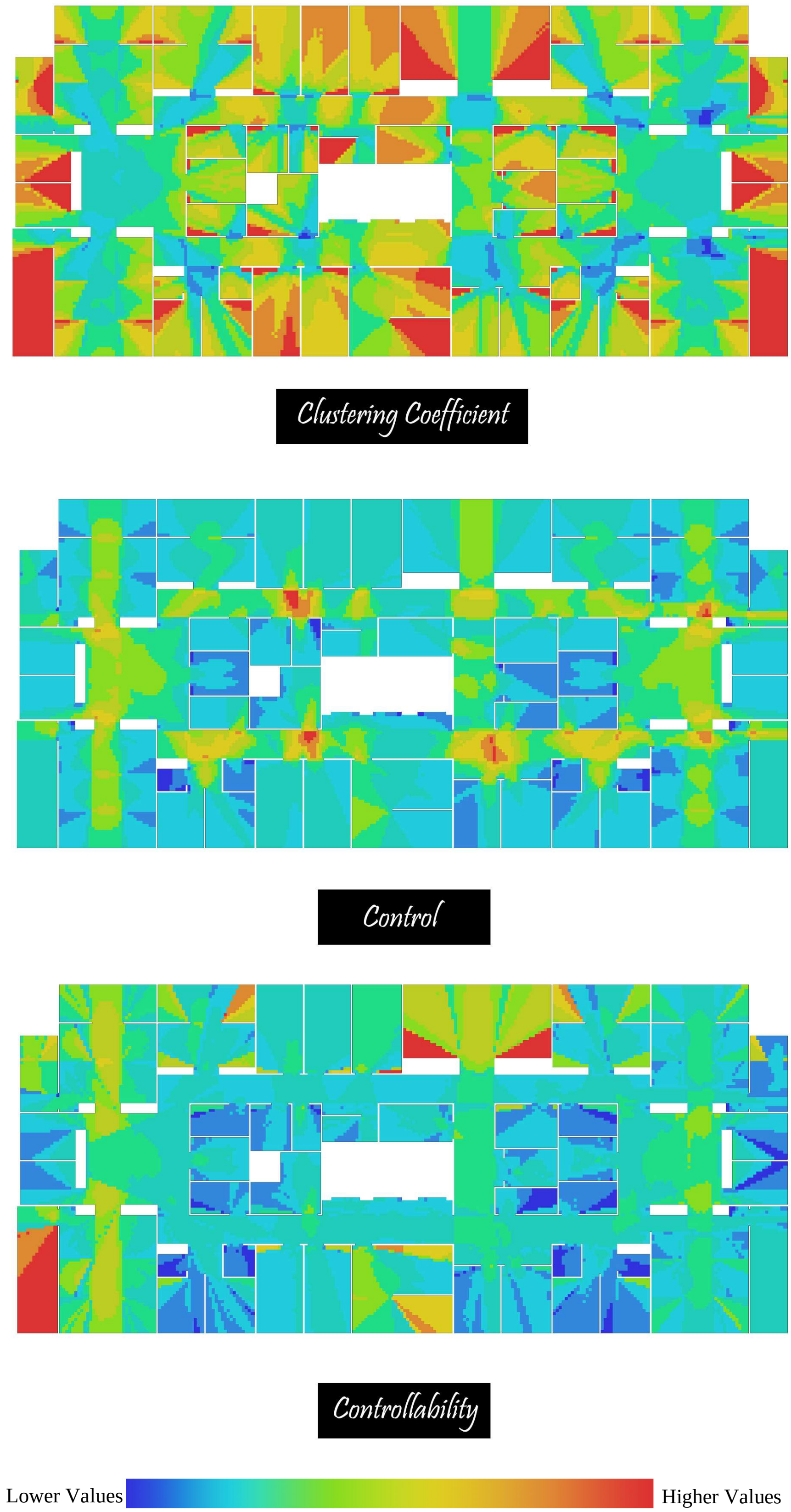


Figure 4.26 - Clustering coefficient, Control and Controllability of ward F.

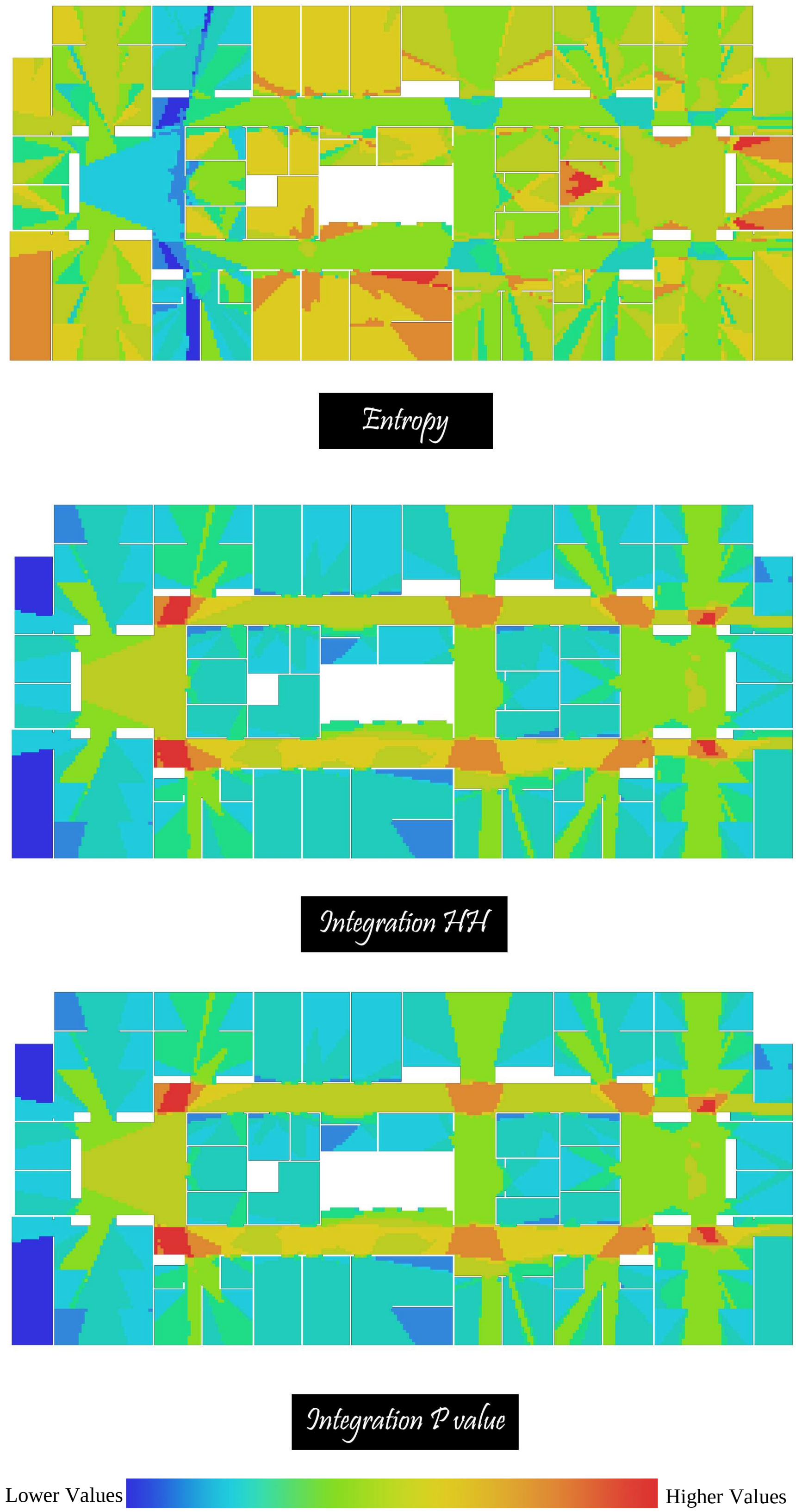


Figure 4.27 - Entropy, Integration HH and Integration p-value of ward F.

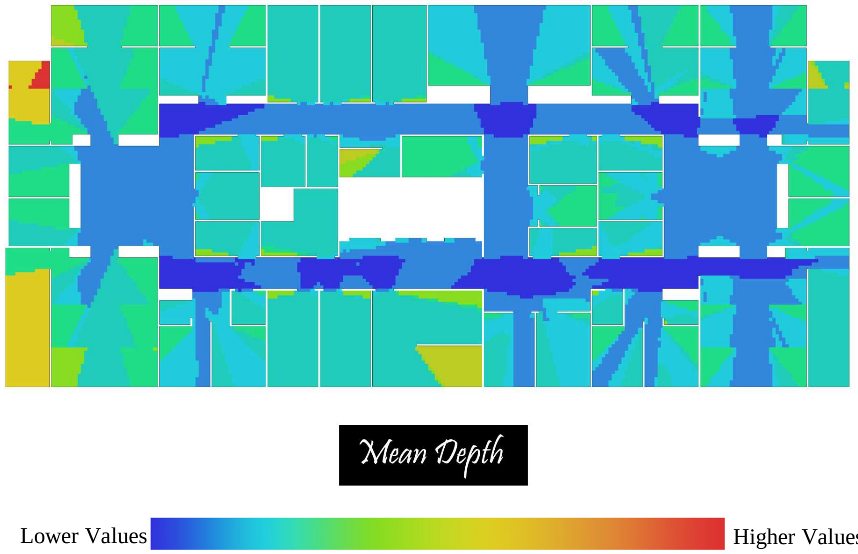


Figure 4.28 - Mean depth of ward F.

	Connectivity	Isovist Maximum Radial	Clustering Coefficient	Control	Controllability	Entropy	Integration [HH]	Integration [P-value]	Mean Depth
Ward F	1123.9330	1362.9490	0.7147	0.9994	0.1926	1.9093	5.6101	0.4644	3.2687
Bed 1	627.7955	889.4352	0.7641	0.7519	0.2412	2.0234	3.8451	0.3183	4.1844
Bed 2	602.3561	855.1396	0.7714	0.7343	0.2149	1.9000	4.3438	0.3596	3.7870
Bed 3	574.3485	728.3267	0.7919	0.8203	0.2429	1.6576	4.8268	0.3995	3.5213
Bed 4	592.3864	886.5292	0.7657	0.8211	0.3152	1.6486	4.7776	0.3955	3.5676
Bed 5	603.8333	925.0065	0.7560	0.8627	0.2903	1.9320	4.6413	0.3842	3.6360
Bed 6	564.9470	717.1198	0.8000	0.8091	0.2413	1.9533	4.5582	0.3773	3.6677
Bed 7	626.6288	893.3186	0.7627	0.7337	0.1827	1.9628	4.8845	0.4043	3.5147
Bed 8	603.2955	851.7769	0.7729	0.7229	0.1995	1.9451	4.7769	0.3954	3.5661
Bed 9	770.8182	934.5045	0.6682	0.8207	0.2492	1.8778	4.5724	0.3785	3.6799
Bed10	745.7045	893.2890	0.6769	0.7971	0.2144	1.9480	4.4376	0.3673	3.7281
Bed11	691.7197	744.2767	0.7309	0.8501	0.1897	1.6734	5.4018	0.4471	3.2418
Bed12	940.1833	1443.8410	0.6161	0.9548	0.1719	1.7398	5.8372	0.4832	3.0808
Bed13	930.4697	1431.8750	0.6155	0.9440	0.1501	1.9027	5.8439	0.4837	3.0940
Bed14	688.8788	814.9581	0.7278	0.8495	0.1807	1.9139	5.1399	0.4255	3.3564
Bed15	771.3333	919.2352	0.6689	0.7604	0.1602	1.9624	5.2907	0.4379	3.3025
Bed16	783.4924	1018.9430	0.6514	0.7649	0.1569	1.9567	5.3707	0.4446	3.2806
Bed17	1052.4240	1560.4690	0.5782	0.9164	0.1796	1.8174	5.5278	0.4576	3.2276
Bed18	763.2121	904.9460	0.7018	0.7655	0.1924	1.9220	4.5919	0.3801	3.6372
Bed19	1216.1360	1608.0900	0.6287	0.8069	0.1422	1.9525	6.1371	0.5080	3.0006
Bed20	1456.8110	2522.5300	0.5451	0.9486	0.1416	1.8868	6.7465	0.5584	2.8135
Bed21	1039.8110	1458.3390	0.5775	0.8832	0.1719	1.8663	5.5088	0.4560	3.2330
Bed22	770.0379	904.9453	0.6953	0.7431	0.1835	1.9689	4.5927	0.3802	3.6380
Bed23	1261.3110	1655.7380	0.6217	0.7927	0.1380	1.9572	6.2481	0.5172	2.9672
Bed24	1484.0680	2496.2620	0.5448	0.9146	0.1369	1.8900	6.8445	0.5666	2.7890
Bed25	789.3257	934.5941	0.6697	0.8376	0.2541	1.9307	4.5534	0.3769	3.6924
Bed26	763.4773	893.2741	0.6787	0.8086	0.2102	2.0038	4.4311	0.3668	3.7332
Bed27	788.8864	916.3025	0.6703	0.7735	0.1594	1.9749	5.3243	0.4407	3.2905
Bed28	802.0530	1017.9110	0.6537	0.7811	0.1597	1.9636	5.3918	0.4463	3.2724
Bed29	622.4243	879.5892	0.7644	0.7498	0.2382	2.0266	3.8412	0.3180	4.1858
Bed30	597.0000	844.6642	0.7725	0.7318	0.2117	1.9559	4.3180	0.3574	3.8051
Bed31	620.4697	886.4188	0.7638	0.7309	0.1793	1.9690	4.8943	0.4051	3.5109
Bed32	598.9091	841.9632	0.7730	0.7213	0.1962	1.9576	4.7797	0.3956	3.5652

Table 4.6 – The spatial values of ward F.

4.8 Summary

In this chapter three spatial analysis techniques (isovist, space syntax and visibility graph analysis) were reviewed, the limitations of each one were outlined and a comparison of their ability to analyse urban and building spaces was made. As a result of this comparison, visibility graph analysis (VGA) was the technique employed to analyse the spatial configuration of the six case study wards. And Depthmap release 5.4 was the software used to conduct VGA.

Six different open wards were used as case studies to investigate the relationship between the spatial attributes and people preferences for privacy in open wards. Nine spatial attributes were considered, which are: Connectivity, Isovist maximum radial, Clustering coefficient, Control, Controllability, Entropy, Integration HH, Integration p-value and Mean depth. These spatial attributes were calculated for each ward and each bed. The spatial attributes of beds were calculated by averaging the values of the points that represent each bed.

The importance of this chapter is to provide an essential numerical database to address the aim of this study by calculating the spatial attributes for each case study and for each bed in each case study, providing a quantitative description of the spatial attributes for both layouts and beds. This numeric description can enhance the investigation by allowing statistical analyses to explain the relationships between people preferences and dislikes for location with regards to privacy and the spatial attributes of ward layouts. The statistical analyses carried out to address the aim of this research are described in chapter six.

Chapter Five:

Paper-Based Questionnaire

5.1 Introduction

This chapter describes initial findings from the paper-based questionnaire used in this research. It starts with an explanation of the ideas around which the questionnaire was designed and the framework around which the questionnaire was structured. Following this, the importance of the pilot study in such research is discussed and a description of piloting and administering the current questionnaire is provided. Then, the descriptive analysis along with some inferential analysis carried out for each section of the questionnaire is reported following the question order in the original questionnaire. Lastly, the results of the analyses are discussed.

The importance of this chapter is that it reports the results of questions number 3 and 5. Subjects were asked in question number three to rank the wards shown in the questionnaire according to their preference. In question number five, subjects were asked to choose the bed they would prefer and the bed they would dislike in each ward with respect to their preferences for privacy .These two questions will serve, along with the numerical data resulted from the previous chapter, as a basis for the statistical analysis presented in the following chapter in order to address the first objective of this study. In other words, the subjective judgments on spatial location for privacy which have been assessed by means of a questionnaire are reported in this chapter.

In addition to the significance of these two questions (questions 3 & 5) for the current study, the remaining questions were included in the questionnaire to provide a wider insight into aspects of privacy in hospital wards. The results of the descriptive and inferential analyses of these questions are discussed here and linked to the literature.

5.2 Questionnaire Design and Structure

The questionnaire design was based around ideas in environmental psychology on people aspects of space. Questions in the questionnaire have been designed around three areas in line with Canter's (1977) research:

- Environmental Features.
- Activities carried out in the space.
- Perceptions and attitudes towards the place.

These areas have been covered in the questionnaire through four main sections. In addition, personal questions were added in a separate section. Hence, the questionnaire consists of five sections in addition to some illustration when necessary. The questionnaire's sections are: personal information, hospital ward design, activities carried out in the space, perceptions and attitudes towards the place and environmental conditions. The environmental features were covered in two separate sections which are: hospital ward design and environmental conditions. The reason was to simplify the questions to the respondents by categorizing them in smaller sections. The environmental conditions questions were directed to those who had stayed in a hospital ward previously. On the other hand, the questions about hospital ward design were designed to be answered by all respondents. The questionnaire design and structure are shown in Figure 5.1.

In writing the questions, jargon terms and words that have ambiguous meaning were avoided. In addition, leading questions were also avoided. In general, one question was asked at a time, the amount of writing the respondents had to do was minimized and the questions were arranged in logical order.

In order to get useful information from the questionnaire, the variables need to be measured in a quantitative way. While personal information and hospital ward design questions can be measured precisely by numerical values, other psychological constructs require the use of surrogates or proxies that indirectly measure a variable. To elicit measurable information from respondents, psychometric response scales were used in this research by which the respondents could indicate the depth of their feeling or attitude for a particular variable on a numerical scale. The appropriate level of measurement for each variable depends on two things: firstly, how a construct is conceptualised and secondly, the type of indicator used by the researcher (Neuman, 2003). There are many advantages in the use of scales. For example, it can increase reliability and validity as well as aid in data reduction. In addition, it simplifies the information that is collected (Neuman, 2003). The five sections of the questionnaire are described in detail in the following paragraphs.

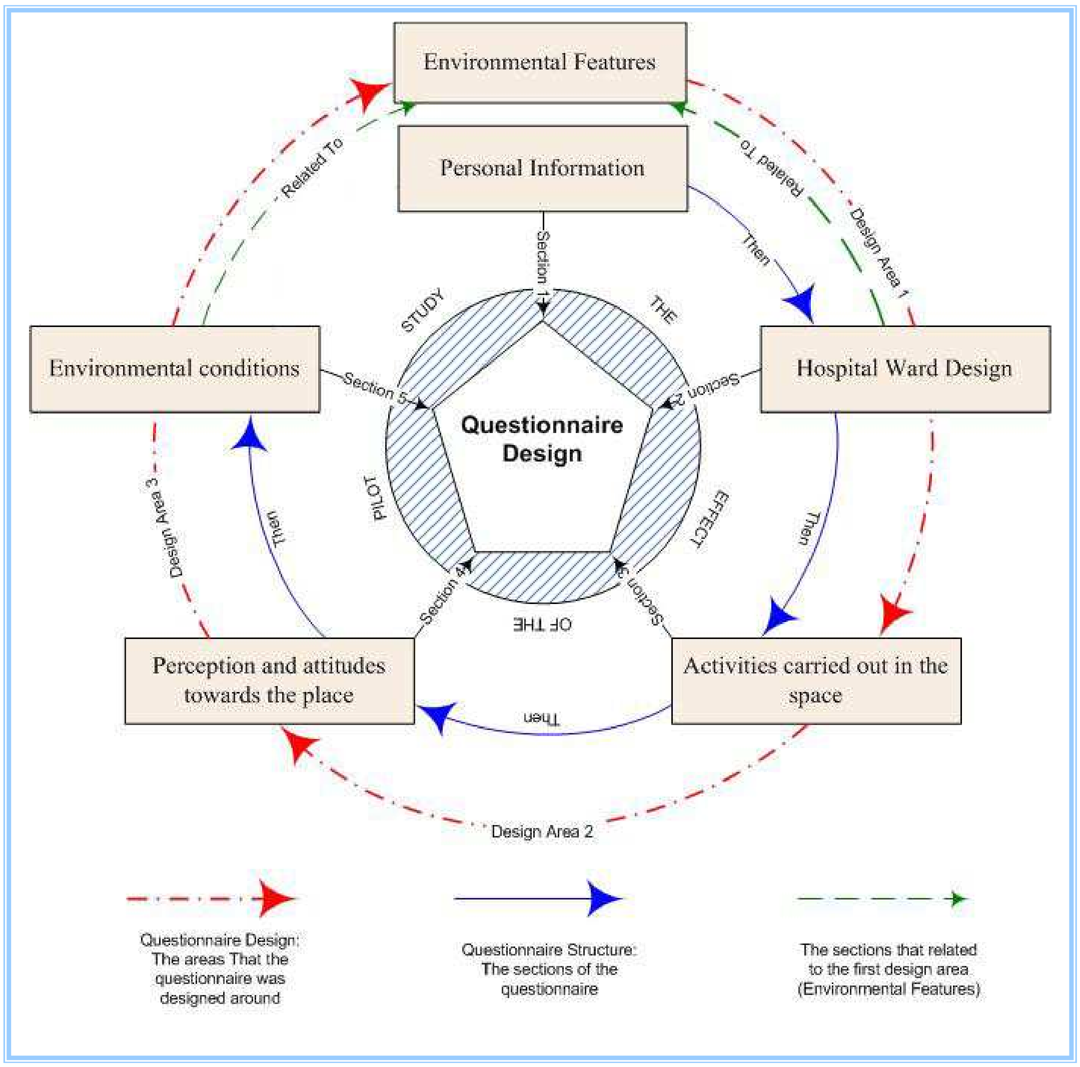


Figure 5.1 – Questionnaire design and structure (Source: the author)

● *Personal Information*

This section included four open-ended questions which covered the respondent's occupation, age, gender and nationality. After looking through the responses to these questions, the answers were classified in groups when possible. For example, the occupations were classified in three groups (students, professionals and non-professional workers), ages were classified in four categories (21-30, 31-40, 41-50 and +50), and the nationalities were split into two main cultural groups (European and Arabic). The decision to gather respondents into two cultural groups has been supported by the literature and the hypothesis that these particular two cultures manifest extremes cases of privacy, with higher privacy likely in the Arabic culture.

This classification allows further investigation in order to explore the effect of the age, gender or, more importantly, the cultural background on people preferences for privacy in open wards.

● *Hospital Ward Design*

The second section of the questionnaire included six questions; five closed and one open. This section investigated people preferences in open wards in terms of the architectural design of these wards. The variables investigated in this section are: the type of ward people prefer (single-bed room or open ward), whether the respondents actually had experience of staying in a ward or not, the type of open ward subjects prefer, the key reasons for their preference, the bed location they prefer, the bed location they dislike and the type of partition between the beds in open wards they prefer.

The two main questions in this research were located in this section. This research aims at exploring people preferences for privacy in open wards, therefore the questions about the type of open ward subjects prefer and the question about the bed locations they prefer and the bed locations they dislike in each ward are key questions in this questionnaire.

The plans of the six case studies, which are detailed in the previous chapter, were presented in the second page of the questionnaire. All furniture was omitted from the plans except bed locations. The point behind that is to avoid the effect of other features (such as the location of the nurse's station) on people's choices. Subjects were asked in question number three to rank the wards shown in the questionnaire according to their preference. In addition, in question number five, subjects were asked to choose the bed they would prefer and the bed they would dislike in each ward with respect to their preferences for privacy. These two questions (questions number three and five) are linked later (in chapter 6) to the spatial attributes of ward layouts calculated by VGA which were reported in the previous chapter (chapter 4).

● *Activities carried out in the space*

In this section some activities which are usually carried out in open wards and related to privacy were considered. It consists of one question split into six sub-questions. In this section, the degrees to which some activities in open wards may violate subjects' privacy were measured using a four-point scale (Not at all, Not very, Fairly and Very). These activities are: using the bed pan, going to the toilet, speaking with the doctor about the medical record, regular nurses jobs (such as: pulse rate, temperature measuring and injection), the medical check by the doctor and finally the speech of other patients. The scale used to measure these variables allows the researcher to analyse the responses statistically in order to distil meaningful information which may help to understand the types of the activities that may violate patients' privacy the most.

● *Perception and attitudes towards the place*

Six questions were included in this section. The aim of this section is to investigate subjects' perception and attitude towards open wards. This section asks about some privacy-related attitudinal issues in open wards which are: the safeness in open wards and single-bed rooms regarding nurses' monitoring, the effectiveness of the type of ward in helping the patient to recover, the morale in an open ward, the nurses station location in open wards, the acoustic privacy in open wards and finally patients' feeling of embarrassment in open wards.

It is generally accepted that attitudes are composed of three components: affective (feelings), cognitive (beliefs) and behavioural (actual actions) as shown in Figure 5.2 (Spooncer, 1992 reprint). Similarly, Baron and Byrne (1984) define attitudes as '*relatively lasting clusters of feelings, beliefs, and behaviour tendencies directed towards specific persons, ideas, objects or groups*'.

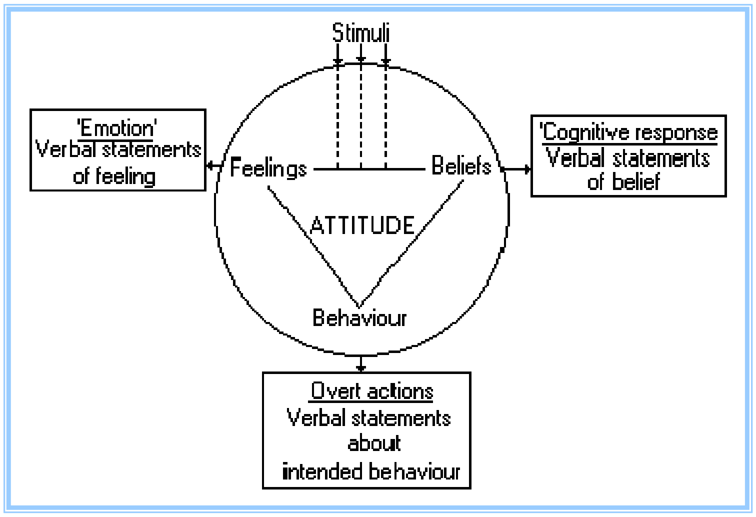


Figure 5.2 – Attitude components (Spooncer, 1992 reprint)

To measure respondents' attitude towards statements related to privacy in open wards, a rating scale was needed. Rating scales are a particular form of closed questions used whenever respondents are asked to make a judgement, in terms of sets of order categories, such as 'strongly agree', 'favourable' or 'very often' (Neuman, 2003). There are a variety of rating scales, with the most commonly used scale and the one most suitable for this questionnaire being the Likert Scale (Likert, 1932). This uses five-point scales to measure respondents' agreement or disagreement about some attitudinal statement allowing them to represent their judgments along a scale ranging from 1 (strongly agree) to 5 (strongly disagree). The most common numbers of answers or points on ranking scales are: five, seven or nine. The use of a five-point scale has long been a favourite in social survey (Neuman, 2003). However, a recent study showed that the use of different scale levels (i.e. 5-levels, 7-levels and 10-levels) may not significantly affect the statistical properties (i.e. mean, variance, skewness and kurtosis) of the data collected after applying a simple transformation (Dawes, 2008).

Using a rating scale technique may be associated with some distortion as a consequence of the following causes: the extreme responses categories may be avoided by the respondents (central density bias), the respondents may be inclined to present themselves in a more accepted manner from others' point of view (social desirability bias) or they may accept the statements as they are (acquiescence response bias).

A 5-point Likert Scale was used to measure people's response for the attitudinal statements in section four (Perceptions and attitudes towards the place). An example of the Likert Scale used is given below:

Please consider these statements and tick the box that indicates your opinion:

1- The attitudinal statement.

☐ Strongly agree ☐ Agree ☐ Neither ☐ Disagree ☐Strongly disagree

● *Environmental conditions*

This section is directed to the respondents who had previously stayed in an open ward as patients. It surveys subjects' experiences in open wards in terms of the environmental conditions of the wards they occupied. The environmental features considered are: temperature, light level, humidity, noise, acoustic privacy and visual privacy.

For each environmental condition a five-point scale was developed. The indicators of the temperature were: too hot, hot, just right, cold and too cold. The indicators of the light level were: too bright, bright, just right, dark and too dark. The indicators of the humidity were: too high, high, just right, low and too low. The indicators of the noise were: too loud, loud, just right, low and too low. Finally the same indicators were used to measure the acoustic and visual privacy which were: too high, high, just right, low and too low.

5.3 The Pilot Study and Administering the Questionnaire

After the completion of the questionnaire design, a pilot study was carried out. The pilot study is a pre-study of the main study and a mini version of it. It can be limited by using fewer subjects than those in the main study, a smaller range of types of subjects than the full types range in the main study, or the procedure may be more limited. The pilot study can help the researcher to identify, and as a consequence solve, some of the procedural bugs. There are many reasons for conducting pilot studies, according to Teijlingen and Hundley (2001) pilot studies are a crucial element of a good study design because of several reasons which can be summarized in the following points: testing the feasibility and effectiveness of sampling frame and recruitment approaches, collecting preliminary data to assess the potential problems in data analysis and developing a research question and plan.

In addition, feedback can be obtained from the subjects in many survey pilot studies where questionnaires are used. This feedback could be useful to assess the difficulties subjects face in answering the questions and the suitability of the time required to answer the questionnaire. Peat et al (2002) suggested some procedures for pilot studies in order to improve the internal validity of a questionnaire:

- Administer the questionnaire to pilot subjects in exactly the same way as it will be administered in the main study.
- Ask the subjects for feedback to identify ambiguities and difficult questions.
- Record the time taken to complete the questionnaire to assess its reasonability.
- Discard all unnecessary, difficult or ambiguous questions.
- Assess whether each question gives an adequate range of responses.
- Establish that replies can be interpreted in terms of the information that is required.
- Check that all questions are answered.
- Re-word or re-scale any questions that are not answered as expected.
- Shorten, revise and, if possible, pilot again.

For the aims of the pilot study in this research, twelve copies of the questionnaire were distributed to students, researchers and lecturers in Heriot-Watt University. Subjects were asked at the end of the pilot questionnaire to give their feedback and the time required to answer the questionnaire. This pilot study resulted in the following:

1- There were a language mistakes in some questions. These language mistakes were corrected and the questionnaire was revised.

2- Subjects for whom English is not the first language, found some questions difficult to understand. As a consequence, some questions were simplified and rephrased.

3- The key words or sentences in some questions were underlined to be clearly noticeable by the subjects and to emphasise the meaning of the question. Such words and sentences are: for each of the wards, prefer, dislike and bothersome.

4- Question number five was left uncompleted by some pilot subjects. This particular question asked people to choose the most preferred, second preferred, most disliked and second disliked bed location in each ward. Some subjects reported that this question was quite long and making four choices in each ward of the six wards was not easy. According to this observation and feedback, question number five was limited to asking the subjects to choose the most preferred and most disliked bed location only in each ward.

5- In question number nine, which asked about how bothersome some of the activities related to privacy in open wards are, one activity was added which was using the bed pan. This activity was suggested by three subjects.

After preparing the final version of the questionnaire in English, it was translated carefully into Arabic. See Appendices B and C for the English and Arabic versions of the questionnaire respectively.

In spite of the fact that face to face interviews are a more expensive way of administering a survey than using a postal questionnaire, most of the questionnaires were administered using face to face interviews. The reason for that is that face to face interviews allow the researcher to gain direct contact with the respondents and enable him/her to achieve higher response rates with more detailed and rich content than any other survey approach. On the other hand, time and travel expenses must be considered in face to face interviews, because the researcher is involved in arranging long meetings with a large number of interviewees (Denscombe, 1998). Most of the questionnaires were administered using face to face interviews. However, some questionnaires were handed over to respondents and collected later according to their preference, as some respondents preferred to spend some extra time when answering the questionnaire. This was carried out between June and August 2005 by the author.

5.4 Questions Coding

In total 79 subjects responded to the questionnaire. In order to enter the data collected in the fieldwork into computer for statistical analysis, the data were reduced to a numerical format and questions were coded and then built into a computer file to be analysed using SPSS (Statistical Package for the Social Sciences).

A unique name was given to each question identified in the original questionnaire. Generally, question names consisted of 6 digits except questions related to VGA which consisted of 9 digits. The first three digits indicate the main section of the questionnaire, followed by a digit indicating the number of the question and the last two digits indicate question description. In case the number of a question consists of two digits, question description will be the last digit only as shown in the Tables 5.1.

Section	Question number	Question description
XXX	0/00	XX/X

Table 5.1 – variable names

The questionnaire was divided into five main sections: personal information (PIN), hospital ward design (HWD), activities carried out in the space (ACS), perceptions and attitudes towards the place (PAP), and environmental condition (ENC). Three digits were added to questions related to respondents' subjective choices and VGA in order to distinguish the spatial attributes. Table 5.2 shows the coding of the spatial attributes considered in the study (see appendix D for the coding book of all questions).

VGA attributes	coding
Connectivity	Cnt
Isovist Maximum Radial	IMR
Clustering Coefficient	ClC
Control	Con
Controllability	Cnb
Entropy	Ent
Integration [HH]	InH
Integration [P-value]	InP
Mean Depth	MnD

Table 5.2 – VGA attributes coding

5.5 Sample Breakdown

As any person can be a patient in an open ward, the sample was as wide ranging as possible and varied in gender, age, cultural background and education level. However no claim is made about its representativeness for the general population as a whole. Subjects were approached in the UK and Syria. In the UK subjects were students and staff from Heriot-Watt University, friends of the author and friends of the author's friends (i.e. snowball sampling). In Syria subjects were relatives and friends of the author. People who came from an Arabic background but have been living permanently in a European country (e.g. the UK) or have been raised outside the Arabic world were excluded from the study. In total, 79 subjects responded to the questionnaire.

Of the subjects, 34.2% (27 subjects) were either postgraduate or undergraduate students, 45.6% (36 subjects) were professionals, and 20.3% (16 subjects) were non-professional workers. The age of the subjects ranged between 21 and 63 with mean age of 33.24 years and standard deviation = 12.224. In detail: 55.7% (44 subjects) were between 21-30 years old, 16.5% (13 subjects) were between 31- 40 years old, 15.2% (12 subjects) were between 41- 50 years old and 12.7% (10 subjects) were over 50. Of the subjects, 57% (45 subjects) were male and 43% (34 subjects) were female. Finally, 39.2% subjects (31 subjects) come from European countries and 60.8% subjects (48 subjects) come from Arabic countries. The sample breakdown is summarized in table 5.3.

Demographics		Frequency	Percentage
Education level	Students	27	34.2%
	Professionals	36	45.6%
	Non-professional workers	16	20.3%
Age	21 – 30	44	55.7%
	31 – 40	13	16.5%
	41 – 50	12	15.2%
	+ 50	10	12.7%
Gender	Male	45	57%
	Female	34	43%
Cultural background	EU	31	39.2%
	Arabic	48	60.8%

Table 5.3 – Sample breakdown (n = 79)

This variation in the sample was necessary to allow the investigation of the effect of respondents' demographics on the chosen spatial location for privacy and the exploration of the existence of sub-groups of people with different latent profiles across the variables.

5.6 Descriptive Analysis

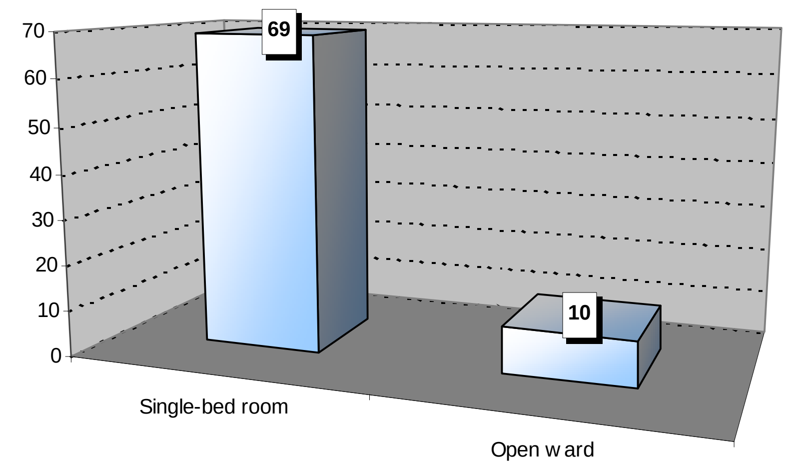
In this section the descriptive analyses carried out using the statistical package SPSS for windows are reported. Microsoft Excel was used to produce the graphs shown below. The results shown below follow the question order in the original questionnaire, which was split into the following sections:

5.6.1 Hospital ward design

Q1- Suppose you are a patient in a hospital ward, which ward would you prefer to stay in?

☐ Single-bed room ☐ open ward

This particular question is related to the recent debate on single-bed versus multi-bed rooms which was discussed in chapter two. Of the subjects, 87.3% preferred to stay in a single-bed room (69 subjects) and 12.7% (10 subjects) preferred to stay in an open ward. In spite of the trend for the provision of a single-bed room hospital, this result shows that there are a significant proportion of people who prefer to stay in multi-bed rooms. The results are shown in Figure 5.3.



	Frequency	Percent	Valid Percent	Cumulative Percent
Single-bed room	69	87.3	87.3	87.3
Open ward	10	12.7	12.7	100.0
Total	79	100.0	100.0	
Missing	0			
Total	79			

Figure 5.3 – Preferences of staying either in a single-bed room or in an open ward

In studies of patients' preferences for single-bed room versus multi-bed rooms, mixed results have been obtained (see chapter 2). For instance, Lawson and Phiri (2003) interviewed 473 patients all in Poole General Hospital and found that 54% of the patients expressed a preference for multi-bed rooms, 43% preferred single-bed room and the rest did not express any preferences. More importantly they found that the patients who were accommodated in the type of wards they prefer did significantly better than those who would have preferred the other type of wards.

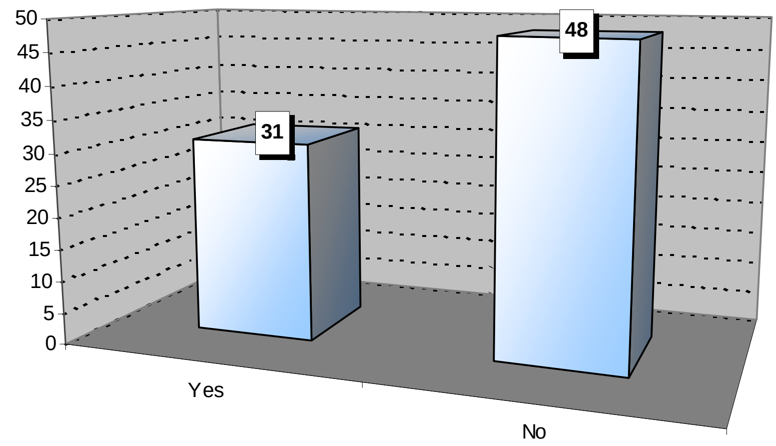
They related this variation in preference to two factors: personality and/or demographics. They investigated the differences associated with age and gender only, which showed no significant differences in ward type preferences between age and gender groups. Data collected in the current study also allows the examination of differences against age, gender, and cultural background. A Chi-Square test was conducted because the variables are at a categorical data level. The results showed that for each demographic variable, there is at least one cell that has expected frequencies of less than 5. As a consequence, the assumption for a Chi-Square test has not been met. Collecting more data may boost the proportion of cases into each category (Field, 2005). However this was not possible in this stage of the research because of the time and expenses limitation.

Q2 - Have you stayed in a hospital ward as a patient?

☐ Yes ☐ No

The literature suggested that previous experience of space is associated with differences in privacy preferences and expectations in hospital wards (Back and Wikblad, 1998). This question allows the investigation of the effect of previous experience of hospital wards on people's chosen spatial location for privacy. The results are shown in Figure 5.4.

Only 39.2% of the subjects (31 subjects) had stayed in a hospital ward as a patient and the rest 60.8% (48 subjects) had had no experience in being a patient in a hospital ward. Ideally it would have been of benefit if a greater number of the people sampled had had direct experience of hospital wards.



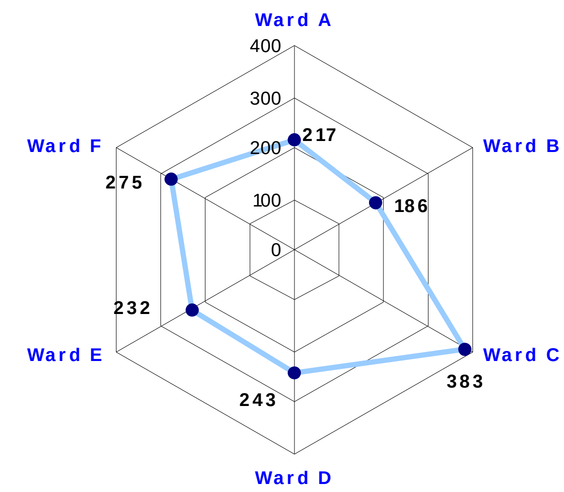
	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	31	39.2	39.2	39.2
No	48	60.8	60.8	100.0
Total	79	100	100	
Missing	0			
Total	79			

Figure 5.4 – Previous hospital experience

Q3- If you had to stay in a hospital in an open ward, which type of open wards shown in the previous page would you most prefer? Please rank them from 1 to 6 (1 is the most preferred one).

Ward type:	A	B	C	D	E	F
Preferred ward:	☐	☐	☐	☐	☐	☐

A six-point scale was used to measure respondents' preferences for ward type. The analysis in this sub-section makes use of SPSS software. This allows the researcher to combine and distil the ratings measured on a six-point scale. Figure 5.5 gives the total respondents' score of the variables.



	Sum	Mean	STD. Deviation
Ward A	217	2.97	1.650
Ward B	186	2.55	1.259
Ward C	383	5.25	1.278
Ward D	243	3.33	1.334
Ward E	232	3.18	1.636
Ward F	275	3.77	1.663

Valid N= 73, Missing= 6, Total= 79.

Figure 5.5 – Ward Preference (Higher score=less preference)

The analysis revealed that the lowest score was for ward B, hence ward B is the most preferred ward. The second preferred ward was ward A, the third preferred ward was ward E, the fourth preferred ward was ward D, the fifth preferred ward was ward F and finally the least preferred ward was ward C with the highest score. Table 5.4 ranks the preferences of the ward as 1 = the most preferred ward and 6= the least preferred ward.

Ward	B	A	E	D	F	C
Preference ranking	1	2	3	4	5	6

Table 5.4 – Ward preference (1= the most preferred ward and 6= the least preferred ward)

Thus, the question was whether there is a correlation between ward preference and bed numbers in wards? A scatter plot between the two variables would give an indication of the existence of such relationship. Figure 5.6 shows that there is no relationship between the two variables. In addition, the Pearson product-moment correlation coefficient confirms that there is no significant relationship between the two variables ($r = -0.524$, $p = 0.29$).

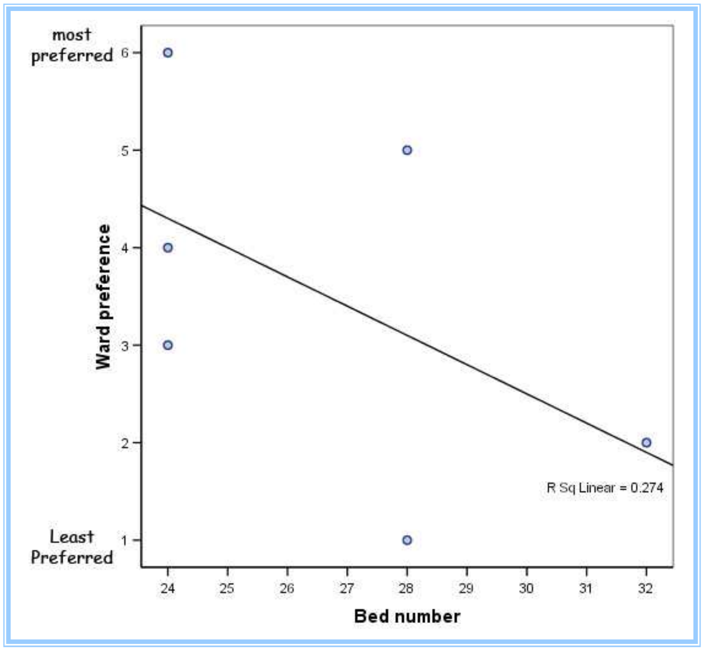
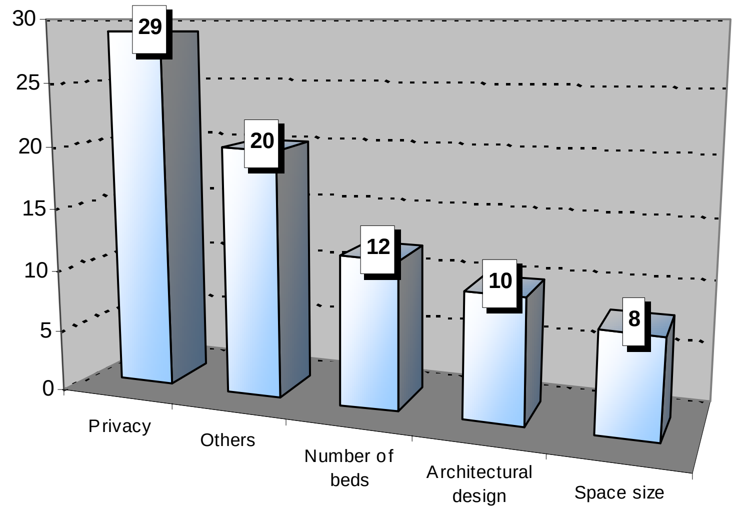


Figure 5.6 – Ward preference and bed number

Q4- Please, give reasons for your choice: ………………………………………..

After going through the answers of the open-ended question which asked about the reasons for ward type preferences, the answers were classified into five categories which are: architectural design, privacy, number of beds, space and others.

Preferences were related to privacy by 36.7% of the respondents; ‘other reason’ such as services, the ventilation etc, were the reason for the choice of 25.3% of the subjects; ‘number of beds’ was the reason of the choice for 15.2% of the subjects; 12.7% of the subjects reported ‘architectural design’ features as the main reason for their choices; and finally 10.1% of the subjects ranked their choices according to ‘space size’. Figure 5.7 shows frequencies of these categories.



	Frequency	Percent	Valid Percent	Cumulative Percent
Privacy	29	36.7	36.7	36.7
Others	20	25.3	25.3	62
Number of beds	12	15.2	15.2	77.2
Architectural design	10	12.7	12.7	89.9
Space size	8	10.1	10.1	100.0
Total	79	100.0	100.0	
Missing	0			

Figure 5.7 – Reasons for ward preferences

Q5- With respect to privacy, <u>for each of the wards</u>, please choose on the diagram shown on the previous page the bed you would <u>prefer</u> by using (√) and the bed you would <u>dislike</u> by using (X).

In order to explain the relationship between people preferences for locational privacy in open wards and the spatial attributes of ward layouts, respondents were asked to choose the bed they would prefer and the bed they would dislike in each ward shown in the questionnaire. The different number of beds in each ward depends on the design type, services and area of the ward. The number of the beds ranged between 24 and 32 with a mean of 26.67 beds/ward. The beds in each ward were numbered as shown in Figure 4.14 in chapter four. The most preferred and disliked beds in each ward are shown in Table 5.5.

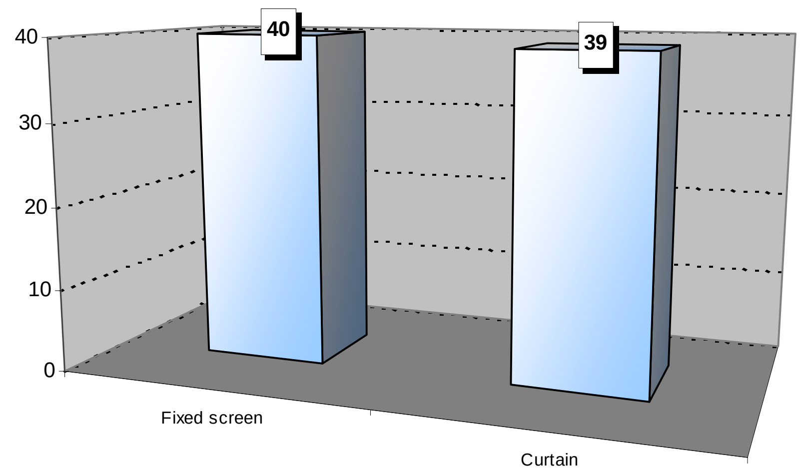
Ward	Most preferred bed						Most disliked bed					
	Bed number	Frequency	Valid Percentage	Valid Number	Missing	Total	Bed number	Frequency	Percentage	Valid Number	Missing	Total
A	8	10	13.5 %	74	5	79	4	13	16.9 %	77	2	79
B	4	15	20.5 %	73	6	79	11	12	16.0 %	75	4	79
C	1	24	30.8 %	78	1	79	21	19	24.4 %	78	1	79
D	3	22	28.2 %	78	1	79	22	15	19.2 %	78	1	79
E	11	13	16.7 %	78	1	79	7	14	17.9 %	78	1	79
F	4	16	20.5 %	78	1	79	17	15	19.2 %	78	1	79

Table 5.5 – Most preferred and most disliked beds in each ward

Q6- Which type of screening would make you more comfortable if you are occupying a bed in an open ward?

☐ Fixed screen ☐ Curtains

In answering this question, 50.6% (40 subjects) of the subjects preferred fixed screen and 49.37% (39 subjects) of the subjects preferred curtains. Figure 5.8 shows the result of the frequency analysis of this question.



	Frequency	Percent	Valid Percent	Cumulative Percent
Fixed screen	40	50.6	50.6	50.6
Curtains	39	49.4	49.4	100.0
Total	79	100.0	100.0	
Missing	0			
Total	79			

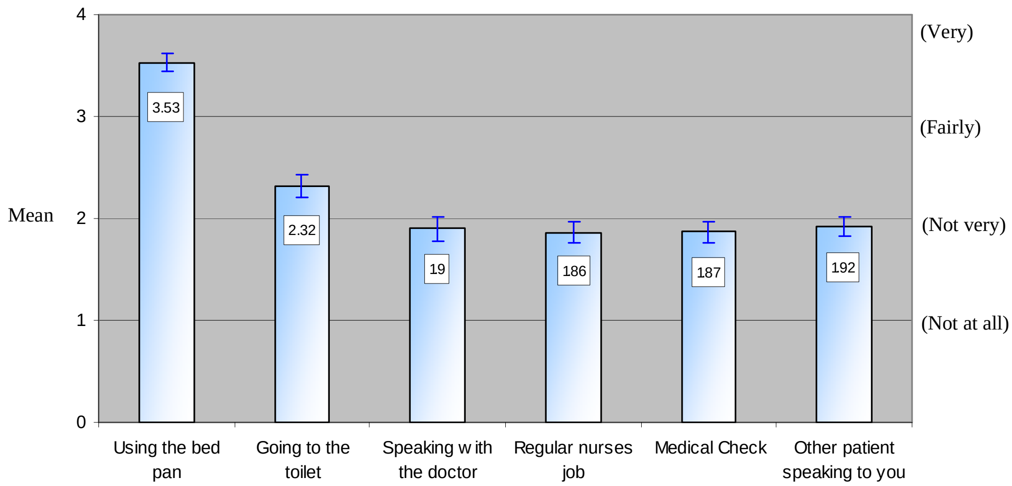
Figure 5.8 – Screening type preference

5.6.2 Activities carried out in the space

Q7- With respect to privacy, please indicate how <u>bothersome</u> each of the following would be in an open ward.

	Not at all	Not very	Fairly	Very
- Using the bedpan.	☐	☐	☐	☐
- Going to the toilet.	☐	☐	☐	☐
- Speaking with the doctor about your medical record.	☐	☐	☐	☐
- Regular nurses job (pulls rate, temperature, injection, etc.)	☐	☐	☐	☐
- Medical check by the doctor.	☐	☐	☐	☐
- Other patient speaking to you.	☐	☐	☐	☐

A four-point scale was used to measure how bothersome six privacy-related activities in open wards are for the respondents. The activities included are related to visual and auditory privacy. For each activity, the responses were averaged. The results are shown in Figure 5.9.



	Not at all	Not very	Fairly	Very	Total	Mean	Std.Error of Mean	Std. Deviation
Using the bed pan	2.5% (2)	7.6% (6)	24.1% (19)	65.8% (52)	100% (79)	3.53	0.084	0.748
Going to the toilet	22.8% (18)	35.4% (28)	29.1% (23)	12.7% (10)	100% (79)	2.32	0.109	0.968
Speaking with the doctor	50.6% (40)	20.3% (16)	17.7% (14)	11.4% (9)	100% (79)	1.9	0.120	1.069
Regular nurses job	44.3% (35)	31.6% (25)	17.7% (14)	6.3% (5)	100% (79)	1.86	0.105	0.930
Medical check	45.6% (36)	26.6% (21)	22.8% (18)	5.1% (4)	100% (79)	1.87	0.106	0.939
Other patient speaking to you	32.9% (26)	44.3% (35)	20.3% (16)	2.5% (2)	100% (79)	1.92	0.090	0.797

Figure 5.9 – Descriptive analysis of section 2: Activities carried out in the space

The activities that related to visual privacy appeared to cause more bother to the respondents than those related to auditory privacy. In particular, using the bed pan and going to the toilet were rated as the main causes of visual privacy violation. These two activities seem to cause more exposure than other activities. For simplicity, the activities were reduced to three groups each including two activities. These groups of activities are: visual privacy violators (using the bad pan & going to the toilet), visual privacy related (Regular nurses job & medical check) and auditory privacy related (speaking with the doctor & other patient speaking to you). Then, the mean for each group was calculated for each subject.

Test of differences was used to investigate the differences between these groups of activities. The normality of these distributions was checked using a one-sample Komogorov-Smirnov test (visual privacy violators $p < 0.01$, visual privacy related p<

0.01 and auditory privacy related p< 0.01). As these distributions were not normal distributed, the non-parametric Wilcoxon match pair test was used. The results are shown in Table 5.6. Visual privacy violators were significantly different from both visual privacy related and auditory privacy related activities, which suggests that in open wards the activities that involve more exposure (i.e. using the bed pan and going to the toilet) are likely to violate patient' privacy the most and hence affect negatively patients' satisfaction. In addition, more attention should be given to toilet location in hospital wards.

Wilcoxon matched pair test

	Visual Privacy Violators - Visual Privacy Related	Visual Privacy Related - Auditory Privacy Related	Visual Privacy Violators - Auditory Privacy Related
Z	-6.643[a]	-.489[b]	-6.565[a]
Asymp.Sig. (2-tailed)	.000	.625	.000

a Based on positive ranks.
b Based on negative ranks.

Table 5.6 – Comparison of the activity groups

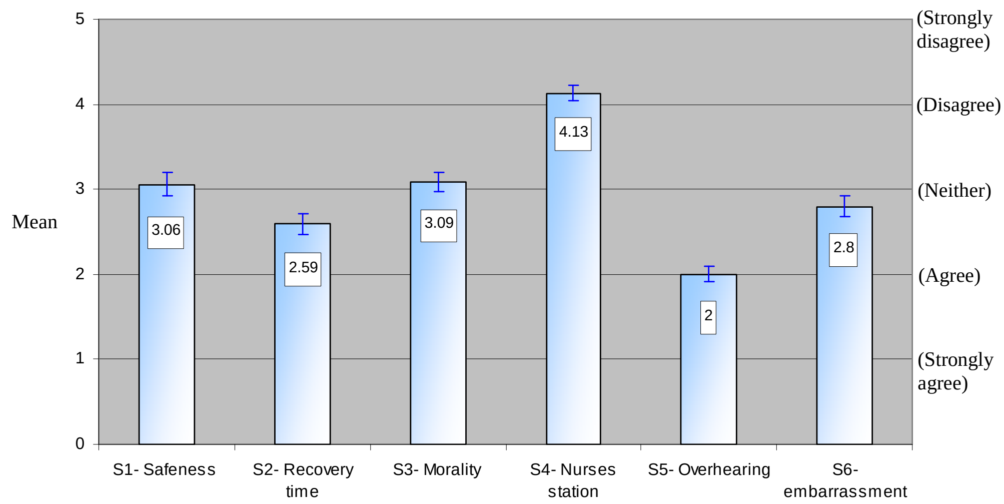
5.6.3 Perception and attitudes towards the place

Q8- Please, consider these statements and tick the box that indicates your opinion.

- The attitudinal statement.

☐ Strongly agree ☐ Agree ☐ Neither ☐ Disagree ☐Strongly disagree

The respondents were asked to indicate their opinion about some statements related to their perception and attitude towards privacy in hospital wards. A 5-point Likert scale measures the extent to which a person agrees or disagrees with the statements was designed to indicate respondents opinion, with 1 indicating strongly agree and 5 indicating strongly disagree. The results are shown in Figure 5.10.



	Strongly agree	Agree	Neither	Disagree	Strongly disagree	Total	Mean	Std.Error of Mean	Std. Deviation
S1- Regarding the nurses monitoring of patients, an open ward is safer than Single-bed room	8.9% (7)	35.4% (28)	11.4% (9)	29.1% (23)	15.2% (12)	79	3.06	0.143	1.274
S2- Single-bed room helps the patient to recover faster than an open ward.	13.9% (11)	40.5% (32)	17.7% (14)	27.8% (22)	0	79	2.59	0.117	1.044
S3- Open wards help to maintain the morale among the patients.	5.1% (4)	25.3% (20)	32.9% (26)	29.1% (23)	7.9% (6)	79	3.09	0.116	1.028
S4- In open wards, the best bed for a patient is the one which can not be seen well by the nurses.	0	6.3% (5)	5.1% (4)	58.2% (46)	30.4% (24)	79	4.13	0.087	0.774
S5- Patients in an open ward could overhear personal information about each other	20.3% (16)	68.4% (54)	5.1% (4)	3.8% (3)	2.5% (2)	79	2	0.09	0.801
S6- It is embarrassing to be a patient in an open ward.	8.9% (7)	38% (30)	24.1% (19)	22.8% (18)	6.3% (5)	79	2.8	0.123	1.091

Figure 5.10 – Descriptive analysis of section 3: Perception and attitude towards the place

Generally speaking, nurses monitoring was not perceived as a significant factor which may improve the safety of patients in open wards comparing with single rooms (S1 mean = 3.06). However, respondents were aware of the importance of this factor in open wards. This awareness was reflected in the general disagreement on sentence 4 ‘In open wards, the best bed for a patient is the one which can not be seen well by the nurses’ (S4 mean = 4.13). On the other hand, participants agreed that single bed rooms may provide an opportunity for quicker recovery comparing with open wards (S2 mean = 2.59).

On average, participants felt neutral towards the role of open wards in maintaining the morale among patients (S3 mean = 3.09). But they agreed that open wards may provide an opportunity for the violation of auditory privacy (S5 mean = 2). Moreover, open wards were perceived to cause embarrassment for patients (S6 mean = 2.8).

Following the descriptive analysis, the six attitudinal statements were analysed inferentially with Kruskal-Wallis and Mann-Whitney U analysis of variance tests, with age, gender, cultural background and previous experience of hospital wards being the independent variables. The results are shown in Table 5.7.

Independents variables		S1- Regarding the nurses monitoring of patients, an open ward is safer than Single-bed room	S2- Single-bed room helps the patient to recover faster than an open ward.	S3- Open wards help to maintain the morale among the patients.	S4- In open wards, the best bed for a patient is the one which can not be seen well by the nurses.	S5- Patients in an open ward could overhear personal information about each other	S6- It is embarrassing to be a patient in an open ward.
[a] Age	Chi-Square	10.836	5.852	4.549	7.382	3.206	1.239
	df	3	3	3	3	3	3
	Asymp. Sig.	.013*	.119	.208	.061	.361	.744
[b] Gender	Mann-Whitney U	699.500	746.000	728.500	719.000	625.500	718.000
	Wilcoxon W	1734.500	1781.000	1323.500	1754.000	1660.500	1753.000
	Z	-.674	-.198	-.376	-.518	-1.685	-.486
	Asymp.Sig(2-tailed)	.500	.843	.707	.605	.092	.627
[b] Cultural Background	Mann-Whitney U	467.500	595.000	540.500	737.000	594.500	406.500
	Wilcoxon W	963.500	1771.000	1036.500	1233.000	1770.500	1582.500
	Z	-2.886	-1.574	-2.127	-.080	-1.831	-3.535
	Asymp.Sig(2-tailed)	.004**	.116	.033*	.936	.067	.000**
[b] Experience of hospitals	Mann-Whitney U	412.500	600.000	579.500	618.000	562.000	468.000
	Wilcoxon W	908.500	1776.000	1075.500	1114.000	1738.000	1644.000
	Z	-3.460	-1.521	-1.719	-1.438	-2.229	-2.891
	Asymp.Sig(2-tailed)	.001**	.128	.086	.151	.026*	.004**

a Kruskal Wallis Test, b Mann-Whitney U Test *significant at the 0.05 level **significant at the 0.01 level

Table 5.7 – The differences between the demographics groups in the attitudinal statements

Firstly, there were highly significant differences between age groups' perception about the safeness in open wards with regards to nurses monitoring (S1 $p<0.05$). The older the group the lower the mean rank on a scale of 1= strongly agree to 5= strongly disagree (+50 mean rank = 24.95, 41-50 mean rank = 28.75, 31- 40 mean rank = 44.42 and 21-30 mean rank = 47). Older people believed that good nurses monitoring in open wards may result in improving the safeness in these wards comparing with single bed rooms. In contrast, gender has not been associated with any significant differences in participants' attitude towards hospital wards.

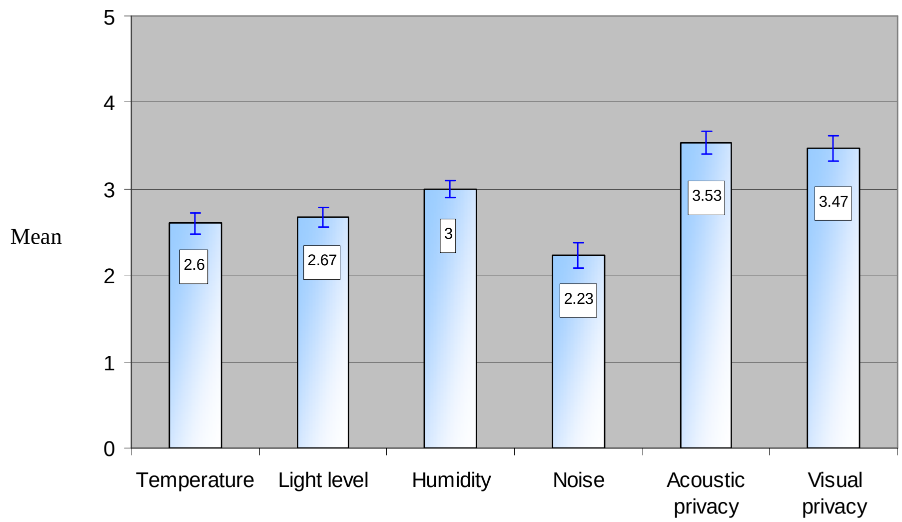
Secondly, people from different cultures (i.e. Arabic or European) expressed significantly different agreement levels to some attitudinal questions about hospital wards. European people believed that in open wards, nurses monitoring contributes positively to the safeness of patients comparing with single bed rooms (S1 $p<0.01$, European mean rank = 31.08, Arabic mean rank = 45.76). In addition, they expressed more agreement that open wards may help in maintaining the morale among the patients comparing with Arab people (S3 $p<0.01$, European mean rank = 33.44, Arabic mean rank = 44.24), whereas Arab people may experience more embarrassment in open wards than European people (S6 $p<0.01$, European mean rank = 50.89, Arabic mean rank = 32.97).

And finally, previous experience of hospital wards appeared to be a significant factor associated with differences in some attitudinal statements. Respondents who experienced admission to hospital wards scored significantly less (mean rank = 29.31) than those who have not (mean rank = 46.91) in response to a statement about the safeness in open wards and nurses monitoring (S1 $p<0.05$), hence they expressed stronger agreement to the statement. Moreover, they showed significantly stronger disagreement to the statement about the violation of auditory privacy in open wards (S5 $P<0.05$, with experience mean rank =45.87, without experience mean rank = 36.21) and the embarrassment in open wards (S6 $p<0.05$, with experience mean rank = 48.90, without experience mean rank = 34.25) comparing with people with no previous experience of being a patient in hospital wards.

5.6.4 Environmental conditions

Q9- If you have previously stayed in an open ward as a patient, how did you find the following environmental conditions?

Respondents who have previously stayed in a hospital ward were asked about some environmental conditions in the wards they occupied, such as: temperature, light level, humidity, noise, acoustic privacy and visual privacy. 31 (39.2 %) of the subjects only were eligible to answer this question and 48 (59.8 %) were not. The results of the descriptive analysis of this question are shown in Figure 5.11.



						Valid Number	Missing	Not applicable	Total	Mean	Std.Error of Mean	Std. Deviation
Temperature	Too hot	Hot	Just right	Cold	Too cold	30	1	48	79	2.6	.123	.675
	2	9	18	1	0							
Light level	Too bright	Bright	Just right	Dark	Too dark	30	1	48	79	2.67	.111	.606
	0	12	16	2	0							
Humidity	Too high	High	Just right	Low	Too low	30	1	48	79	3	.096	.525
	0	4	22	4	0							
Noise	Too loud	Loud	Just right	Quiet	Too quiet	30	1	48	79	2.23	.141	.774
	4	17	7	2	0							
Acoustic privacy	Too high	High	Just right	Low	Too low	30	1	48	79	3.53	.133	.730
	0	3	9	17	1							
Visual privacy	Too high	High	Just right	Low	Too low	30	1	48	79	3.47	.142	.776
	0	3	12	13	2							

Figure 5.11 – Descriptive analysis of section 4: Environmental conditions

For each environmental condition, a suitable 5-point scale was developed. Temperature, light level and humidity were rated as 'just right' by most of the respondents while noise level was rated as 'loud' the most. On the other hand, both acoustic and visual privacy levels were perceived as lower than patients' expectations in open wards (acoustics privacy: mean = 3.53, visual privacy: mean = 3.47).

5.7 Discussion and Conclusions

The data collected and analysed indicate a range of significant findings. These are summarised as follows:

- In spite of the common preference for single bed over multi bed rooms, there is a significant proportion of people who prefer to be accommodated in open wards. This finding is consistent with the results obtained from the literature which shows that mixed results were obtained on such a topic (see chapter two). Further research is needed to identify the factors that contribute significance to the differences between those who prefer single bed rooms and those who prefer multi-bed rooms. This variation in ward type preference may relate to personal, demographic and/or cultural properties (Lawson and Phiri, 2003).

- Privacy appeared to be the main reason for ward preferences, and that reflects two things: firstly, it emphasises the importance of privacy for people in hospital settings which has been reported widely in the literature. And secondly, it shows that people are aware of the importance of privacy in hospital wards, a fact reported previously in earlier studies (Back and Wikblad, 1998). In spite of this, it seems that open wards still can not meet patients' expectation for privacy. On average, both visual and auditory privacy were rated as low by respondents with previous experience of staying in open wards.

- The usual activities in open wards that may involve a violation of visual privacy of patients have been seen to cause a higher level of stress and bother for patients compared with activities that may involve a violation of auditory privacy. This finding suggests that more attention needs to be given to visual privacy in ward environments. In particular, using the bed pan and going to the toilet have been perceived as significant causes of stress and bother by the subjects. Actually, the sensitivity of the location of the sanitary facilities, especially the toilets, for patients' satisfaction has been recognized in many studies. For example, Health Building Note 04 emphasised that easy access, convenient location and good design of WCs are of great importance for patients (NHS Estates,1997).

- Older people expressed more agreement than younger ones that the feeling of safeness in multi-bed wards is higher than single bed rooms because of better nurse monitoring, and as a consequence, they may be more prepared to be accommodated in open wards.

- Although the investigation of cultural differences in ward type preference (single or multi-bed) has not been possible in this study because of insufficient data, some other aspects of cultural differences appeared to be statistically significant. People from European culture perceived open wards to offer more safeness with regard to nurses monitoring and morale support than single bed rooms comparing with people from Arabic culture. In contrast, Arab people believed that 'it is embarrassing to be a patient in open ward' more than European people. As a consequence, people from European culture seem to be more prepared to be accommodated in open wards than people from Arabic culture.

- It has been revealed that previous experience of hospital wards is significantly associated with differences in some respondents' attitudes towards hospital wards. For example, those who experienced being a patient in an open ward showed more agreement that an open ward is safer than single bed rooms with regard to nurses monitoring than those who have not previously stayed in a hospital ward. On the other hand, people with no previous experience of being in hospital wards as patients agreed that it is embarrassing to be a patient in open ward and that auditory privacy could be violated more in open wards. These views were more significant than from those with experience of being a patient in a hospital ward. Hence, the experience of being a patient in wards seems to improve the attitude towards open wards.

In addition to the importance of these findings, the significance of this chapter is that it reported data on participants' subjective judgments on spatial location for privacy (questions 3 and 5). This data along with the numerical values of the spatial attributes of the case studies calculated by VGA which were obtained from the previous chapter formulate a rich database which allows the investigation of the relationship between measures of the plan configuration of open wards, and subjective judgements on spatial locations for privacy. The next chapter reports the statistical analysis carried out in order to explore this relationship.

Chapter Six:
Spatial Attributes and Privacy Preferences

6.1 Introduction

This chapter aims at addressing research objectives 1 and 2. Firstly, a series of statistical analyses were run using SPSS to explore the relationship between measures of the plan configuration of hospital multi-bed wards and subjective judgment on locations for privacy. The findings which resulted from these analyses, along with the literature, suggested further investigation to explore preference for privacy among people with different demographics, cultural backgrounds and experience of space. This was done using different statistical techniques and supported by Latent Class Cluster Analysis (LCA) using Windows-based software package Latent GOLD 4.0 (http://www.statisticalinnovations.com/) and Answer Tree regression (SPSS Answer Tree option CART). Moreover, further analyses were run on individual wards in order to obtain a deeper insight into patterns of privacy preference at a finer scale.

This chapter makes use of the data reported in chapters 4 and 5. Respondents were asked (in chapter 5) to choose the bed they would prefer and the bed they would dislike if they had to stay in each of the six wards shown in the questionnaire. Each bed was represented by the numerical values of the spatial attributes, which were calculated using Depth Map (chapter 4). Then, for each respondent, the average of each spatial value of the six most preferred beds chosen across wards was calculated and similarly the average of each spatial value of the six most disliked beds. Consequently, the preferences for each subject were represented as two sets of spatial values - one from the average of the 6 preferred and one from the average of the 6 disliked bed locations. Then these variables were used in the main analysis.

6.2 Spatial Location Differences between Preferred and Non-preferred Locations

The initial question was whether the selected preferred or disliked locations for privacy differed on the spatial attributes obtained from Depthmap. Firstly, the normality of the distributions of the spatial attributes of the preferred and disliked beds was checked using One-sample Kolmogorov-Smirnov test (K-S test). The significant value of this test ($p < 0.05$) indicates a deviation from normality. The results are shown in Table 6.1.

		Connectivity	Isovist maximum radial	Clustering coefficient	Control	Controllability	Entropy	Integration HH	Integration P	Mean Depth
Preferred locations	Kolmogorov-Smirnov Z	1.380	1.371	1.296	0.692	0.881	0.972	1.638	1.584	1.720
	Asymp.Sig. (2-tailed)	0.044	0.047	0.069	0.724	0.419	0.301	0.009	0.013	0.005
Disliked locations	Kolmogorov-Smirnov Z	0.745	.629	0.676	0.511	0.884	0.653	0.843	0.805	1.061
	Asymp.Sig. (2-tailed)	0.635	0.824	0.751	0.956	0.416	0.788	0.477	0.536	0.210

Table 6.1 – The normality of the spatial attributes of preferred and disliked beds

As some of the distributions were not normal, the non-parametric Wilcoxon matched pairs test was used to compare the spatial attributes of preferred and disliked locations. All spatial measures show that the chosen locations are significantly different with most measures indicating high levels of significant difference. Results are shown in Table 6.2.

Wilcoxon matched pairs test

	Connectivity	Isovist maximum radial	Clustering coefficient	Control	Controllability	Entropy	Integration HH	Integration P	Mean Depth
Z	-5.175[a]	-5.039[a]	-4.447[b]	-3.138[a]	-3.470[b]	-2.175[a]	-4.139[b]	-4.105[b]	-3.616[a]
Asymp. Sig. (2-tailed)	.000	.000	.000	.002	.001	.030	.000	.000	.000

a Based on negative ranks.
b Based on positive ranks.

Table 6.2 - Comparison of spatial locations of preferred and disliked privacy

The next question is to examine the underlying relationship between the spatial variables for the two situations. In order to do this, two Principal Component Factor Analyses were carried out – one on the spatial attributes across all wards for the preferred bed locations, and one on the spatial attributes across all wards for the disliked bed locations. Prior to this, the assumptions and stages of principal component analysis were reviewed.

6.3 Principal Component Analysis (PCA) on Spatial Locations

Principal component analysis is a factor extraction method used usually by researchers to understand and determine the underlying structure inherent in the way people have responded to different questions. The underlying structure, called Factors, is the fewest independent dimensions which explain the variation in response variables under question (Tabachnick and Fidell, 2001). It operates on the matrix of inter-correlations between the chosen variables. If the questions are related to the same underlying dimension, then they would be expected to correlate highly with each other. On the other hand, if each question was unique then there may be as many dimensions as questions emerging from the analysis.

Three main stages are involved in conducting principal component analysis, which are: checking if the data is suitable for factor analysis, factor extraction and factor rotation.

Assessment of the suitability of the data for principal component analysis involves checking some assumptions, such as: linearity, outliers, factorability of the correlation matrix, sample size and normality of the distributions (Pallant, 2005).

Principal component factor analysis assumes that the relationship between the variable is linear. Tabachnick and Fidell (2001) suggest a spot check of linearity using scatter plots. These scatter plots can also be used to check the outliers among the cases. If any outliers found, it is recommended to reduce its influence or even remove it (Pallant, 2005).

The correlation matrix should include at least correlation of $r = 0.3$ to be suitable for factor analysis. Two tests should be checked, Bartlett's test of Sphericity which should be significant ($p < 0.05$) (the significance of this test means that there are some significant relationships between the variables involved in factor analysis (Bartlett, 1954)) and the Kaiser-Meyer-Olkin statistic should have a value greater than ($p = 0.5$) to be acceptable (Kaiser, 1974). If these two conditions are achieved, then factor analysis is appropriate for the data.

The reliability of the principal component analysis relies on sample size. The common sample size is 10-15 subjects per variable (Field, 2005). However, Kass and Tinsley (1979) recommended having 5-10 subjects per variable. According to Field's (2005) review, Comrey and Lee (1992) rank the sample size for factor analysis as 100 poor, 300 good and 1000 excellent. However, Stevens (1996) reported that the sample size required by research has been reduced over the years as a result of increasing studies done in this field. Another study suggests that the reliability of the factor solution is determined by sample size and the magnitude of factor loadings. Guadagnoli and Velicer (1988) found that the factor is reliable if it has more than three loadings greater than 0.6 regardless of the sample size. In line with this research, MacCallum et al (1999) argued that the importance of the sample size decreases with increasing of the factor loadings. If all loading is above 0.6, a small sample (less than 100) may be perfectly sufficient.

One more assumption which requires checking before running principal component analysis is the normality of the distributions. The tests to use to determine whether a distribution is normal or not are: Komogorov-Smirnov and Shapiro-Wilk test. These tests compare the distribution needing to be tested to a normal one with the same mean and the same standard deviation (Field, 2005). The non-significant result ($p > 0.05$) indicates that the distribution is normal, and vice-versa the significant result ($p < 0.05$) indicates that the distribution is not normal. A one-sample Komogorov-Smirnov test (or K-S test) is used in this thesis, as required, to check the normality of variables' distributions.

After checking the suitability of the data for principal component analysis, factors should be extracted. Factor extraction involves identifying the fewest number of factors that best represent the underlying structure between the variables. There are different ways to extract the factors. The most common one, which has been used in this thesis, is principal component, which determines the number of independent factors to be kept using Kaiser's criterion and graphically the scree test. In Kaiser's criterion, the eigenvalue of the factor is calculated, which is the total variance explained by the factor. Factors are retained if they have eigenvalues of 1.0 or more (Pallant, 2005). The scree test involves plotting the eigenvalues values of the factors and finding the changing point in the curve's shape (Catell, 1966).

The third stage in conducting principal component analysis, after assessment of the suitability of the data and factor extraction, is factor rotation. Factor rotation is a process to assist in interpreting the factor solution without changing the underlying properties. There are two approaches of rotation: orthogonal and oblique.

Orthogonal rotation assumes that all the factors are uncorrelated with each other (i.e. they are independent). The most commonly used approach is Varimax, because it is a good general method to simplify the interpretation of the factors (Field, 2005). Furthermore, the Varimax method minimises the factor loadings associated with a variable, in other words, it minimises the complexity of the factor (Tabachnick and Fidell, 2001). On the other hand, oblique rotation assumes that the factors are correlated with each other, and are therefore not independent. The most commonly used approach is Direct Oblimin which outputs the amount of correlation allowed between the factors (δ) (Tabachnick and Fidell, 2001).

6.3.1 Preferred location for privacy

Prior to using principal component analysis (PCA) to investigate the underlying spatial structure associated with the preferred bed, the normality of the nine spatial variables which resulted from averaging the spatial values of the six preferred beds of each subject were checked using the Komogorov-Smirnov test. The results are shown in Table 6.1.

Five spatial attributes were non-normal with significant results. In order to improve the analysis and to reduce the impact of non-normal data, Tabachnick and Fidell (2001) recommended transformation of variables. Connectivity ($z = 1.127$, $p = 0.16$) and isovist maximum radial ($z = 1.22$, $p = 0.1$) were successfully normalized using a logarithmic transformation. However, the other three non-normal variables (integration HH, integration P value and mean depth) failed to be transformed into a normal distribution in spite of trying several transformation formulas. However, Tabachnick and Fidell (2001) stated that while the assumption of normality enhances the stability of the solution resulting from PCA, if the normality fails, but is not too skewed or dichotomous, the solution is still worthwhile. On this basis PCA was carried out.

An additional check on the suitability of the data for factor analysis was made: linearity and outliers were checked using scatter plots; inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above; the Kaiser-Meyer-Olkin value was 0.843, exceeding the recommended minimum of 0.6 (Kaiser, 1970; Kaiser, 1974); and the Barlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, all supporting the appropriateness of factor analysis on the correlation matrix.

The nine spatial attributes, obtained from VGA, of the most preferred bed, were subjected to principal components analysis (PCA), which revealed the presence of two components with eigenvalues exceeding the normal criteria of 1, and which explained 76.028 per cent and 14.369 per cent of the variance respectively - with a cumulative percentage of 90.396 per cent. An inspection of the screeplot revealed a clear break after the second component reinforcing a two component solution. To aid in the interpretation of these two components, Varimax rotation was performed. The rotated solution reveals the presence of a simple structure, with both components showing a number of strong correlational loadings. The matrix of the rotated components using Varimax method is shown in Table 6.3.

Rotated Component Matrix of the most preferred bed

	Component	
	1	2
Connectivity (LG10)	.964	
Isovist maximum radial (LG10)	.957	
Clustering coefficient	-.941	
Control		.949
Controllability	-.693	.615
Entropy	-.804	
Integration HH	.994	
Integration [P value]	.992	
Mean Depth	-.985	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

Table 6.3 – The spatial structure of the most preferred bed

A Direct Oblimin rotation was performed ($\delta = 0$), to check if the components correlated with each other or not, and as a consequence, ensure that the decision to rely on Varimax rotation is reasonable. The component correlation matrix reveals that the relationship between the two components is very low, at -0.035. This value is lower than the recommended value for oblique rotation (above 0.3) (Pallant, 2005). Hence, the Varimax rotation is the appropriate rotation for this data.

The interpretation of the two components reveals that there are two fundamental dimensions which underpin people's locational preferences for privacy. The best representative of the first dimension is Integration HH, as it has the highest loading on factor 1. Whereas the best representative of the second dimension is Control, as it has the highest loading on factor 2.

6.3.2 Non-preferred location for privacy

Similarly the underlying spatial structure associated with the disliked bed has been investigated. One-sample Komogorov-Smirnov test revealed that the distribution of the nine spatial variables which resulted from averaging the spatial values of the six disliked beds for each subject are normal with non-significant results. The results are shown in Table 6.1.

Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser-Meyer-Olkin value was 0.755, exceeding the recommended minimum value of 0.6 (Kaiser, 1970; Kaiser, 1974) and the Barlett's Test of Sphericity (Bartlett, 1954) reached statistical significance ($p < 0.001$), supporting factoring the correlation matrix.

The nine spatial attributes, obtained from VGA, of the most disliked bed, were subjected to (PCA) which revealed the presence of two components with eigenvalues exceeding 1, explaining 76.509 per cent and 13.758 per cent of the variance respectively, with a cumulative percentage of 90.267 per cent. An inspection of the screeplot revealed a clear break after the second component. Again it was appropriate to retain two components for further investigation. To aid in the interpretation of these two components, Varimax rotation was performed. The matrix of the rotated components using Varimax method is shown in Table 6.4.

Rotated Component Matrix of the most disliked bed

	Component	
	1	2
Connectivity (LG10)	.901	
Isovist maximum radial (LG10)	.913	
Clustering coefficient	-.915	
Control		.885
Controllability	-.725	.586
Entropy	-.839	
Integration HH	.983	
Integration [P value]	.980	
Mean Depth	-.981	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

Table 6.4 – The spatial structure of the most disliked bed

A Direct Oblimin rotation was performed ($\delta = 0$), to check if the components correlated with each other or not, and as a consequence, ensure that the decision to rely on Varimax rotation is reasonable. The component correlation matrix reveals that the relationship between the two components is very low, at 0.054. Hence, the Varimax rotation is the appropriate rotation for this data.

Once again it appears that there are two fundamental dimensions underpinning people's dislikes for bed location. The best representative of the first dimension is Integration HH, as it has the highest loading on factor 1 and the best representative of the second dimension is Control, as it has the highest loading on factor 2.

6.3.3 Spatial attributes of preferred and non-preferred privacy

The spatial attributes associated with peoples' preferences for privacy and the spatial attributes associated with peoples' judgements of locations with low privacy have been determined as Integration HH and Control. In order to understand the relationship between these variables, a further principal component analysis was run on the four variables: integration of the preferred bed (P-Integration HH), control of the preferred bed (P-Control), integration of the disliked bed (D-Integration HH) and control of the disliked bed (D-Control). The other spatial attributes were ignored because they were highly correlated with the two dimensional solutions in the two situations and were not adding to the accounted variance.

The principal components analysis of the four variables revealed the presence of two components with eigenvalues exceeding 1, explaining 50.887 per cent and 26.563 per cent of the variance respectively, with a cumulative percentage of 77.451. The two component solution was rotated using Varimax rotation. The matrix of the rotated components using Varimax method is shown in Table 6.5.

Rotated Component Matrix for the 4 selected variables

	Component	
	1	2
P-Integration HH	-.876	
D-Integration HH	.938	
P-Control		.939
D-Control	.542	-.517

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

Table 6.5 – The spatial structure of preference and non-preference

The two component solution reveals that the integration of the preferred bed (-ve sign) is in the opposite direction and highly correlated with the integration of the disliked bed (+ve sign). Similarly, the control of the preferred bed (+ve sign) is in the opposite direction to the disliked bed (-ve sign). In other words, there is a simple spatial structure behind the preference for privacy. However, while the integration value of the disliked bed is again simple and opposite to that of the high privacy bed, judgements on the control variable for low privacy are more complex. This is partly because of the correlation between integration and control on component 1, and partly because of a shared loading of control across the two components.

The strong linear negative relationship between the integration of the preferred beds and the integration of the disliked beds is illustrated in the scatter plot between the two variables in Figure 6.1.

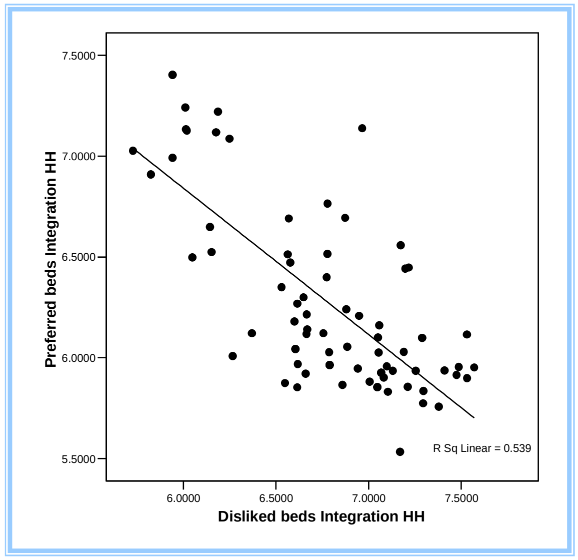


Figure 6.1 – The relationship between integration of the preferred and disliked bed locations

Pearson product-moment correlation coefficient confirms the significant negative correlation between the two variables ($r = -0.734$, $p < 0.01$), with high level of integration of the preferred bed associated with lower level of integration of the disliked beds.

A similar scatter plot for the relationship between the control value of the preferred bed and the control value of the disliked bed is shown in Figure 6.2. The scatter plot reveals a weaker linear negative relationship between the control of the preferred beds and the control of the disliked beds.

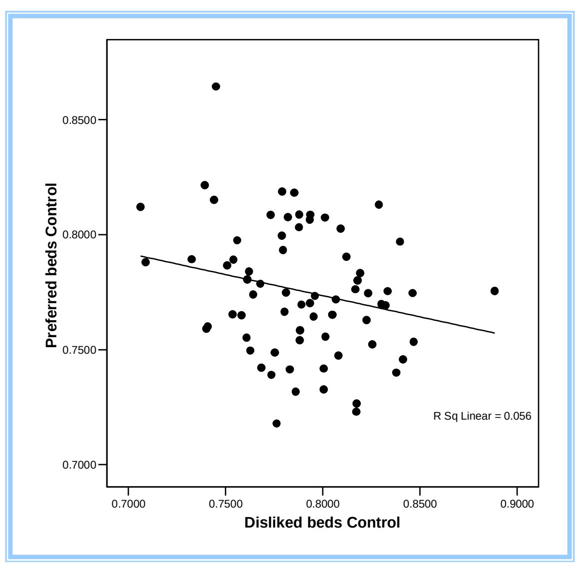


Figure 6.2 – The relationship between control of the preferred and disliked bed locations

The Pearson product-moment correlation coefficient confirms the significant negative correlation between the two variables ($r = -0.237$, $p = 0.036$), with high control of the preferred bed associated with lower control of the disliked beds.

In summary, the spatial attributes associated with preferences for high and low privacy appeared to be integration and control. The structure of these attributes in the case of high privacy is clear, but there is greater uncertainty over choices of the disliked or low privacy locations. When people choose what they prefer, control is independent from integration, but when people choose what they dislike, there is a link between the control and the integration.

6.4 A Comparison between Preferred and Non-preferred Spatial Locations of Beds

In section 6.2, preferred and non-preferred locations of beds showed significant differences in all spatial attributes. The focus in this section is on the differences in the integration and control values between preferred and non-preferred locations, as these two spatial attributes had emerged from the previous analysis as independent measures which are associated with people preferences for locational privacy.

Firstly, as shown in Table 6.1 the integration of the preferred bed locations is not normally distributed ($z = 1.64$, $p < 0.05$), whereas the integration of the disliked bed location is normally distributed ($z = 0.84$, $p = 0.477$). As a consequence, the non-parametric Wilcoxon single rank test was used. The results of Wilcoxon single rank test showed that there is a significant difference between the integration of the preferred beds and the integration of the disliked beds ($z = -4.139$, $p < 0.01$).

The parametric tests are more powerful than the non-parametric tests, as they are more likely to sense the actual effect in the data (Field, 2005). Hence, a Paired-Samples t Test was performed in spite of the non-normal distribution to check the genuineness of the results obtained from Wilcoxon single rank test. This violation of the assumption of normality probably will not cause any vital problem when a large sample is used because of the robustness of this test (Gravetter and Wallnau, 2000). A sample of (+30) seems to be large enough to violate the assumption of normality (Pallant, 2005).

A Paired-Samples t Test was conducted to test if there is a significant difference in the integration value of the preferred beds and disliked beds. The results showed that there was a statistically significant difference (t (78) = - 4.82, p < 0.01) between the integration of the preferred bed (M = 6.289, SD = 0.466) and the integration of the disliked bed (M = 6.761, SD = 0.471). The effect size can be calculated using eta square formula:

$$\text{Eta square} = \frac{t^2}{t^2 + (N-1)} = \frac{(4.82)^2}{(4.82)^2 + (79-1)} = 0.23$$

The eta square statistic (0.23) indicates large effect (Cohen, 1988).

The mean of the first condition (preferred bed) is smaller than the mean of the second condition (disliked bed). That means that the integration value was increased significantly from preferred bed to disliked bed. Therefore, people prefer low integration bed locations.

Secondly, Table 6.1 shows that the control of both preferred and disliked chosen locations are normally distributed (Preferred z = 0.69, p = 0.72, Disliked z = 0.51 p = 0.96). As a consequence, Paired-Samples t Test was used.

The results showed that there was a statistically significant difference (t (78) = - 2.96, p < 0.01) between the control of the preferred bed (M = 0.775, SD = 0.027) and the control of the disliked bed (M = 0.791, SD = 0.035). The eta square statistic (0.1) indicates moderate effect (Cohen, 1988).

The mean of the first condition (preferred bed) is smaller than the mean of the second condition (disliked bed). To explain, the control value was increased significantly from preferred bed to disliked bed. Therefore, people prefer low control bed locations.

In summary, there are significant differences between the integration and control of preferred and disliked bed location. In general and at a bed level, people's preference for privacy is in lower integration and lower control values.

6.5 Ward Preference and the Spatial Attributes

People were asked to rank the wards according to their preferences using a six point scale. The sum score for wards across subjects reveals the total preference in ranking the wards as shown in Table 6.6. The table shows a high preference for ward B with ward A in second place. The two key spatial attributes from earlier analysis (Integration and Control) were calculated by Depthmap for each ward (Chapter 4).

Ward	A	B	C	D	E	F
Preference ranking	2	1	6	4	3	2
Mean	2.97	2.55	5.25	3.33	3.18	3.77
Std. Deviation	1.650	1.259	1.278	1.334	1.636	1.663

Table 6.6 – Ward preferences ranking (1= the most preferred ward and 6= the most disliked ward)

The relationships between the ward preferences and the integration and control values of the wards were assessed using Pearson product-moment correlation coefficient. The normality of the distributions of the variables (ward preference, ward integration and ward control) was checked using a One-sample Komogorov-Smirnov test. The results of K-S test indicate that the three distributions are normal (Preference: $p = 1$, integration HH: $p = 0.929$ and control: $p = 0.373$).

A scatter plot illustrating the initial relationship between ward preference and the integration of the wards was conducted. This scatter plot showed a clear outlier. The outlier was removed and a scatter plot re-conducted, Figure 6.3. The scatter plot reveals a strong linear negative relationship between the two variables.

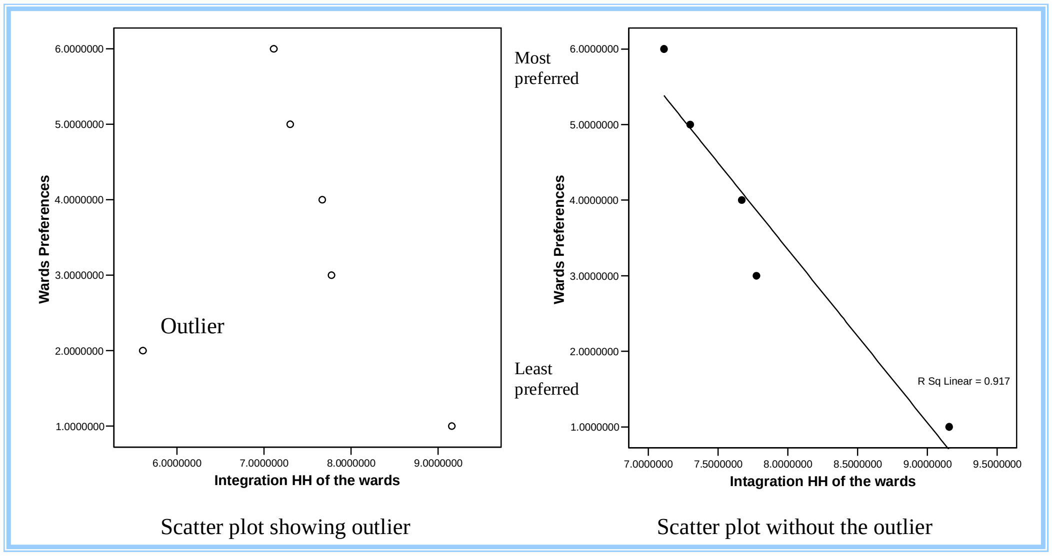


Figure 6.3 – scatter plots between the preferences and the integration HH of the wards.

To quantify this relationship statistically, a Pearson product-moment correlation coefficient was conducted between the two variables. There is a strong negative correlation between the two variables ($r = -0.957$, $p < 0.05$), with high level of wards preferences associated with lower level of integration HH of the wards

Similarly, Pearson product-moment correlation coefficient was conducted between the ward preferences and the control measures of the wards. This time there was a strong positive correlation between the two variables ($r = 0.813$, $p < 0.05$), with high level of ward preferences associated with higher level of control of the wards.

To sum up, people preference for privacy at ward level is for the combination of low integration and high control.

6.6 Inter-Relationship of Choices for Wards and Beds

In order to investigate the inter-relationship between spatial parameters of bed locations and wards and judgements on locational privacy, an analysis of variance with repeated measures was carried out. This was done separately for the two spatial attributes, integration and control, as these had emerged as independent measures in principal component analysis.

Firstly, repeated measure analysis of variance needs to be understood in terms of its design and assumptions. The review by Field (2005) has been summarized and refined in the following paragraphs.

Being a parametric test, analysis of variance has four main assumptions which should be met for the test to be reliable. However, Field (2005) argued that these assumption may be violated in some cases without affecting the accuracy of the results obtained from analysis of variance, these assumptions are:

- Interval data: the scale used should be at interval level. However, using a dichotomous dependent variable may result in accurate results from analysis of variance if the group sizes are equal, depends on the degree of freedom and the number in the smallest category (Lunney, 1970).
- Homogenousity in variance: the variance should be homogenous across all choice conditions. But if the sample sizes are equal, the analysis of variance is robust enough to violate this assumption (Glass et al., 1972).
- Normally distributed data: the violation of this assumption may not result in major problems if the sample is large enough (i.e. +30) (Pallant, 2005), because of the robustness of this test (Gravetter and Wallnau, 2000).
- Independence: There should be no correlation between the variables. In spite of the fact that the violation of this assumption could be more serious (Scariano and Davenport, 1987), it is more likely to violate this assumption when repeated measure is used (Field, 2005) as the data come from the same subjects. As a consequence, the assumption that the variances of the differences between choice conditions are equal should be checked. This assumption is known as the assumption of sphericity.

Sphericity can be checked using Mauchly's test of sphericity which is calculated automatically when conducting analysis of variance using SPSS. The significant statistic of the Mauchly test means that the variance of differences between the conditions is significantly different, and hence the assumption of sphericity is not met. In this case, F-ratio[15] should be corrected, such corrections are: Greenhouse and Geisser

[15] F-ratio is a measure of the ratio of the variation explained by the model and the variation explained by unsystematic factors (Field, 2005 page 437)

(1959) and Huynh and Feldt (1976). These two corrections improve the degree of freedom used to calculate the F-ratio by applying a correction factor. However, the Greenhouse-Geisser correction has been seen to be more conservative (see the review by Field, 2005, page 430). In summary, it is recommended to use Greenhouse and Geisser correction if the estimate of sphericity is less than 0.75 (Girden, 1992).

Based on the above review, the variables in all choice conditions in the current study (i.e. integration and control of the preferred and disliked bed locations in each ward) were measured at interval level, the sample sizes were nearly equal in all choice conditions allowing the violation of homogenousity of the variance (in case the variances were not homogeneous) and the sample size was significantly more than 30 respondents allowing the violation of the assumption of normality.

Secondly, the first factorial repeated measures analysis of variance was carried out for integration. The result of Mauchly's test indicates that the assumption of sphericity had been violated for the main effect of ward's type ($X^2(14) = 95.6$, $p<0.01$) and interaction effect between ward type and bed location ($X^2(14) = 110.3$, $p<0.01$). Therefore, the degree of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.63$ for the main effect of ward type and $\varepsilon = 0.61$ for the interaction effect). It was not possible to conduct Mauchly's test of sphericity for the main effect of bed locations (df = 0), hence Greenhouse-Geisser correction of degree of freedom was used with accordance with Girden (1992) recommendation who suggests using Greenhouse-Geisser correction when there is no information about the sphericity ($\varepsilon = 1$ for the main effect of bed locations).

All effects are reported as highly significant at $p < 0.01$. There was a significant main effect of ward type on people choices for locational privacy ($F(3.151, 195.368) = 444.744$, $p < 0.01$). There was also a significant main effect of the integration of bed locations on people choices ($F(1, 62) = 19.618$, $p < 0.01$). Moreover, the interaction effect between ward type and bed locations was significant as well ($F(3.053, 189.293) = 9.264$, $p < 0.01$), which indicates that the integration of bed locations had different effects on people choices for locational privacy depending on ward type. The interaction graph is shown in Figure 6.4 with the ward order re-arranged to reflect increasing beds' integration values. The results show that across all integration values, within any ward the preferred bed location has a consistently lower integration value than the disliked bed location.

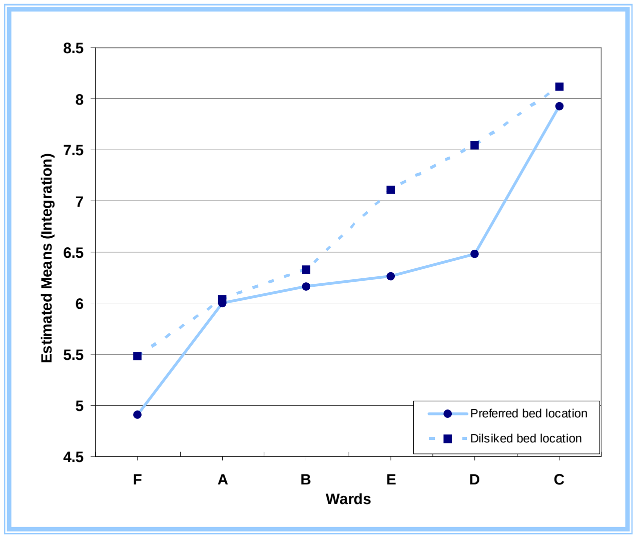


Figure 6.4 – The mean of the integration of the preferred and disliked bed locations in all wards

Finally, the equivalent factorial repeated measures analysis of variance was carried out for control. The result of Mauchly's test indicates that the assumption of sphericity had been violated for the main effect of ward type ($X^2(14) = 99.48$, $p<0.01$) and interaction effect between ward type and bed location ($X^2(14) = 82.74$, $p<0.01$). Therefore, the degree of freedom was corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.59$ for the main effect of ward type and $\varepsilon = 0.71$ for the interaction effect). It was not possible to conduct Mauchly's test of sphericity for the main effect of bed locations (df = 0), hence Greenhouse-Geisser correction of degree of freedom was used ($\varepsilon = 1$ for the main effect of bed locations).

All effects are reported as highly significant at $p < 0.05$. There was a significant main effect of ward type on people's choices for locational privacy ($F(2.967, 183.97) = 66.539$, $p < 0.01$). There was also a significant main effect of the control of bed locations on people's choices ($F(1, 62) = 6.843$, $p < 0.05$). Moreover, the interaction effect between ward type and bed locations was significant as well ($F(3.543, 219.639) = 3.299$, $p < 0.05$), which indicates that the control of bed locations had different effects on people's choices for locational privacy depends on ward type. The interaction graph is shown in Figure 6.5 with the ward order re-arranged to reflect increasing beds' control values. On this occasion for all wards, except ward E, there is a systematic trend indicating that preferred beds within wards have lower control values.

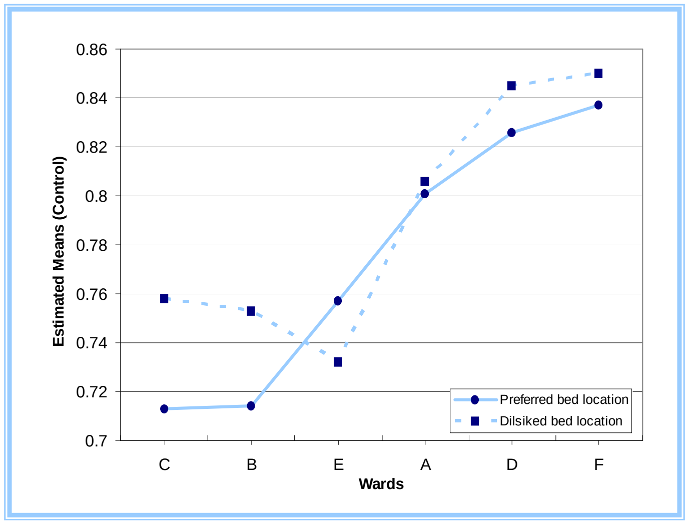


Figure 6.5 – The mean of the control of the preferred and disliked bed locations in all wards

In summary, analysis of variance revealed that the significant choice locations for privacy are determined at the level of wards, bed locations within wards and ward-bed interaction. In addition, people's preference for privacy within any ward is consistent. People preference for privacy at bed level is in lower integration and lower control within any ward. This is consistent, as expected, with the finding which resulted from the analysis across all wards (see section 6.4). The only exception to this trend would appear to be in ward E in control value. A further analysis at an individual ward level with particular focus on ward E is provided in sections 6.10 and 6.11.

6.7 Demographics, Privacy Preference and the Spatial Attributes

The literature, which was reviewed in chapter 3, suggested that demographics (i.e. age, gender and cultural background) and previous experience of space are relevant to privacy. Hence, each of the 4 key spatial attributes (i.e. integration and control of preferred and disliked bed locations) which were linked to privacy in the earlier analysis, were examined for differences against the demographic variables and previous experience of hospital wards.

Because the result of Kolmogorov-Smirnov test showed that age ($z = 2.99$, $p < 0.01$), gender ($z = 3.34$, $p < 0.01$), cultural background ($z = 3.51$, $p < 0.01$) and previous experience of hospital wards ($z = 3.51$, $p < 0.01$) were not normally distributed, the non-parametric Kruskal-Wallis or Mann-Whitney test were used depending on the number of category in the variable under question. The results are shown on Table 6.7.

Demographics		Preferred bed Integration	Preferred bed Control	Disliked bed Integration	Disliked bed Control
[a] Age	Chi-Square	5.714	3.069	4.914	4.920
	df	3	3	3	3
	Asymp. Sig.	0.126	0.381	0.178	0.178
[b] Gender	Mann-Whitney U	698.500	581.500	696.500	725.500
	Wilcoxon W	1293.500	1616.500	1291.500	1320.500
	Z	-.658	-1.817	-.678	-.391
	Asymp.Sig (2-tailed)	0.510	0.069	0.498	0.696
[b] Cultural Background	Mann-Whitney U	662.000	646.000	627.000	693.000
	Wilcoxon W	1838.000	1142.000	1123.000	1869.000
	Z	-.823	-.984	-1.175	-.512
	Asymp.Sig (2-tailed)	0.410	0.325	0.240	0.609
[b] Experience of hospitals	Mann-Whitney U	528.000	736.000	503.000	699.000
	Wilcoxon W	1704.000	1912.000	999.000	1195.000
	Z	-2.169	-.080	-2.420	-.452
	Asymp.Sig (2-tailed)	0.030	0.936	0.016	0.651

a Kruskal Wallis Test
b Mann-Whitney U Test

Table 6.7 – The differences of the demographics groups in the spatial attributes of the chosen beds

Neither age, gender nor cultural background is associated with differences in spatial location values. However experience of being in hospital does affect spatial location preferences for privacy in terms of integration of the preferred beds ($z = -2.17$, $p < 0.05$) and integration of the disliked beds ($z = -2.42$, $p < 0.05$). There are no demographic differences for control.

Inspection of the mean rank revealed that people with experience of being a patient in a ward prefer beds with higher integration values (Yes = 46.97, No: = 35.50), whereas the disliked beds chosen by people who haven't stayed in a hospital ward previously have higher integration values (Yes: = 32.23, No: = 45.02). In other words, people who experienced being patients in a ward choose as their preference beds with higher integration values (i.e. less privacy) than those preferred by people without experience as a patient, and the disliked beds they identify have lower integration values (i.e. more privacy) than those disliked by people without experience as a patient. This may suggest that people are likely to overestimate their privacy needs in hospital wards before having hospital experience. While there is a current trend towards a 100% single-bed room hospital (NHS Estates,2005), those people with experience of staying on a hospital ward may be more inclined to attempt to balance their privacy and community needs. Lawson and Phiri (2003) showed that there are a significant number of people who preferred to be in multi-bed bays (for details see chapter two).

6.8 Exploration of Subgroups in Privacy Preferences (Latent Clusters)

In the previous section, demographic differences in spatial location were presented. The focus was whether there were differences in spatial measures as a consequence of these demographic factors. The question addressed in this section is whether there are combinations of factors (demographic and spatial) which form different preference clusters (i.e. latent classes). In other words are there subgroups of people with different latent profiles across the variables?

Latent class analysis was used to investigate possible subgroups of respondents with different preferences. This was particularly relevant given the literature survey, in chapter three, which indicated different attitudes to privacy which were dependent on age, cultural background etc.

Latent Class (LC) model is a statistical model by which the differences in the model's parameters distinguish cases in one unobserved subgroup (or latent class) from cases in another. Contrary to traditional models, there are no assumptions (e.g. Normality, linearity and/or homogenousity) associated with LC models which make them an effective tool to be used with a wider range of data (Magidson and Vermunt, 2002). There are different LC model structures, which are: LC Cluster models, D Factor models and LC regression models. In this study, LC Cluster was used.

The LC Cluster model includes a number of categories each representing a cluster. Each cluster contains a number of subjects who share common preferences (Vermunt and

Magidson, 2005). The advantages of the LC Cluster model include the probability-based classification of cases instead of clustering them according to specific definition of distance between them and the possibility of using different kinds of variables (continuous, counts or categorical either nominal or ordinal) or any combination of these (Magidson and Vermunt, 2002). However, LC cluster models, like other LC models, assume local independency between the variables (Vermunt and Magidson, 2005a).

In order to check the homogenousity of subjects' preferences for location of privacy in terms of integration and control, LC Cluster Analysis was developed using Latent Gold 4.0 software[16]. According to the package manual, the software assesses the fit of the model to the data and identifies the number of clusters in the data based on two main criteria: firstly, the lowest particular log likelihood statistic (Bayesian Information Criterion (BIC)) which takes into account, in addition to model fit, the parsimony of the model (Number of Parameters). And secondly, the p-value associated with likelihood ratio chi-squared statistic (L^2). A significant p-value associated with L^2 indicates a poor fit under the assumption that L^2 follows a chi-square distribution.

Eight variables were placed in the cluster analysis (i.e. the four relevant spatial attributes, demographics and previous experience of hospital wards), three of which were determined as nominal scale type (i.e. gender, nationality and previous experience of hospital wards) because they have no natural ordering, whereas the remaining five variable were determined as fixed-ordinal. The number of clusters in the data as determined by the lowest log likelihood statistic was 2. However, L^2 achieved a significant value under the assumption that it follows a chi-square distribution ($p<0.01$), which indicates a poor fit.

The resulting two latent clusters are listed in Table 6.8 below together with the significance of the demographic and spatial variables in determining the clusters. Table 6.8 shows that neither age (p=.43), nor gender (p=.38), nor cultural background (p=0.09) were significantly linked to the two clusters. It would appear therefore that locational preference for privacy is independent of these factors. However experience of

[16] http://www.statisticalinnovations.com

being in hospital (p=.002) was significant, as were integration values of the preferred and disliked bed locations (p<.001, p=.005) and control value of the disliked bed locations (p=.005).

Variables	Cluster1	Cluster2	Wald	p-value	R^2
Age	-0.1031	0.1031	0.6219	0.43	0.0088
Gender	0.2234	-0.2234	0.7652	0.38	0.0108
Cultural Background	-0.4383	0.4383	2.8910	0.09	0.0423
Experience of hospitals	0.8324	-0.8324	9.4114	0.002	0.1447
Preferred bed Integration	-1.8191	1.8191	20.4181	6.2e-6	0.3998
Preferred bed Control	7.5658	-7.5658	1.9775	0.16	0.0287
Disliked bed Integration	5.1398	-5.1398	7.8426	0.005	0.7405
Disliked bed Control	13.0899	-13.0899	7.7909	0.005	0.1212

Table 6.8 – The latent clusters with associated significance of variables

In order to get a more precise estimate of model fit, the effect of the variables which were not significantly associated with privacy preferences were restricted to zero and the assumption that L^2 follows a chi-square distribution was relaxed by using the bootstrap of L^2 option to estimate the p-value. This procedure is of particular importance when dealing with small sample size (Vermunt and Magidson, 2005). The p-value which resulted from the bootstrap procedure is 0.042 with standard error of 0.009 and this value is not significant at 0.01. Hence, the estimate of p-value based on the chi-squared approach seems to be understated.

Furthermore, in order to check local independency between the variables, the Bivariate Residuals (BVR) option was used to assess the extent to which the association between any pair of relevant indicators are explained by the model. Table 6.9 shows Bivariate Residuals between each pair of variables that appeared to be significantly related to privacy preferences. None of the BVRs were larger than the recommended value of 3.84 (Vermunt and Magidson, 2005) which indicates a good fit.

	Experience of hospitals	Preferred bed Integration	Disliked bed Integration	Disliked bed Control
Experience of hospitals	-			
Preferred bed Integration	0.156	-		
Disliked bed Integration	0.001	0.576	-	
Disliked bed Control	0.823	0.015	1.917	-

Table 6.9 – Bivariate Residuals

Table 6.10 gives details of cluster membership. Firstly the table shows that for cluster size, 61.7% of respondents were in cluster 1 and 38.2% in cluster 2. The main body of this table gives a breakdown of the makeup of the two clusters. For example 61.8% of people in cluster 2 have had experience of staying in hospital whereas this applies to only 25.2% of people in cluster 1. Cluster 2 is therefore the hospital experience cluster.

It can be seen that for the next variable (Preferred bed Integration) 70.75% of respondents in cluster 2 have the highest values for integration preference whereas over 90% of cluster 1 respondents select lower integration values. Being in hospital would appear to increase integration values of preferred locations. This finding is also mirrored by a greater dislike for lower integration values in cluster 2 (84.2%). Finally there is also a greater dislike for lower control values in cluster 2 (54.1%) as opposed to 19.7% in cluster 1.

Indicators	Cluster1	Cluster2
Cluster Size	0.6173	0.3827
Experience of hospitals		
Yes	0.2521	0.6187
No	0.7479	0.3813
Mean	1.7479	1.3813
Preferred bed Integration		
1 - 23	0.4593	0.0860
24 - 47	0.4462	0.2065
48 - 70	0.0945	0.7075
Mean	6.0781	6.6289
Disliked bed Integration		
1 - 23	0.0111	0.8420
24 - 47	0.4577	0.1548
48 - 70	0.5312	0.0032
Mean	7.0406	6.3115
Disliked bed Control		
1 - 24	0.1972	0.5419
25 - 48	0.3657	0.3362
49 - 70	0.4371	0.1219
Mean	0.8009	0.7759

Table 6.10 – Cluster size

A profile of the conditional probabilities in Table 6.9 above showing the variables and their association with clusters is given in Figure 6.6 which shows probability values (y axis) against variables (x axis).

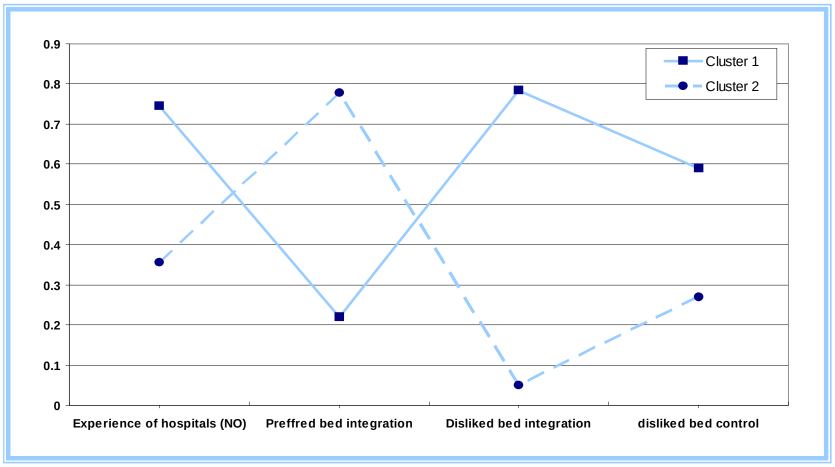


Figure 6.6 – The variables and their association with clusters (conditional probabilities)

Experience of hospitals (cluster 2) has increased integration values of preferred locations and decreased those of disliked locations i.e. it has polarised the differences between the experienced and non experienced groups. In addition while the two groups are not significantly different in preferred control values, the subgroup with experience of hospitals have a significantly lower choice over what they dislike which is low control locations.

Finally, Table 6.11 below shows the likelihood of being in cluster 1 or 2 given a particular value on any variable. So for instance if a person has not had hospital experience there is a 76% chance they are in cluster 1. And again if a person's integration preference is in the 1 to 23 range there is a 95% chance the person is in cluster 1, whereas if the integration preference is in the range 48 to 70, there is an 81% likelihood of being in cluster 2.

Indicators	Cluster1	Cluster2
Overall	0.6173	0.3827
Experience of hospitals		
Yes	0.3938	0.6062
No	0.7620	0.2380
Preferred bed Integration		
1 - 23	0.9541	0.0459
24 - 47	0.7161	0.2839
48 - 70	0.1889	0.8111
Disliked bed Integration		
1 - 23	0.0105	0.9895
24 - 47	0.8396	0.1604
48 - 70	0.9968	0.0032
Disliked bed Control		
1 - 24	0.3665	0.6335
25 - 48	0.6378	0.3622
49 - 70	0.8560	0.1440

Table 6.11 – The likelihood of being in cluster 1 or 2 given a particular value on any variable

6.9 Preferred versus Non-Preferred Locations for Privacy

In section 6.3 the spatial attributes associated with preferences for high and low privacy appeared to be integration and control. In this section the question is: Can spatial or demographic variables predict preferences for locations for privacy?

In order to address this question, the data file was split into two equal random samples for preferred and for disliked bed location. Then, the file was used to run a binary logistic regression which was reinforced later by a sequential answer tree regression (SPSS Answer Tree option CART).

6.9.1 Logistic regression

A binary logistic regression was run to predict preferred from disliked locations using the *Enter* method of regression which is recommended when there is previous knowledge about the topic (Field, 2005). Data was entered in two blocks. The first was the demographic variables of age, gender, cultural background and experience of being in hospitals, which the literature suggests are relevant to privacy. The second block contained the spatial attributes of integration and control, which are unique to this study. The results are shown in Tables 6.12 and 6.13.

		Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Block 1 (Demographics)	a Step 1	Age	.005	.022	.053	1	.819	1.005
		Gender	.608	.480	1.607	1	.205	1.837
		Cultural background	-.239	.538	.198	1	.656	.787
		Experience of hospital	.483	.566	.729	1	.393	1.621
		Constant	-.545	.820	.442	1	.506	.580
Block 2 (the spatial attributes)	b Step 1	Age	-.010	.026	.154	1	.695	.990
		Gender	.466	.576	.655	1	.418	1.594
		Cultural background	-.179	.618	.084	1	.773	.836
		Experience of hospital	.694	.667	1.084	1	.298	2.002
		Integration	-2.294	.635	13.057	1	.000	.101
		Control	-12.786	8.956	2.038	1	.153	.000
		Constant	24.850	7.630	10.606	1	.001	6E+010

a Variable(s) entered on step 1: Age, Gender, Cultural background, experience of hospitals.
b Variable(s) entered on step 1: Integration, Control.

Table 6.12 – Regression analysis for privacy preference

Observed				Predicted		
				Preference - Dislike		Percentage Correct
				Dislike	Preference	
Block 1 (Demographics)	Step 1	Preference	Dislike	22	17	56.4
		Dislike	Preference	20	19	48.7
		Overall Percentage				52.6
Block 2 (the spatial attributes)	Step 1	Preference	Dislike	30	9	76.9
		Dislike	Preference	8	31	79.5
		Overall Percentage				78.2

The cut value is .500

Table 6.13 – Classification accuracy for the regression analysis

A total of 78 cases were analysed and the resulting model for block 1 (Demographics) was non-significant in predicting preferred from disliked locations (omnibus chi-square = 3.931, df = 4, p = 0.415). Overall only 52.6% of the predictions were accurate and none of the demographic variables significantly predicted the preferred from disliked locations.

However, when Integration and Control are added as possible predictors, the resulting model for block 2 significantly predicted preferred from disliked locations (omnibus chi-square = 28.536, df = 6, p < 0.0001). The model accounted for between 30.6% and 40.9% of the variance in privacy location preference with 76.9% of the disliked locations and 79.5% of preferred locations successfully predicted. Overall the model correctly classified 78.2% of the cases. Table 6.12 shows that only Integration reliably predicted the preferred from disliked locations (Wald = 13.057, df = 1, $p < 0.0001$).

Logistic regression allows the researcher to overcome several restrictive assumptions of linear regression such as: it does not assume a linear relationship between the predicted variable and the predictors, the distribution of the predicted variable need not be normal, there is no homogeneity of variance assumption within categories (homoscedasticity) and finally logistic regression does not require the predictors to be interval or unbounded (Garson, 2008). However, multicollinearity (i.e. the existence of strong correlation between predictors) poses a problem for logistic regression as it does for linear regression. Multicollinearity does not affect the value of regression coefficients, only their reliability. In other words, a high level of collinearity may result in underestimating the significance level of the effect coefficients, which may result in excluding a good predictor(s) from the model. Hence, it is essential to test for collinearity in logistic regression models.

Variance inflation factor (VIF) and tolerance statistic are two collinearity diagnostics which can be produced by SPSS. According to Field's (2005) review: a VIF value greater than 10 is cause for concern (Myers, 1990), the average of VIF values should not be substantially greater than 1 (Bowerman and O'Connell, 1990) and a tolerance value less than 0.2 indicates a potential problem (Menard, 1995). Furthermore, SPSS produce a table of eigenvalues of the scale and variance proportions. The importance of this table is that the distribution of predictors' variance is an indicator of collinearity. If two or more predictors have high proportions of the variance of the regression coefficient on the same small eigenvalues, then this is an indicator of collinearity between these predictors (Field, 2005).

For the current model, VIF values and tolerance statistics are shown in Table 6.14. The VIF values are well below 10, the average VIF = 1.25 and the tolerance statistics are all above 0.2, which indicates that there is no collinearity within the data.

Coefficients [a]

	Collinearity Statistics	
	Tolerance	VIF
Age	.811	1.233
Gender	.927	1.079
Cultural background	.780	1.283
Experience of hospital	.701	1.426
Integration	.817	1.225
Control	.817	1.224

Dependent Variable: Preference - Dislike

Table 6.14 – Collinearity Statistics

Table 6.15 shows that no two or more predictors share most of their variance loading onto the same small eigenvalues (Control has 90% of variance on dimension 7, integration has 94% of variance on dimension 6 and experience of hospitals has 69% of variance on dimension 5), which confirms that collinearity is not a problem for this model.

Dimension	Eigenvalues	Condition Index	Variance Proportions						
			(Constant)	Age	Gender	Cultural background	Experience of hospital	Integration	Control
1	6.616	1.000	.00	.00	.00	.00	.00	.00	.00
2	.170	6.239	.00	.18	.06	.12	.11	.00	.00
3	.111	7.719	.00	.20	.31	.20	.07	.00	.00
4	.073	9.550	.00	.28	.54	.33	.07	.00	.00
5	.026	15.887	.01	.25	.08	.30	**.69**	.04	.01
6	.003	46.404	.13	.08	.01	.03	.04	**.94**	.09
7	.001	84.591	.86	.01	.01	.03	.02	.02	**.90**

Dependent Variable: Preference - Dislike

Table 6.15 – Collinearity diagnostics

Although the resulting model significantly predicts preferences for privacy location and reliably estimates the significance level of the regression coefficient (no collinearity), it may be influenced by a small number of cases which can be outliers or influential cases. In order to check this, SPSS produces several analyses of the residuals which can be defined as '*the differences between the values of the outcome predicted by the model and the values of the outcome observed in the sample*' (Field, 2005, page 163). Such analyses are: Cook's distance, Leverage and Standardized residual. These analyses are indicators of how the model fits the data. Again Field (2005) provides a solid review on how to interpret these analyses.

Cook's distance measures the effect of deleting a single case on the model as a whole. The presence of a value greater than 1 indicates possible influential cases (Cook and Weisberg, 1982). For the current model, the largest Cook's distance is 0.62 (case 31) which is far less than the recommended maximum value, which indicates that deleting one case probably will not affect the model significantly.

The second measure of influence is Leverage statistic, which identifies the cases that exert an undue influence on the model. The average leverage equals the number of predictors plus one divided by the sample size. As a cut-off point, Stevens (1992) suggested three time the average to identify influential cases. The average Leverage for the current model is (6+1)/78 = 0.09, hence the cut-off point is 0.27. The largest leverage statistic is 0.24 (case 71) which indicates that there are no cases having undue influence. However, Figure 6.7 shows that case 71 has unusual impact on the model. Hoaglin and Welsch (1978) recommended to use more than twice the average to identify influential cases. In this case the cut-off point would be 0.18 and hence, case 71 is a cause of concern.

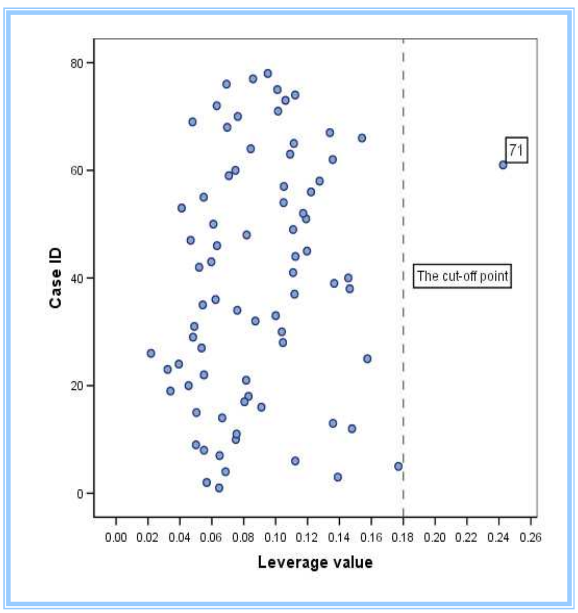


Figure 6.7 – A scatter plot showing the possible unusual impact of one case on the model

The last procedure is to examine the standardized residual, which is a normalization of the residual to make different models comparable. This can identify influential cases as well as outliers. In order to conclude that there are no influential cases, no more than 5% of cases should have absolute standardized residuals greater than 1.96 and no more than 1% of cases should have absolute standardized residuals greater than 2.58. On the other hand, the presence of values more than 3 is an indicator of outliers. The simplest way to examine this is to plot the standardized residual by case ID.

Figure 6.8 shows that there are no possible outliers affecting the model. However, there are 7 cases (9% of the cases) which have absolute residuals greater than 1.96 and 3 cases (3.8% of the cases) which have absolute standardized residuals greater than 2.58. Hence it seems that the model was slightly biased because of some influential cases.

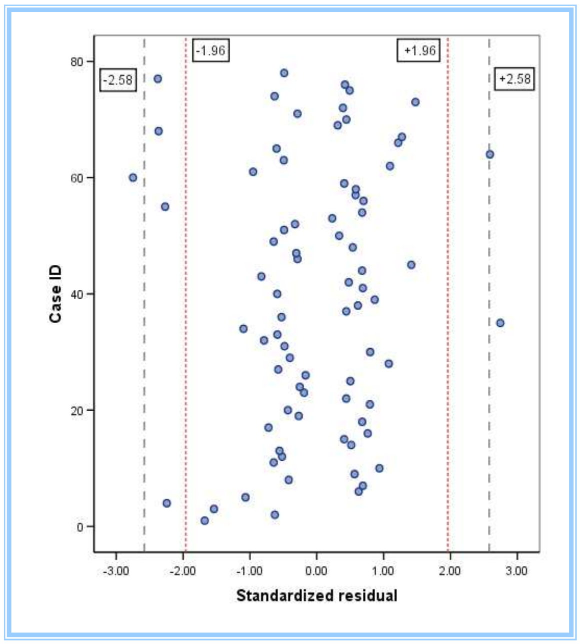


Figure 6.8 – A scatter plot showing the influential cases on the model

To summarize, the resulting regression model is significant and reliably predicts preferred from disliked location with integration being the only significant predictor. However, the analyses of residuals showed evidence that the model is likely to be a poor representation of the data because of the presence of some influential cases. Hence, this model can not be generalized.

These cases need to be isolated and then subjected to further research in order to find the reason why they were unusual, which may lead to development of separated models for different type of cases. And because this analysis is exploratory, dealing with influential cases is out of the scope of this thesis.

6.9.2 Answer tree

The binary logistic regression table was reinforced by a sequential answer tree regression (SPSS Answer Tree option CART). The demographics and the spatial attributes were placed as possible predictors of preferred from disliked location. The resulting tree's classification accuracy is similar to the regression model at 81% with a standard error of (0.045). Figure 6.9 shows that the best overall predictor of preferred from disliked location (first branch at the top of the tree) is the Integration value of the chosen locations with optimal discrimination point on the Integration scale of 6.54. The left hand branch of the tree discriminates preferred locations.

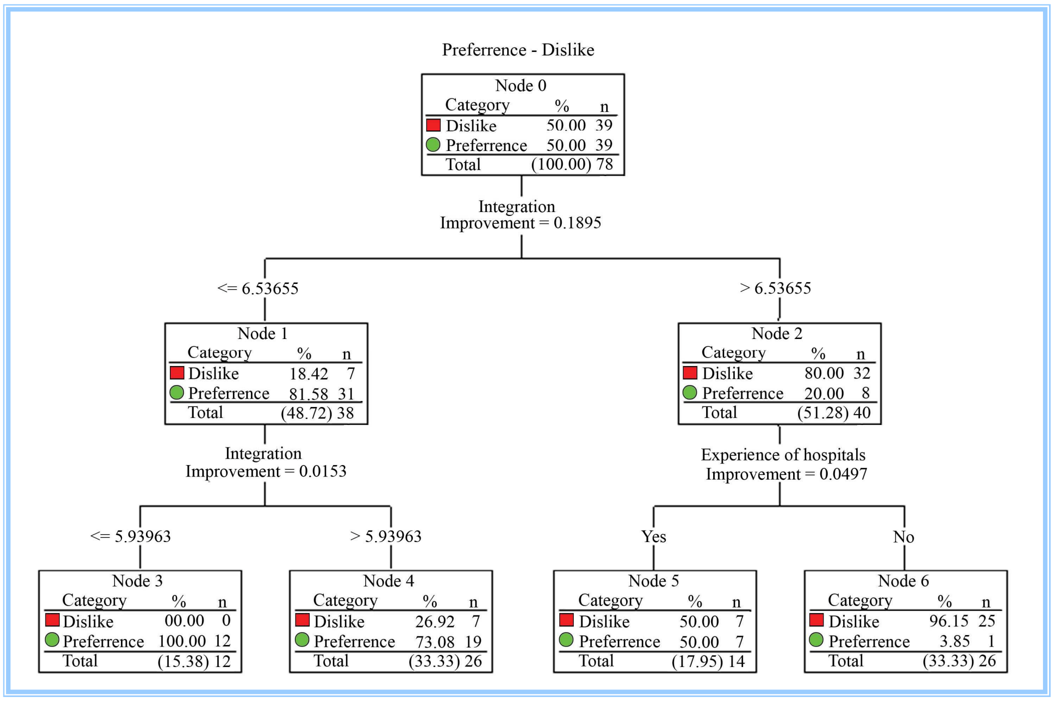


Figure 6.9 – A regression tree predicting preference using the demographics and the spatial attributes

The next level of the tree shows that the preferred locations chosen by 81.58% of the subjects are associated with lower integration values (< = 6.54). Correspondingly for 80% of the subjects higher integration values (>6.54) equate to disliked locations. This is constant with the finding in section 6.4 that people's preference for privacy is in lower integration.

At the third level of the tree the left hand branch shows that all respondents prefer locations with integration value less than 5.93. On the right hand branch which is separating out disliked locations, the optimum discriminator is experience of hospitals with those without experience more certain about disliked locations. The effectiveness of integration as a discriminator of preference at the first level of the tree is shown in Figure 6.10 below.

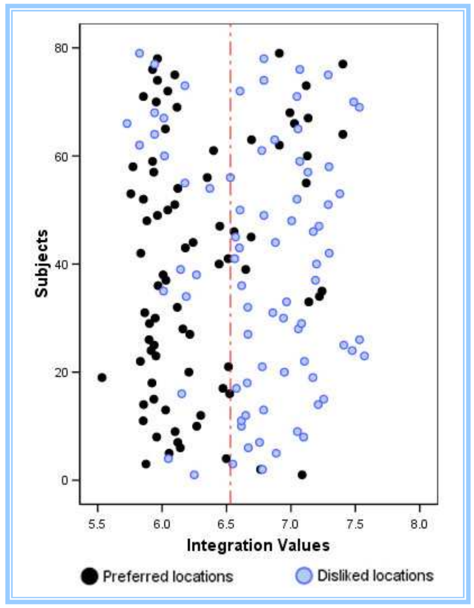


Figure 6.10 – The integration values of the preferred and disliked locations

6.10 Differences between the Wards

The previous analysis has been carried out on 6 generic ward types as defined by James and Tatton-Brown (1986). This has enabled a manageable study to take place across a representative set of designs. However it is likely that individual wards will differ on the spatial parameters both within and between these generic types. Investigating these differences would require a much larger study involving individual ward designs. Nonetheless it is worth considering a brief insight into the pattern of locational privacy preference in each generic ward type.

6.10.1 Predicting high and low privacy location

For each ward an answer tree was run to investigate the strongest predictors of preferred from disliked chosen locations using the key spatial attributes, demographics and previous experience of hospitals. The results are summarised in the Table 6.16 and the answer tree for each ward is shown in Appendix E.

	Risk Estimate	Standard Error	Strongest Predictor (First level of the tree)
Ward A	24%	0.049	Age
Ward B	27%	0.05	Integration
Ward C	19%	0.044	Control
Ward D	19%	0.044	Integration
Ward E	23%	0.048	Integration
Ward F	17%	0.043	Integration

Table 6.16 – Answer tree efficiency and the best predictor of preference in each ward

In summary , a regression analysis of privacy preference on individual wards level using answer tree showed integration being the strongest overall predictor of privacy preference in 4 out of 6 generic ward types examined.

6.10.2 Ward's groups

Differences between generic types on the key spatial parameters which have emerged were investigated using a Wilcoxon matched pair test. For each ward two tests were run, one for integration and one for control. The results are shown in Table 6.17.

Wilcoxon matched pair test

Spatial variables in each ward	A		B		C		D		E		F	
	Integration	Control	Integration	Control	Integration	Control	Integration	Control	Integration	Control	Integration	Control
Z	-0.443[a]	-0.382[b]	-2.745[b]	-3.351[b]	-2.667[b]	-3.373[b]	-4.195[b]	-0.777[b]	-3.660[b]	-3.754[a]	-3.515[b]	-0.690[b]
Asymp. Sig. (2-tailed)	0.657	0.703	0.006	0.001	0.008	0.001	0.000	0.437	0.000	0.000	0.000	0.490

a Based on positive ranks.
b Based on negative ranks.

Table 6.17 – Comparison of spatial location of preferred and disliked privacy in each ward

The table shows that three groups of wards can be distinguished. Ward A is unique in showing no differences in either integration or control for preference locations. All other 5 wards differ on integration values for preference location which has been shown in the above analysis to be a key parameter. However, only wards B, C and E also differ on both integration and control. Actually these groups of wards were reflected previously in Figures 6.4 and 6.5. This suggests that:

A- Ward A as a type has not contributed to the current analysis.

B- Integration is the common underlying parameter for locational preference and the significant discriminator for privacy across all wards as shown by regression analysis.

C- The role of Control requires further analysis in the subgroup of wards B, C and E.

In order to get a deeper insight into ward groups, the integration and control values of the chosen location were mapped using scatter plots for wards A, D and E, each of these being an example of one ward group. Figure 6.11 shows that in ward A the integration and the control values of the preferred and disliked locations are scattered along the spatial attribute scale, in ward D the integration values of the preferred locations are discriminated from the disliked ones but this is not the case for control values, whereas in ward E the discrimination between the integration and the control values of the preferred and disliked location looks more significant with clearer discrimination in the integration values.

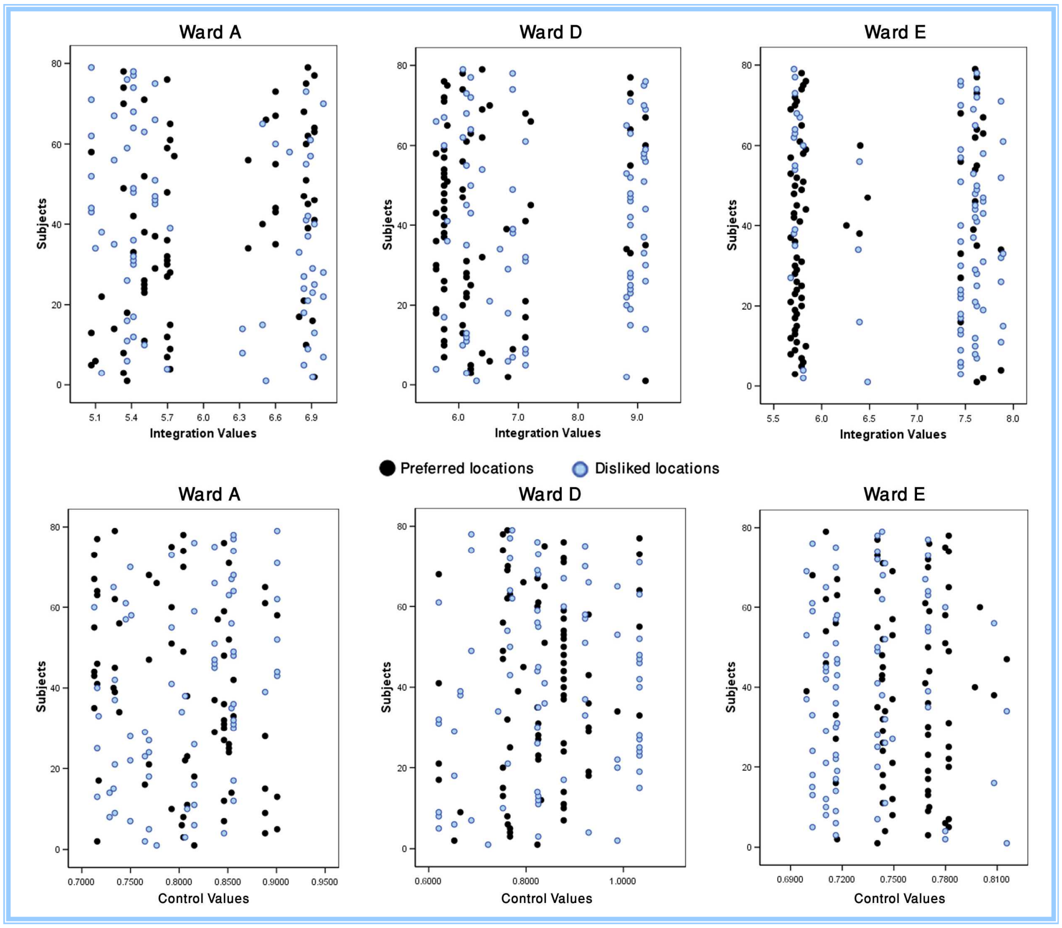


Figure 6.11 – Integration and control values of the chosen locations in wards A, D and E

Figure 6.12 shows the 3 bed locations most frequently chosen by the participants for both preference and dislike in three wards (A, D and E), each of these being an example of one ward group.

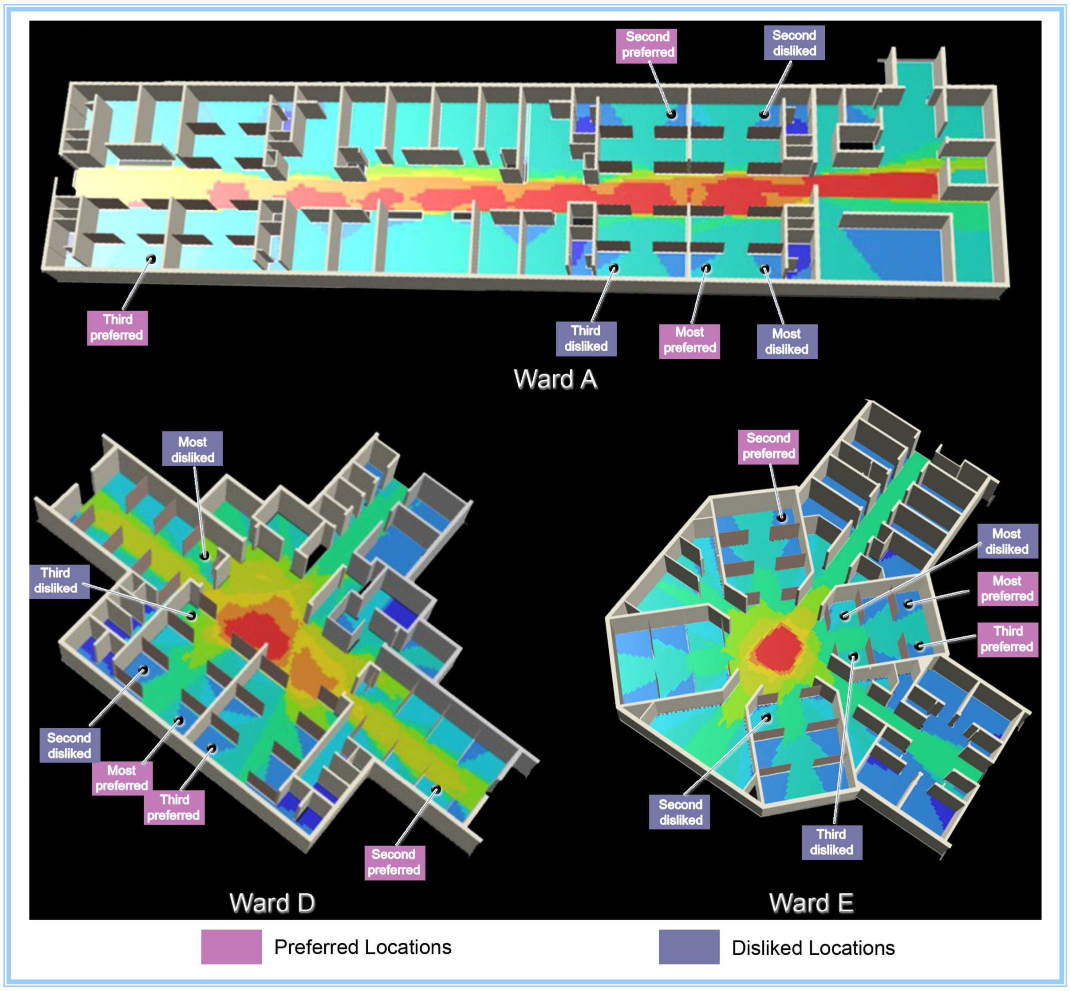


Figure 6.12 – The most frequently chosen bed locations in wards A, D and E and wards' integration

6.11 Control and the Architectural Design

Section 6.6 showed that the preference for privacy within any ward is in lower integration and lower control locations except in ward E, where the selected locations for privacy are associated with higher control values. This result is reflected in figure 6.11 as well. Further investigation was carried out to address the possible reason behind the oddity in control values in ward E.

First of all, let's revise the definition of control as perceived and used by space syntax and VGA community. Control was first introduced by Hillier and Hanson (1984) as a local measure, which was used in visibility graph analysis as *'the area of the current neighbourhood with respect to the total area of the immediately adjoining neighbourhood'* (Turner, 2001).

To simplify, Figure 6.13 shows an abstract illustration of control of a given point (A) in a hypothetical configuration. Each point in the neighbourhood of A has a number of visual connections with the points that are directly connected to it (points B and C), so each point in the neighbourhood gives a fraction of these connections to that given point, the control value for that given point is, therefore, the sum of the fractions it receive from its immediate neighbours. Accordingly, the controlling point is that point which can see a large area and each point in this area can see relatively little.

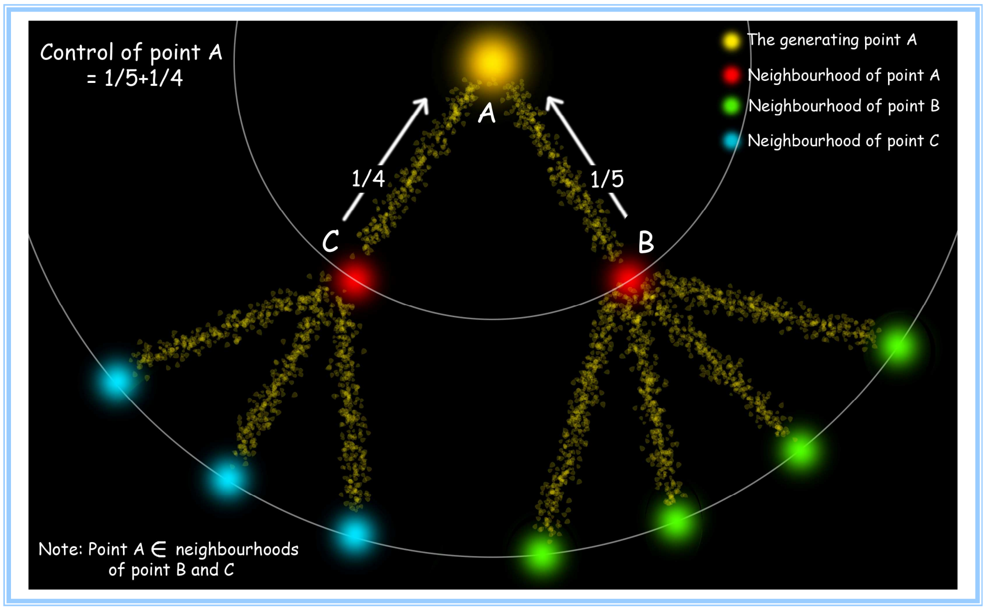
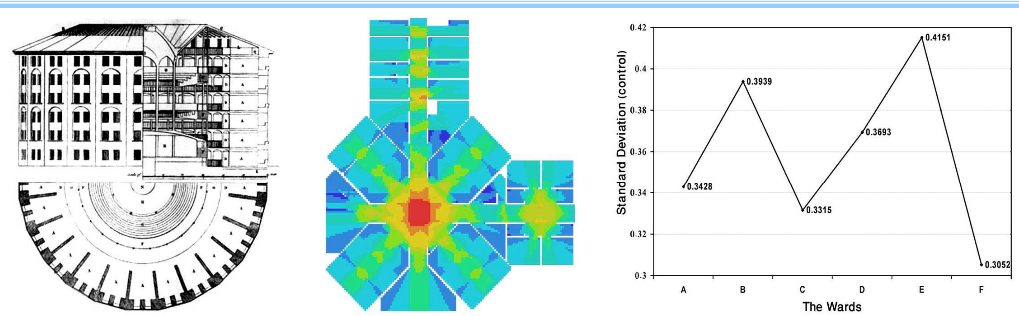


Figure 6.13 – An abstract illustration of control in a hypothetical configuration (Source: the author)

To illustrate the idea of highly controlling and highly controlled areas Turner (2004) used Bentham's panopticon as an example which is shown in Figure 6.14a. It is a prison which incorporates a tower centred to a radial layout which is divided into cells along its boundary (Barton and Marthalee, 1993). The idea behind this design was to allow prisoners to be observed by the inspector without their knowledge. In other words, to give a space (occupied by the inspector) an ultimate visual control over other spaces (occupied by the prisoners). This visually controlling space can see almost all the cells, but each cell can see relatively little.

Bentham's panopticon is similar to ward E in its architecture, as both have a radial layout. Each case study was chosen as an example of ward type category as classified by James and Tatton-Brown (1986) and ward E was the example of the radial ward type. Visually speaking, the inspector's space in the panopticon looks similar to the nursing station in ward E and the prisoners' cells looks similar to bed locations.

In terms of the architectural design of the wards, the radial design (ward E) seems to be the only design, out of the six different designs examined, which allows a single area to be highly dominant in terms of the visual control, as it has visual access to all other spaces which in turn have much lower visual fields (Figure 6.14b). Furthermore, ward E has the highest standard deviation of the control values comparing with the other wards as shown in Figure 6.14c.



a - The Panopticon of Jeremy Bentham b - The visibility graph of ward E (Control) c - Standard Deviation of control values in the six wards

Figure 6.14 – Control and the architectural design in ward E

Hence, the architectural design does significantly affect peoples' chosen location for privacy. In ward E the preferences for privacy was for higher control locations in contrast with the other wards. The reason for that might be the need to balance between the achieved and desired level of visual control. The existence of one central controlling zone, because of the radial design, gives that zone more controlling power over the controlled locations (similar to the panopticon), whereas in the other wards (ward A, B, C, D and F), there are several controlling zones throughout the circulation area (see chapter 4).

6.12 Discussion

This chapter has explored one facet of privacy which in itself is acknowledged to be a complex issue (Gifford, 2002). It has required participants to identify preferred locations for privacy on plans of buildings. Reading plans is not a simple task but its difficulty does depend on the purpose in hand. Choosing a room and selecting a bed location within it would seem to be a relatively simpler task than that requiring wider inference, e.g. tasks of way finding or inter-dimensional inference. In addition plans of this type are widely used by estate agents and are therefore becoming more familiar to the public.

Subjects have carried out the task (after affirming they understood its nature) and provided patterns of preference location across six types of hospital ward which have been shown to have a systematic relationship to spatial properties of the layouts. All the spatial measures considered in this study from VGA analysis were significant in discriminating preferred from non preferred locations. However factor analysis of the inter-correlations between the measures showed there were two independent measures behind choices for both high and low privacy locations best represented by integration and control. These two measures have been found in previous studies to be relevant to locations vulnerable to crime in hospitals (NHS Estates,1994) and integration has been identified as relevant in one previous study regarding privacy (Rashid et al., 2005).

Across the selected wards, there was a privacy preference for wards with lower integration and high control values (section 6.5). However within the wards themselves the consistent choice for privacy was for lower integration and lower control (section 6.4). The only exception to this trend would appear to be in Ward E in control values (but consistent with the trend for integration) in which selected locations for privacy are associated with higher control. The reason for that appeared to be the architectural design of the ward, which creates one central controlling zone that reduces significantly the feel of control in other locations.

However, regression analysis across the 6 ward types showed that the best predictor of high from low privacy locations is integration. This was supported by analysis on individual ward level which showed integration as the strongest predictor of locational preference in 4 out of 6 generic design types. Moreover, integration has been shown to be a significant discriminator between low and high privacy locations in 5 out of 6 design types examined and control played a role in locational preference (together with integration) in 3 of the 6 design types.

This chapter also explored preferences for privacy across different cultures, age groups, gender and previous experience of space. The results showed no significant effect of age, gender, or cultural background on locational preference for privacy. These variables have been found to affect aspects of privacy significantly in previous studies (see chapter 3). However, little attention has been given in the literature to locational preference as one facet of privacy.

Two cultural backgrounds have been considered in the study: Arabic and European. The decision to gather respondents into two culture groups has been supported by the hypothesis that these particular two cultures manifest extremes cases of privacy with higher privacy counts to the Arabic culture. However, privacy regulation may also vary between countries, e.g. the perception of privacy was found to be stronger in some European countries and weaker in others (Schopp et al., 2003).

On the other hand, people with experience of a hospital stay as a patient do have significantly different preferences for privacy location. Their views are significantly polarised towards higher integration for preferred locations and lower integration for disliked locations. This may have implications for the debate on single versus multi-bed wards. Admittance to a hospital ward may lower people's preference for privacy to achieve a better sense of community and feel less isolated, which in turn may support the provision of multi-bed bays in addition to single-bed rooms. Clarke (2008) suggested that 75% of the accommodation in hospital wards need to be single-bed rooms with four-bed bays providing the balance

Whether these findings fit in Altman's (1977) model for privacy or Newell's (1994) systems approach to privacy, or current views of privacy regulation (see chapter 3), will depend on how privacy regulation is defined.

The results on privacy show both general and specific findings across the demographic variables considered. These findings sit within a wider debate on universals and differences taking place within architectural theory (Frampton, 1983; Lefaivre and Tzonis, 2001).

Before the 20th century the practice of architecture mainly involved building with local materials and local expertise to respond to the physical and cultural characteristics of the region. Then, early in the 20th century, the Modernist movement emerged to promote the use of technology and science to allow human beings to create and control their environment (Berman, 1988). Modernist architects rejected the traditions and the specificity of place in pursuing an international style for architecture. As a reaction to this disregard for history in the modernists' ideology the Postmodernist style evolved from the 1960s onwards.

More recently Critical Regionalism is seen as a mid position between these more extreme ideologies. It endeavours to employ technology and science in order to define and reuse regional elements in unusual ways; it mediates the effect of the universal culture by using region's particularities. According to Kenneth Frampton the focus should be on topography, climate and light with particular emphasis on the tectonic form rather than 'scenography'; and the tactile sense rather than the visual (Frampton, 1983).

Such proposals describe the architectural form of buildings rather than focussing on people's preferences and needs in buildings. And because buildings are made for people, more attention needs to be given from architecture theorists to the universals and differences in people's psychological preferences and needs (e.g. privacy preferences). The current study links physical aspects of spatial location (i.e. visibility graph analysis measures) into this discussion. In general, stronger links between architecture theories and environmental psychology may result in more successful architectural designs.

6.13 Conclusions

Systematic findings with respect to plan configurations are not only important in themselves. They provide the context within which detailed design choices can be made (in this case to increase or decrease privacy) to reinforce spatial properties inherent in the basic design itself.

The general findings of this chapter show that:

a) There is a systematic relationship between the spatial attributes of hospital multi-bed wards and locational privacy which are best represented by integration and control.

b) At a ward level people's preference for greater privacy is for wards with low integration and high control values.

c) Within any ward, at a bed location level people's preferences for privacy are in lower integration and lower control locations.

d) Integration has been shown to be the strongest predictor of and discriminator between high and low privacy locations across the wards examined.

e) The architectural design does significantly affect peoples' chosen location for privacy, particularly for control values.

f) The results suggest a universal preference for spatial location of privacy across culture, age and gender and a specific significant difference for spatial location of privacy as a result of previous spatial experience.

g) People with experience of being patients in hospitals seem to have lower privacy preferences than those who have not been in hospital previously.

The focus in this chapter was on people's preferences on locational privacy in hospital multi-bed wards. The random selection of the sample was supported by the assumption that any person can be a patient in a multi-bed ward. In other words, the focus was on the end-users of hospital wards whose expectations and preferences need to be met by the experts who are responsible on providing healthcare facilities.

With respect to the current study, designers (namely architects) are key-players. However, they are bounded by the regulations and guidelines which are related to hospital design in general and ward design criteria in particular. In the UK, these are usually managed by NHS. More importantly, each expert has developed their own view about ward design criteria in terms of their importance and effect. Whether these views have been developed as a result of evidence-base research, personal experience or networking with other experts, they have indeed a direct effect on the architectural design of hospital wards.

The next chapter attempts to identify hospital ward design criteria at two levels: formal ward design criteria, mainly NHS toolkits, and the criteria that seem to be important to experts in ward design.

Chapter Seven: Hospital Ward Design Criteria

7.1 Introduction

In this chapter criteria of ward design are summarized at two levels: formal ward design criteria that are provided by the available regulations and guidelines in the UK including those on privacy, and the criteria that seem to be important to experts in ward design in the UK and Syria. In doing this, this chapter attempts to address the third objective of this thesis.

This chapter begins with a review of some of the most important and used sources of information in hospital design, and as a consequence ward design, in the UK in order to distil design criteria that are related to the architectural design of hospitals. These are design criteria that architects need to be aware of during the hospital design process. The resulting list allows the identification of design criteria that are related to privacy with particular focus on visual privacy. In other words, those design criteria that are under the control of architects and which at the same time may increase or decrease patients' privacy.

In addition, this chapter reports a summary of the semi-structured interviews which were conducted with experts with experience in ward design from the UK and Syria. Interviews with experts from the UK provide the context for the more detailed study which investigates the priorities of architects for privacy when it is placed within other environmental constraints associated with the design of hospital wards (chapter 8). On the other hand, interviews with the Syrian experts provide a more general insight into aspects of hospital design with particular focus on ward design in the country of origin of the researcher.

The choice to include Syria in this part of the study has been driven by the following: Firstly, personal interest as Syria is the home country of the author, who observed that hospital design in Syria corresponds mainly to the clinical functions required and ignores or minimises the attention to human needs (e.g. privacy). However, it is beyond the scope of this work to investigate the reasons behind this, or to review the historical, social and/or economical development in Syria with relation to healthcare facilities design. The second reason to include Syrian response was to allow a comparison of experts' perception and awareness of human-related design criteria in hospital wards between a research-active country like the UK and a country like Syria where the research culture is under development.

7.2 Standards and Guidelines for Hospital Design

In this section the typical sources of standards and guidelines which are relevant to hospital design in the UK were surveyed with particular focus on ward design criteria.

There are several series of documents related to hospital design. The relevant British Standards provide an extensive source of information (searching the word *Hospitals* in the British Standard library results in 835 documents[17]). However they focus on construction and specifications of different elements in hospitals such as furniture and fire resistance more than on spatial design criteria. Nevertheless, documents managed by the Department of Health (DH) and published usually by The Stationery Office (TSO) have been considered as the main sources of information by architects during the hospital design process and NHS trusts in preparing the briefing for hospital projects. These documents are categorized in the following series:

- Health Building Notes (HBNs):

The Health Building Note series is intended to give advice on best-practice in the design and planning of healthcare buildings. It covers a wide range of health building design criteria to support the briefing and design process of NHS projects. Some HBN are being updated at the time of writing this thesis (i.e. HBN 4 'In-patient accommodation') and there is a new structure for HBNs which will be rolled out over time as HBNs are updated. The HBN series is one of the main documents for architects involved in hospital design and briefing.

- Heath Technical Memoranda (HTMs):

The HTM series gives comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of

[17] http://www.bsi-global.com/upload/Standards%20&%20Publications/shop.html

healthcare. The proposed new structure for HTM is based on eight core subjects (i.e. decontamination, medical gases, ventilation systems, water systems, fire safety (Firecode), electrical services, environment and sustainability and specialist services) and one overriding HTM. In addition, the Building Components Series has been considered as a part of Health Technical Memoranda. This series provides specification and design guidelines on building components for use in healthcare buildings such as: windows, partitions, ceilings, flooring, fittings storage system, etc.

- Health Facility Notes (HFNs):

HFNs provide guidance on subjects related to NHS-driven initiatives and aims to provide an insight into such issues (e.g. HFN 05 - Design against crime: a strategic approach to hospital planning). They consider a wide range of alternative options and their associated implications in terms of design, cost and acceptability to users.

- Model Engineering Specifications (MES):

The MES series provides guidance for those responsible for the design, installation and operation of engineering services in healthcare buildings. They cover aspects of electrical engineering (e.g. nurse call system) and mechanical engineering (e.g. heating, hot and cold water systems equipments).

- Fire Practice Notes (FPNs):

In this series advice and guidance on the standards of fire precautions required in healthcare building are provided with focus on the safety of patients, visitors and health service staff.

- Other NHS Estates and Department of Health publications and reports:

NHS Estates have been publishing several documents which are related to hospital design. Some of these documents are results of research funded or carried out by the Department of Health and others based on experiences and case studies. These documents have been categorized by the Department of Health according to the core focus of each document into the following categories: Access and wayfinding; Accident and emergency; Catering; Cleanliness; Infection control and decontamination;

Commissioning; Estate strategy and costing; Energy; Water and waste; Environment, Education (children in hospital); Improving the patient experience; Initiative and events; NHS performance statistics; Research and development; Staff and finally Ward layouts.

- NHS Toolkits:

The above documents contain complex criteria and concepts associated with healthcare building design which are usually difficult to measure and evaluate. The Department of Health in association with different academic and industrial institutes has developed four toolkits to assist Trusts in determining, managing and monitoring their requirements from the initial proposals through to post project evaluation. Nevertheless, these toolkits can be used by architects to self-evaluate their designs. These are: AEDET: Achieving Excellence Design Evaluation Toolkit; ASPECT: A Staff and Patient Environment Calibration Tool; IDEAs: Inspiring Design Excellence and Achievements and NEAT: NHS Environmental Assessment Tool.

The significance of these toolkits is that they incorporate both the design-related criteria which have been reported in the different documental series mentioned earlier and the relevant evidence-based research in a non-technical way. As a consequence, most of design information sources which are related to healthcare building design have been covered in these toolkits in a relatively accessible way. They allow the user to monitor aspects like quality of design, patient and staff environment and the environmental impact of healthcare buildings. In addition, they can be used for new buildings as well as refurbishments.

7.2.1 NHS design evaluation toolkits

These four toolkits formulate a comprehensive source for hospital design criteria, and as a consequence ward design criteria, which incorporates the relevant research evidence, professional expertise and government policies. Hence, these toolkits were used in this research to summarise the existing ward design criteria for architects and designers with a particular focus on design criteria that are related privacy.

- *AEDET: Achieving Excellence- Design Evaluation Toolkit*

AEDET is a result of work carried out by the NHS, The Commission for Architecture and the Built Environment (CABE), The Construction Industry Council (CIC) and Sheffield University. It enables the user to evaluate a design by posing a series of clear, non-technical questions, encompassing the three key areas of Impact, Build Quality and Functionality, which split into 10 assessment criteria. Scoring these criteria assesses how well a healthcare building complies with best practice. The main section of AEDET is shown in figure 7.1.

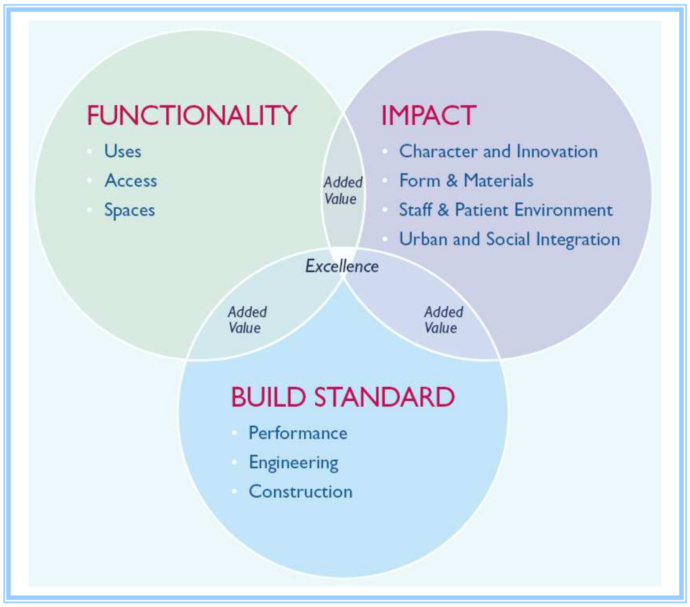


Figure 7.1 – AEDET structure
(Source: AEDET Evolution promotional booklet)

AEDET's main function is to evaluate the quality of design in healthcare building by delivering a profile that determines the strengths and weaknesses of a design. It consists of three layers: scoring layer, guidance layer and evidence layer. The user(s) of AEDET (individual or group in an evaluation routine) respond to statements by giving each a score on a 6 point scoring scale using the scoring layer. More explanation about each statement can be obtained from the guidance layer, whereas the evidence layer summarises the research evidences that support each section. The average score for each section provides an indicator of how successful the design is with regards to this section.

- *ASPECT: A Staff and Patient Environment Calibration Tool*

ASPECT is based on 600 research studies that are related to the relationship between health building environment and patients' and staff satisfaction, patients' healing process and staff performance. It is a more detailed and accurate measure of the quality of design of staff and patients environment in healthcare buildings than the related section in AEDET.

Again, ASPECT consists of three layers (scoring layer, guidance layer and evidence layer) which work in a similar way to AEDET and can be used by individuals or groups in different stages of the project.

It is split into 8 sections. The score of each section is the average score of the statements in this section based on a 6 point scoring scale. These sections are: Privacy; company and dignity; Views; Natural and outdoors; Comfort and control; Legibility of space; Interior appearance; Facilities and Staff.

- *IDEAs: Inspiring Design Excellence and Achievements*

IDEAs is intended to help create aspirations towards good design, rather than evaluating proposals from the beginning of the process, and direct attention towards qualities that otherwise are often lost in highly technical healthcare environments. It can be used to assist in the generation of design briefs, proposals and schemes for both interior and exterior design of healthcare buildings.

The uniqueness of IDEAs is that it approaches the design from people's activities rather than individual spaces or rooms. Examples of activities that occur in hospitals include: arriving, bathing, beds, circulation, consulting, shopping, sanctuary, socialising and waiting.

It works by understanding the activity and the functional and emotional needs of the people involved, a stage called *Challenges*. The next stage, called *Considerations*, looks at what the design can do to respond to these requirements, and the last stage provides information about some existing successful examples of solving the problem, a stage called *Precedents*.

IDEAs is mapped into AEDET and ASPECT. However, the way of presenting information in IDEAs makes it more accessible for architects. It includes three types of information: pictograms, photographs and accompanying text.

- *NEAT: NHS Environmental Assessment Tool*

NEAT has been developed to estimate the impact of healthcare buildings on environmental and social issues and help raise awareness of the impacts that NHS facilities can have on these issues. It is the NHS response to delivering the government’s objective of a more sustainable environment through its sustainable construction programme.

It can be used in different stages of the project to estimate environmental performance, specify performance or monitor ongoing performance. It covers ten issues: Management, Energy, Transport, Water, Materials, Land use and ecology, Pollution, Internal environment, Social and finally Operational waste. Each one of these issues is split into relevant subcategories.

NEAT consists of a set of questions in each section. Most of these questions are simple and can be answered using Yes or NO answers which make it a useable tool by those who have limited knowledge of environmental issues and measures. However, knowledge of building services is required. The rating scale of NEAT is: Fail, Pass, Good, Very good and Excellent. As a general rule of thump, a score rating of Excellent is required for new buildings and Very good for refurbishments.

7.2.2 Establishing a hierarchy of ward design criteria

As mentioned previously, NHS toolkits cover a wide range of healthcare building design criteria based on a comprehensive review of the related literature, evidence-based research and available expertise. This ranges from urban and social integration through internal environment to waste treatment. Some of these criteria are directly related to the architectural design of hospitals and wards whereas others focus on engineering, construction and environmental aspects of healthcare buildings.

The aim of this section is to filter these criteria and distil the ones that are related to hospital architecture, ward design, ward spatial arrangements, privacy and visual privacy. The resulting database aims to be particularly important for architects as it provides a clear and comprehensive view of design criteria that need to be considered during the hospital and ward architectural design process. In addition, it summarizes the design criteria that are related to privacy and visual privacy.

In order to do this a taxonomy or hierarchical structure by which the distilled design criteria can be categorized needed to be defined and then filtered against particular filtering aspects. This was done in two stages:

Firstly, AEDET has a clear structure which was shown in Figure 7.1. This structure has been used to categorize all design criteria which were distilled from the four NHS toolkits for the following reasons: firstly, two toolkits (i.e. ASPECT and IDEAs) are mapped into the AEDET and as a consequence the criteria distilled from them can be smoothly fitted into AEDET structure. Secondly, this structure was developed based on a well-establish evaluation tool called Design Quality Indicators (DQI[18]).

The DQI tool has been developed to evaluate design quality of buildings in the four key stages of building development (i.e. the brief, mid-design, ready for occupation and in-use). It can be used by all stakeholders involved in the development process including end-users. In 2002, the Strategic Forum for Construction in its report 'Accelerating

[18] http://www.dqi.org.uk/DQI/default.htm

Change' recommended using the DQI evaluation tool to judge the industry's ongoing performance in terms of building quality, which was highlighted as one of the key issues driving change in the built environment. Since then DQI has been used widely in different types of projects (e.g. The British Library Centre for Conservation, Peckham Pulse Healthy Living Centre, Parliament Hill School London and Doha and Chennai Embassies). Later the DQI has been seen to be a tool for thinking rather than evaluating as it has the potential to capture lessons from current building design for strategic future use (Gann et al., 2003).

Secondly, all design criteria were filtered against five aspects according to the following definitions:

- Hospital architecture: this includes the criteria that may affect the architectural design of hospitals. It is a summary for architects who may not be aware of all hospital design criteria available.
- Ward design: these are the criteria that related to different aspects of ward design (i.e. architectural design, interior design and engineering).
- Ward spatial arrangements: a criterion was included under this category if it affects the spatial structure of the ward and as a consequence affects the value of spatial attributes of the ward. This does not include physical aspects in wards such as colour scheme, texture, lighting, etc.
- Privacy: Hall (1969) has analysed five factors (accessibility, visibility, proximity, vocal and olfactory) in relation to how people perceive their surrounding and as consequence control their privacy. This is based on the fact that humans communicate with their environment through their senses. A criterion was listed under this category if it affected only two factors, visual and acoustic, in line with Sundstrom et al (1980) definition of architectural privacy. They suggested, in page 2, that '*Architectural privacy refers to visual and acoustic isolation supplied by an environment*'.
- Visual Privacy: These are design criteria that may influence the visual privacy of patients.

Appendix F summarizes all healthcare design criteria which were collected from the toolkits including the source for each criterion, a brief explanation about each one and the five filtering aspects. It provides a rich database which can be used by architects and researchers in the field of hospital design.

Because of the large number of criteria collected from the toolkits (in total 128 criteria were collected), each one required filtering against five aspects (that is 640 tasks). Given the time and funds available for this study, it was not possible to arrange interviews or focus groups with architects or experts in healthcare building design to filter the criteria. Instead the criteria were filtered according to the author's expertise and understanding and validated by several discussions with the supervisors of the current study, who come from architectural and psychological backgrounds.

The following sections report design criteria which are related to ward spatial arrangement, privacy and visual privacy using the AEDET structure where appropriate. Then, for each filtering aspect the related criteria were regrouped in one set of categories to make it more accessible for architects and researchers. However, no claim has been made about the independency of the resulting categories. Some criteria in a certain category may affect other categories as an interaction effect between some criteria is very likely. For instance, the staff station can be listed under 'Legibility of place & way finding' category as it can act as a landmark, but at the same time the location of staff station may affect the visual privacy of patients.

7.2.3 Design criteria that affect ward spatial arrangements

Ward Design Criteria				Source: AEDET	Source: ASPECT	Source: IDEAs	Source: NEAT	Consideration	Ward Spatial Arrangements
Functionality	Uses	Function		√		√		The functional requirements and the relationships	√
Functionality	Uses	Workflows & logistics		√				The optimal arrangements of the workflows and logistics	√
Functionality	Uses	Flexibility & adaptability		√				The flexibility for the change and expansion and the adaptability in use	√
Functionality	Uses	Sufficient space		√		√		Sufficient spaces for the different activities and the workloads	√
Functionality	Uses	Security & supervision		√				The facilitation of control, security and supervision	√
Functionality	Spaces	Standards and guidance		√		√		The use of appropriate space standards and guidance	√
Functionality	Spaces	Space utilization		√		√		Acceptable ratio of usable space to the total area	√
Functionality	Spaces	Storage space		√		√		The provision of adequate storage spaces	√
Functionality	Spaces	Space segregation		√		√		Achieving segregation between spaces when necessary	√
Functionality	Staff & Patient Environment	Access to nature		√	√	√		Patients' access to nature outside and inside the building	√
Functionality	Staff & Patient Environment	Privacy, company and dignity		√	√	√		The ability of patients to maintain their privacy and their interaction with others	√
Functionality	Staff & Patient Environment		Visual privacy		√	√		Patients can chose to have visual privacy in bed area and changing area	√
Functionality	Staff & Patient Environment		Private conversation		√	√		Patients can have private conversation	√
Functionality	Staff & Patient Environment		Gender segregation		√	√		Gender segregation principles are reflected in the design	√
Functionality	Staff & Patient Environment		Company		√	√		Patients have places where they can be with others	√
Functionality	Staff & Patient Environment		Toilet & bathroom		√	√		Toilet & bathroom are located logically, conveniently and discreetly	√
Functionality	Staff & Patient Environment	Views		√	√	√	√	The optimization of the patient, staff and public spaces with pleasant view	√
Functionality	Staff & Patient Environment	Control		√	√	√		The ability of the patients to control their environment	√
Functionality	Staff & Patient Environment	Legibility of place & way finding		√	√	√	√	The extent to which the design supports an intuitive way finding strategy and the extent to which the layout of the building is understandable by the users	√
Functionality	Staff & Patient Environment		Hierarchy of place		√			There is a logical hierarchical structure of places in the building	√
Functionality	Staff & Patient Environment		The way out		√			The way out is obvious	√
Functionality	Staff & Patient Environment		Staff station		√			It is obvious where to find a member of staff	√
Functionality	Staff & Patient Environment	Light & shade		√		√		Enhancing the three-dimensional space by the appropriate use of light and shade	√
Functionality	Staff & Patient Environment	Facilities for patients		√	√	√		The provision of the important facilities for patient	√
Functionality	Staff & Patient Environment		Bathroom choice		√			Patients can have the choice for bath/shower and assisted/unassisted bathroom	√
Functionality	Staff & Patient Environment		Furniture		√			There are easy chairs, tables and desks in patients' space	√
Functionality	Staff & Patient Environment		Drinks facilities		√			Patients have facilities to make drinks	√
Functionality	Staff & Patient Environment		Relatives/friends stay		√			There are facilities for patients' relatives/friends to stay overnight	√
Functionality	Staff & Patient Environment	Facilities for staff		√	√	√		The provision of the important facilities for staff to lead their personal lives as well as their professional duties	√
Functionality	Staff & Patient Environment		Changing place & lockers		√			Staff have a convenient place to change and securely store belonging and cloth	√
Functionality	Staff & Patient Environment		Calm working place		√			Staff have a convenient place to concentrate on work without being on demand	√
Functionality	Staff & Patient Environment		Relaxing place		√			Staff can rest and relax in a place segregated from patients and visitors areas	√
Functionality	Staff & Patient Environment		Access to IT		√			All staff have easy and convenient access to IT	√
Building Standards	Performance	Acoustic design and noise		√		√	√	Comfortable sound level, good sound insulation and enhancing the communication	√

	Engineering	Fire planning strategy	√				The incorporation of a clear fire planning strategy in the design	√

Table 7.1 – Design criteria that affect ward spatial arrangements (see Appendix F for full table)

Table 7.2 summarizes the criteria that are related to hospital architecture in 14 categories based on Table 7.1. This formulates the minimum criteria that need to be met by the architectural design of hospitals.

Ward design Criteria		**Category**	**Consideration**
1	Function	Function	The functional requirements and the relationships
2	Workflows & logistics	Workflows & logistics	The optimal arrangements of the workflows and logistics
3	Flexibility & adaptability	Flexibility & adaptability	The flexibility for the change and expansion and the adaptability in use
4	Security & supervision	Security & supervision	The facilitation of control, security and supervision of the nurses
5	Views	Views	The optimization of the patient, staff and public spaces with pleasant view
6	Access to nature	Access to nature	Patients have access to nature outside and inside the building
7	Space segregation	Space segregation	Achieving segregation between spaces when necessary (gender, illness…etc).
8	Fire planning strategy	Fire planning strategy	The incorporation of a clear fire planning strategy in the design
9	Standards and guidance Storage space Sufficient space Space utilization	Space Standards, guidance & utilization	The use of appropriate space standards and guidance to achieve sufficient spaces, adequate storage spaces and acceptable ratio of usable space to the total area
10	Way finding Hierarchy of place The way out Staff station Light & shade	Legibility of place & way finding	The extent to which the design supports an intuitive way finding strategy and the extent to which the layout of the building is understandable by the users
11	Privacy/Company Control Toilet & bathroom	Visual Privacy	The ability of patients to maintain and control their privacy and their interaction with others. Toilet & bathroom are located logically, conveniently and discreetly
12	Private conversation Acoustic design	Acoustic privacy	Comfortable sound level, good sound insulation, enhancing the communication and giving the patient the choice to have privet conversation.
13	Bathroom choice Furniture Drinks facilities Relatives/friends stay	Facilities for patients	The provision of the important facilities for patients (Bathroom choice, chairs, tables, desks, drinking facilities and facilities for patients' relatives/friends to stay overnight)
14	Changing place & lockers Calm working place Relaxing place Access to IT	Facilities for staff	The provision of the important facilities for staff

Table 7.2 – Regrouping the criteria that affect ward spatial arrangements

7.2.4 Design criteria that affect privacy in hospital wards

Ward design Criteria				**Source**				**Consideration**	**Privacy**
				AEDET	**ASPECT**	**IDEAs**	**NEAT**		
Functionality	Uses	Security & supervision		√				The facilitation of control, security and supervision	√
Functionality	Spaces	Standards and guidance		√		√		The use of appropriate space standards and guidance	√
Functionality	Spaces	Space segregation		√		√		Achieving segregation between spaces when necessary	√
Functionality	Staff & Patient Environment	Privacy, company and dignity		√	√	√		The ability of patients to maintain their privacy and their interaction with others	√
Functionality	Staff & Patient Environment		Visual privacy		√	√		Patients can chose to have visual privacy in bed area and changing area	√
Functionality	Staff & Patient Environment		Private conversation		√	√		Patients can have private conversation	√
Functionality	Staff & Patient Environment		Gender segregation		√	√		Gender segregation principles are reflected in the design	√
Functionality	Staff & Patient Environment		Toilet & bathroom		√	√		Toilet & bathroom are located logically, conveniently and discreetly	√
Functionality	Staff & Patient Environment	Views		√	√	√	√	The optimization of the patient, staff and public spaces with pleasant view	√
Functionality	Staff & Patient Environment		Windows		√	√		Spaces where staff and patients spend time have windows	√
Functionality	Staff & Patient Environment		Ground view		√	√		Patient and staff can easily see the ground	√
Functionality	Staff & Patient Environment	Control		√	√	√		The ability of the patients to control their environment	√
Functionality	Staff & Patient Environment		Artificial lighting		√			Patients and staff can easily control the artificial lighting	√
Functionality	Staff & Patient Environment		Natural light		√			Patients and staff can easily exclude the sun and day light	√
Functionality	Staff & Patient Environment	Facilities for patients		√	√	√		The provision of the important facilities for patient	√
Functionality	Staff & Patient Environment		Drinks facilities		√			Patients have facilities to make drinks	√
Functionality	Staff & Patient Environment		Relatives/friends stay		√			There are facilities for patients' relatives/friends to stay overnight	√
Building Standards	Performance	Acoustic design and noise		√		√	√	Comfortable sound level, good sound insulation and enhancing the communication	√

Table 7.3 – Ward design criteria that affect patients' privacy

Table 7.4 provides a summary of the design criteria that are related to patients' privacy based on Table 7.3. These can be utilized by architects to increase or decrease patients' sense of privacy in hospital wards.

	Ward design Criteria	Category	Consideration
1	Standards & Guidance	Standards & Guidance	The use of appropriate space standards and guidance.
2	Space Segregation	Space Segregation	Achieving segregation between spaces when necessary (gender, illness…etc).
3	Security & supervision	Security & supervision	The facilitation of control, security and supervision by the nurses.
4	Pleasant Views Windows Ground View	Views	The optimization of pleasant views through the windows in patient and staff areas with visual access to the ground and sky.
5	Drinking Facilities Relatives/friends Stay	Facilities for patients	The provision of the important facilities for patient such as, facilities to make drinks and facilities for patients' relatives/friends to stay overnight.
6	Privacy/Company Artificial/Natural light	Control	The ability of the patients to control their environment by maintaining their privacy and their interaction with others and controlling the artificial lighting and the natural light.
7	Toilet & Bathroom	Toilet & Bathroom	Toilet & bathroom are located logically, conveniently and discreetly
8	Acoustics Design Private Conversation	Acoustics Design	Comfortable sound level, good sound insulation, enhancing the communication and giving the patient the choice to have privet conversation.

Table 7.4 – Regrouping the criteria that affect patients' privacy

7.2.5 Design criteria that affect visual privacy in hospital wards

Ward design Criteria				Source: AEDET	Source: ASPECT	Source: IDEAs	Source: NEAT	Consideration	Visual Privacy
Functionality	Uses	Security & supervision		√				The facilitation of control, security and supervision	√
Functionality	Spaces	Standards and guidance		√		√		The use of appropriate space standards and guidance	√
Functionality	Spaces	Space segregation		√		√		Achieving segregation between spaces when necessary	√
Functionality	Staff & Patient Environment	Privacy, company and dignity		√	√	√		The ability of patients to maintain their privacy and their interaction with others	√
Functionality	Staff & Patient Environment		Visual privacy		√	√		Patients can chose to have visual privacy in bed area and changing area	√
Functionality	Staff & Patient Environment		Gender segregation		√	√		Gender segregation principles are reflected in the design	√
Functionality	Staff & Patient Environment		Toilet & bathroom		√	√		Toilet & bathroom are located logically, conveniently and discreetly	√
Functionality	Staff & Patient Environment	Views		√	√	√	√	The optimization of the patient, staff and public spaces with pleasant view	√
Functionality	Staff & Patient Environment		Windows		√	√		Spaces where staff and patients spend time have windows	√
Functionality	Staff & Patient Environment		Ground view		√	√		Patient and staff can easily see the ground	√
Functionality	Staff & Patient Environment	Control		√	√	√		The ability of the patients to control their environment	√
Functionality	Staff & Patient Environment		Artificial lighting		√			Patients and staff can easily control the artificial lighting	√
Functionality	Staff & Patient Environment		Natural light		√			Patients and staff can easily exclude the sun and day light	√
Functionality	Staff & Patient Environment	Facilities for patients		√	√	√		The provision of the important facilities for patient	√
Functionality	Staff & Patient Environment		Drinks facilities		√			Patients have facilities to make drinks	√
Functionality	Staff & Patient Environment		Relatives/friends stay		√			There are facilities for patients' relatives/friends to stay overnight	√

Table 7.5 – Ward design criteria that affect patients' visual privacy

Table 7.6 categorises design criteria that may affect the visual privacy of patients in seven categories based on Table 7.5. This illustrates the relationship between the architectural design, and as a consequence the spatial structure, of hospital wards and visual privacy of patients.

Ward design Criteria		Category	Consideration
1	Standards & Guidance	Standards & Guidance	The use of appropriate space standards and guidance.
2	Space Segregation	Space Segregation	Achieving segregation between spaces when necessary (gender, illness…etc).
3	Security & supervision	Security & supervision	The facilitation of control, security and supervision by the nurses.
4	Pleasant Views Windows Ground View	Views	The optimization of pleasant views through the windows in patient and staff areas with visual access to the ground and sky.
5	Drinking Facilities Relatives/friends Stay	Facilities for patients	The provision of the important facilities for patient such as, facilities to make drinks and facilities for patients' relatives/friends to stay overnight.
6	Privacy/Company Artificial/Natural light	Control	The ability of the patients to control their environment by maintaining their privacy and their interaction with others and controlling the artificial lighting and the natural light.
7	Toilet & Bathroom	Toilet & Bathroom	Toilet & bathroom are located logically, conveniently and discreetly

Table 7.6 – Regrouping the criteria that affect patients' visual privacy

To sum up, there are a large number of design criteria that need to be taken into account by the designer during the hospital ward design process. This is not an easy task as these criteria seem to be complicated and to interact with each other. This is true even for design criteria that are related to visual privacy. It would be useful then to see how experts in the field of hospital design perceive these criteria in terms of importance.

In the previous part of this chapter the available guidelines for hospital ward design have been explored and summarized. The second part of this chapter focuses on experts' views regarding hospital ward design criteria which also help in turn to refine the list that resulted from the literature survey.

7.3 Inside Expert Minds

Qualitative semi-structured interviews were carried out aiming at collecting ward design criteria which seem to be important from the point of view of a selected group of experts who are experienced in hospital design. The additional aim was to obtain the perceptions of those experts regarding patients' privacy. Moreover, the information sources that these experts refer to during the hospital ward design process were also surveyed.

Several reasons supported the decision to conduct semi-structured interviews. There is a tendency, however, to refer to semi-structured and unstructured interview as in-depth interviews (Bryman, 2004). Firstly, it is more flexible comparing with structured interviews, and allows the interviewee to express his/her opinions, concerns, priorities and/or perceptions in rich and detailed answers. Secondly, it involves a more structured list of question to be addressed during the interviews than the unstructured interviews; this in turn allows the investigation to have a fairly clear focus rather than a very general approach.

The interviews were carried out with two groups of experts (experts from the UK and Syria). The first group included experts in hospital design from the UK. These experts are expected to be aware of ward design criteria that emerged as a result of evidence-based research, particularly that link the physical environment to patients' outcome and satisfaction (e.g. views to outside, patients' privacy). In a country like the UK, it seems that there is a relatively strong connection between academic institutes, industry and policy makers. On the other hand, in a country where the research culture seems to be less developed, like Syria, hospital design experts are generally expected to be limited to the basic design criteria (e.g. adequate area, the provision of toilet, etc). The second group of experts to be interviewed are experts from Syria. This provides an insight into aspects of hospital design in Syria, the home country of the author.

7.3.1 Interview guide

Prior to the interviews an interview guide was prepared. This is a list of fairly specific topics and questions to be covered in all interviews which ensure cross-case comparability and a fairly clear focus on a particular concern (Bryman, 2004). A set of open-ended questions were formulated to cover three main sections as shown in Figure 7.2. These sections are:

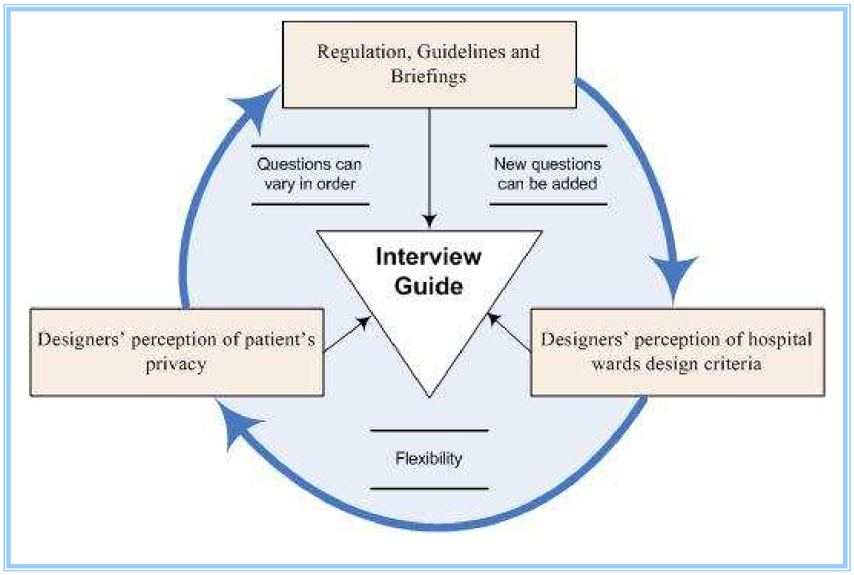


Figure 7.2 – Interview guide structure (Source: the author)

- Regulation, Guidelines and Briefings:

The aim of this section was to identify the information sources that are available to architects and designers with regards to hospital and ward design. This helped to ensure that nothing is missing from the literature which was surveyed in the previous part of this chapter. In addition, this section asked about the extent to which the available information helps the architects to design successful wards.

- Designers' perception of hospital ward design criteria.

The questions in this section focused on identifying ward design criteria that seem to be important from an experts' point of view and obtaining an initial idea about the relative importance of patient's privacy from those experts opinion comparing with other design criteria. Interviewees were asked to determine what they thought were the most important and least important ward design criterion. This helped to contextualise the design criteria within which patients' privacy can located.

- Designers' perception of patients' privacy.

The last section concerned interviewees' perception of patient privacy as a ward design criterion. Particularly it tested interviewees' awareness of the relationship between the architectural design, and as a consequence the spatial structure, of wards and the visual privacy of patients.

The interview guide is shown in Figure 7.3. An attempt was made to formulate the questions using a language that is comprehensible and relevant to the interviewees. This was supported by the fact that the researcher comes from the same background as the interviewees (i.e. architecture). In addition, leading questions were avoided. Although a fairly structured interview guide was developed, the interviews were flexible as new questions that followed interviewee's replies were asked.

Prior to the interviews, the researcher familiarized himself with the qualification criteria of an interviewer suggested by Kvale (1996) and Bryman (2004). These are being: knowledgeable, organised, clear, gentle, sensitive, open, steering, critical, remembering, interpreting, balanced and ethically sensitive. In addition, face-sheet information was recorded for each interviewee in which the position and relevant experience of the interviewee were documented.

Interview Guide

Part One: Regulation, Guidelines and Briefings.

1- During hospital design, what are the major regulations and guidelines you have to consider? And who are these issued by?
2- Are there any guidelines to guide the architect during the ward design process? If yes, what are they and who issues them?
3- Does the client briefing typically provide more or different criteria of ward design than the regulations and the guidelines? If yes, what are these criteria?
4- What other sources of information on hospital and ward design do you consider when designing these?
5- To what extent do you think the available information on ward design (regulation, guidelines, briefings, etc) helps the architect design successful hospital wards?

Part Two: Designers' perception of hospital ward's design Criteria

1- What are the ward design criteria that you tried to address at the outset of the design process when you engaged in hospital design?
2- What are the ward design criteria that you might focus on drawing on lessons from hospital designs you've been involved with which have been implemented?
3- What is the most important ward design criterion in your point of view? And what is the least important? Where do you place privacy between these two?

Part Three: Designers' perception of patient's privacy.

1- Did you consider patient's privacy, particularly visual privacy, in the wards you designed? If so, how? If not, why not?
2- Is privacy in an open ward something that you think is relevant to your design concerns as an architect or is it something which you think can be fixed at a later stage using screens?
3- Do you think an architect can improve privacy by the design itself? If so how?

Figure 7.3 – The interview guide

7.3.2 Semi-structured interviews with experts from the UK

The initial plan was to interview experts from the Edinburgh area because of the time and funding limitations for this research. In order to identify the architectural practices with experience in hospital design, the author contacted The Royal Incorporation of Architects in Scotland (RIAS), which provided a list of practices in Edinburgh with experience of hospital design (Appendix G). The websites of these practices were surveyed to identify the practices with more experience in terms of the number of hospitals they were involved in. However the available web-portfolio of these practices showed that most of them have not been involved in hospital design. This may be related to lack of updating of practices' web-profiles.

As a consequence, all practices were contacted by email and asked to provide information about their experience in hospital design; the email is shown in Appendix H. This was followed after a week by a phone call. Only three practices came back with a reply showing that they have experience of hospital design. Some practices ignored the email and others showed that they are not interested in taking part in the study either because of the confidentiality of the clients or their own time commitments.

Because of the difficulties in getting experts into interviews due to their own time commitments, travel difficulties and time limitation for this research, the author attended the Community Healthcare Design Conference which was held in 13th September 2007 in London as one of the Architects' Journal conferences where several experts from different areas in the UK with experience in hospital design were gathered. Semi-structured interviews were conducted on delegates willing to be interviewed at the conference.

In total, four interviews were conducted. Interviewees were chosen from the attendance sheet. Priority was given to those who have practical experience in hospital design and at the same time were involved in producing guidelines for healthcare building design. The interviews were short and condensed, about 12 to 15 minutes, due to the fact that it was one day conference with few and short breaks. The interviews were carried out during the breaks in the hall of the conference centre in a busy setting.

The first expert to be interviewed is a director/partner of a practice which specialises in the design and realisation of healthcare buildings. He worked with the department of health as author of some new publications and with NHS as a member of their design review panel. The second expert to be interviewed had 30 years of healthcare experience in both private and public sector in different countries. He has authored and is assisting the NHS on a number of guidelines, HBN's, HTM's and workshops. The third expert to be interviewed is a director of a practice which specialises in healthcare buildings. He has long experience in medical architectural research and he is a consultant to NHS Estates for design and technical guidance. The last expert to be interviewed was a director of healthcare in an international design practice with offices around Europe and America. Being in an international practice allows him to bring influences from other countries and to build upon that. A summary of each interview is provided in Appendix I.

7.3.3 Qualitative analysis across the UK interviews

The interviews with experts in ward design from the UK revealed an adequate awareness among the interviewees of the importance of patients' privacy in hospital wards. All interviewees ranked patients' privacy as a very highly important criterion of ward design. However, they assess privacy either from a nursing perspective (e.g the balance between good observation and privacy) or from a designer point of view (e.g. using screens might obstruct the view to outside) but in some cases not through the patient's eye (e.g. locational preference).

There is a general agreement that patients' privacy should be considered from the early stages of the design. Some designers tried to address this through particular design procedures which affect the whole ward design (i.e. the bed does not directly face the other bed).

The main information sources of ward design (and hospital design in general) are the NHS guidance and publications such as: Health Building Notes (HBNs) and Health Technical Memoranda (HTMs). All information sources mentioned during the interviews were covered in the first part of this chapter. There is a common belief that this guidance accumulates results of research and knowledge based on long experience and good understanding of health care design. In addition, case studies from around the world and networking with people in the field can be good secondary sources of information.

Without denying the benefits of multi-bed wards, i.e. the good observation and social reasons, it seems that there is a tendency towards single-bed rooms rather than multi-bed bays among the designers, following the trend in America and France (according to the third interviewee). Some designers think that single-bed rooms improve the overall performance of the ward without extra cost.

The important ward design criteria from the experts' point of view which were mentioned across all interviews are: patients' privacy and dignity, infection control, good observation, access to sanitary facility in a dignified way, good view to outside, good finishing and surfaces, giving the patient the control over the environment, creating enough social space, flexibility on the ward level and short travel distances.

7.3.4 Semi-structured interviews with experts from Syria

The author travelled to Aleppo, Syria in a field trip (from 01/03/2007 to 20/03/2007) in order to conduct semi-structured interviews with Syrian experts who are experienced in hospital design. These interviews allowed the researcher to understand the hospital design process in Syria and more importantly, identify the ward design criteria that are usually considered during the design process of hospital wards in Syria and the criteria that designers are aware of.

In total five interviews were conducted: four with architects who have been involved in hospital design and one with an architect working for the Ministry of Health who is responsible for approving the architectural design of private hospitals in Syria. Because there is no database which can be used to identify designers with experience in hospital design in Syria, the author used his personal relationships and networking with others in the field to choose and approach the interviewees. Priority was given to those who were involved in academia in addition to their practical experience, as they are expected to be more updated with research findings in this field. Interviews lasted on average for about 18 minutes because of the time commitments of the interviewees and were carried out in the interviewee's office, which was in general a calm setting.

In spite of attempts by the interviewer to keep the interviews focused on ward design criteria, interviewees tended to change the direction of the interviews to discuss general aspects of hospital design, broader problems that were associated with healthcare organization in Syria or to describe their own experience as patients in a hospital ward. This may be related to two reasons: firstly, there is, perhaps, a common feeling among experts that attention should be given to more general concerns in healthcare facilities design sector in Syria rather than focusing on detailed issues (e.g. ward design criteria). Secondly, there may be a lack of knowledge about the proposed topic.

The first expert to be interviewed is an architect who is working for The Syrian Ministry of Health and responsible for checking and approving the architectural design of private hospitals. The second expert to be interviewed is an architect who designed a newly built hospital in Aleppo, Syria. The third expert to be interviewed was involved in several hospital projects and used to teach architectural design at Faculty of Architecture, Aleppo University, Syria. The fourth expert to be interviewed was responsible for a refurbishment hospital project and he is teaching architectural design at the Faculty of Architecture, Aleppo University, Syria. The last expert to be interviewed has designed several hospital projects in different areas in Syria and he is a lecturer at Faculty of Architecture, Aleppo University, Syria. A summary of each interview is provided in Appendix J.

7.3.5 Qualitative analysis across Syrian interviews

The interviews with experts in ward design from Syria revealed a general agreement that there are no formal regulations or guidelines regarding hospital design. The exception is one document which deals with private hospitals (owned by individuals, not by the government). This document was issued in 1953 and since then it has not been revised. Recently, this document has been subjected to a revision, which had not been issued at the time of conducting the interviews. According to interviewee 1, who has seen the draft of the revised version of this document, the information provided by this document (the old and revised versions) regulates the process of approving the building warrant rather than the architectural design.

In terms of the briefing, the interviewees agreed that the client usually does not provide a satisfactory briefing except for very limited notes which usually address general issues such as the number of beds and departments required.

In general, the interviewees obtain the information on hospital design from the following sources: general architectural references (i.e. Neufert Architects’ Data and Time Saver Standards), textbooks on hospital design, personal experience, conversations with doctors and the manuals of the required equipments.

Ward design criteria that were seen as important by the interviewees are mostly related to the clinical functions of wards such as the provision of adequate areas which allow the ward to function successfully and the appropriate use of materials. In addition some interviewees mentioned other types of design criteria (i.e. view to outside and the correct use of colours).

In terms of patients’ privacy, not one of the interviewees proposed patients’ privacy as a design criterion by himself (without prompting). Some interviewees considered visual privacy as an important design aspect and others saw it as an unimportant issue in hospital wards. In both cases this was as a response to the interviewer’s suggestion that visual privacy may be a design criterion.

One point worth consideration is the self-contradiction in some interviews, particularly interviews 1, 2 and 4, between the designer characteristic and the patient characteristic of the same interviewee. To explain, as designers some interviewees viewed visual privacy as an unimportant criterion, but they considered it as a very important design criterion when they were describing their experience as patients in a hospital ward. And as a consequence, they changed their point of view as designers during the interview.

7.4 Discussion and Conclusions

This chapter has reported the two studies which were carried out to identify, summarize and re-categorize ward design criteria that are provided by the available regulation and guidelines in the UK, and criteria that seem to be important from ward design experts' point of view. In addition, this chapter has provided an insight into aspects of hospital and ward design in Syria. This was achieved by the means of two methods: a comprehensive review of the relevant literature and guidelines in the UK, and semi-structured interviews with experts from the UK and Syria. This chapter suggests the following:

- There is a wide range of guidelines in the UK that focus on different aspects of hospital design such as the architectural and engineering design, fire safety design, sustainability issues, etc. Most of these guidelines are not compulsory. It is up to NHS Trusts to refer to a particular guideline document or section as a compulsory requirement in the briefing. However, document series like HBNs and HTMs formulate the baseline for any hospital project.

- NHS Design Evaluation Toolkits (AEDET, ASPECT, IDEAs and NEAT) cover a wide range of information resources that are related to hospital design; this includes guidelines, evidence-based research, experience and case studies. The way in which most of the toolkits work is based on a subjective evaluation of a design against particular criteria. However, using the toolkits in a workshop which consists of representatives of each stakeholder group including the end-user may result in a more accurate evaluation of the design under question.

- Patients' privacy has been acknowledged on many occasions in both toolkits and guidelines and there are several design criteria that are under the control of architects and do relate to patients' privacy. However, locational preference has not been seen as a facet of privacy nor as a function of the spatial structure of wards.

- Experts with experience in ward design from the UK showed an adequate awareness of the different design criteria associated with ward design. This ranged from criteria that are related to the functional use of wards to criteria related to human needs. In addition, HBNs appeared to be the fundamental guidelines that they rely on during design process.

- Ten ward design criteria are considered as more important than any other design criteria by experts from the UK interviewed for this research, these criteria are: patients' privacy and dignity, infection control, good observation, access to sanitary facility in a dignified way, good view to outside, good finishing and surfaces, giving the patient the control over the environment, creating enough social space, flexibility on the ward level and short travel distances. These design criteria were used for a more detailed study in the next chapter.

- Experts from the UK seem to be aware of the role of architects in achieving better patients' privacy, particularly visual privacy. In general, patients' privacy was seen to be highly important as a design criterion. However, other criteria such as good observation, infection control and view to outside were considered to be more important.

- Although the social reason behind multi-bed wards has not been denied by experts from the UK, it seems that there is a tendency towards single-bed rooms. There is a common belief among those experts that single-bed rooms are better for patients' privacy and infection control and they do not cost significantly more in the capital and revenue in comparison with multi-bed wards.

- There is a significant lack of information and guidelines on hospital design in Syria. This seems to be part of a wider range of problems associated with healthcare building in Syria, in spite of the attempts by some individuals to address and propose solutions for some problems associated with healthcare building design. For instance, Aljawabra (2006) studied the optimization of hospital design to meet the climate condition in Damascus. However a much larger study is needed to review the different aspects associated with healthcare building design in Syria and to propose solutions that meet social, environmental and economic needs of the country. This requires, in addition to the will of policy makers, an extended period of time and efforts of an experienced team. However, learning from others' experience may save a good proportion of time and effort required.

- Experts with experience in hospital design from Syria perceive ward design as a response to the clinical function of that ward and they tend to disregard design criteria that are related to human needs and satisfaction within hospital settings. The reason behind that is, most probably, a complex matrix of social, economic and educational factors which are out of the scope and possibilities of this research. One obvious reason is that a focus on the relationships between the physical environment and human behaviour and need (i.e. environmental psychology) is not part of the programme delivered to students in architectural schools in Syrian universities.

In the UK, it seems that academics are both relatively successful in dissemination of the findings of their research in the field of healthcare design and in 'selling' them to policy makers who in turn reflect the implications of these finding in the regulations and guidelines. On the other hand, a lot of these studies are funded by the government. In terms of ward design criteria, this is strongly connected to the way in which architects prioritize design criteria during a design process.

In addition to the specific finding of this chapter, it provides a context for a more detailed study which investigates the priority of privacy within design constraints associated with the design criteria of hospital wards. This will be investigated in the next chapter using the ten design criteria that were considered as more important by the interviewees.

Chapter Eight:
Choice Based Conjoint Study

8.1 Introduction

The design process in architecture inevitably involves a prioritization of design criteria by architects. The process by which architects arrive at decisions is complicated, not easy to understand, and involves some mix of rationalisation, intuition and preference. When designing a hospital ward, where there are a lot of combinations and permutations, this process seems to be more difficult than usual due to the complex clinical functions of wards and patients' conditions. This chapter attempts to address objective 4 of this thesis. It uses choice based conjoint analysis to understand the priorities of architects for privacy when it is placed within other environmental constraints and design criteria associated with the design of hospital wards.

The design criteria used for the conjoint study are criteria which have been considered as important design criteria by experts from the UK with experience in ward design in the previous chapter. These criteria are: patients' privacy, infection control, good observation, access to sanitary facility in a dignified way, good view to outside, good finishing and surfaces, giving the patient the control over the environment, creating enough social space, flexibility on the ward level and short travel distances.

8.2 What is Conjoint Analysis?

Conjoint analysis has been developed to measure respondent preferences in real world situations of choice where there are combinations of attributes with different levels that characterise a product, service or situation (Orme, 2007a). In simple terms, respondents are presented with pairs of possible scenarios which are computationally generated from a number of attributes of interest to the study. Each attribute is presented at levels which reflect the possible variation of that scenario characteristic. Respondents are asked to choose which combination they prefer. This process is repeated for a number of choices or tasks, with the respondent choosing from a potentially different pair of alternatives each time. The conjoint task can be performed using cards, on-site computing or via the internet, as in this study. The data collected can then be analysed to provide individual or aggregate relative importance (or utilities) for each attribute in question. Utility refers to '*a degree of worth or preference for a product feature*' (Orme, 2007a, page 384).

The effectiveness of CA in preferences studies is that it enables the user to make a choice between alternatives when several items of information are presented together. This has three advantages which may be best summarized by Aspinall (2007, page 182): '*First, the presentation is natural and closer to real-world choices we face when we select, decide, evaluate or buy something. Second, it removes the problem inherent in many research studies or decisional programmes, whereby an overall choice is determined by summing results from a combination of choices across its separate elements. Conjoint analysis is more likely to reveal realistic and integrated choices than such additive models, that is, the whole is more than the sum of its parts (Tversky and Kahneman, 1982). Third, there is considerable evidence from psychological studies that people are better at making relative choices than they are at making absolute judgments, and that relative choice judgements have greater reliability and validity for preference studies (Tversky and Kahneman, 1982)*'.

CA has its origin in mathematical psychology (Luce and Tukey, 1964), but has been used mostly as a quantitative marketing research tool (Orme, 2007a). CA was introduced to marketing research by Green and Rao (1971), who used it for marketing and product evaluation. Then application of CA has been used for estimating market share potential, product image analysis and segmentation analysis (Hair et al., 2003).

The use of CA has not been limited to marketing research only, but extended to a wider range of fields. David et al (1992) used CA to evaluate students' preferences regarding university accommodation in order to inform a discussion on services of non-profit organisations. In his thesis, Zuin (2002) investigated the preferences of landscape architects worldwide as to how much value they place in certain aspects of landscape architectural education. In another study, CA was used to identify new housing preferences of households and establish how they actually shape real purchasing decisions (Leishman et al., 2004). Recently, influence of pavement design parameters in safety perception in the elderly was investigated using CA (Zamora et al., 2008). In addition, CA was recommended to the UK Treasury for valuing quality in the provision of public services (Cave et al. (1993), cited in Ryan and Farrar (2000)).

In healthcare research, CA has been gaining widespread acceptance and been applied successfully in many areas. According to the review by Ryan and Farrar (2000) this includes eliciting patients' and the community's preferences in the delivery of health services, establishing consultants' preferences in priority setting, developing outcome measures, determining optimal treatments for patients, evaluating alternatives within randomised controlled trials and establishing patients' preferences in the doctor-patient relationship. For example, Aspinall et al (2008) have investigated the quality of life and priorities of patients with glaucoma using three methodologies, one of which was CA. Casarett et al (2008) have investigated how to design a supportive cancer care from the patient’s perspective using CA.

8.3 The Conjoint Study

The continuous development of conjoint analysis, in terms of use and research, has resulted in a variety of conjoint methods which in turn encouraged the production of more efficient CA computer packages. Sawtooth Software is a leading producer in this field; they offer three conjoint software packages: Adaptive Conjoint Analysis (ACA), Traditional Full-Profile Conjoint Analysis (CVA) and Choice-Based Conjoint (CBC).

The author was awarded a Sawtooth Software Grant which allows a research student to obtain a full licence to products that are required to carry out the proposed study. As access to the different conjoint-related packages was granted, the remaining question was which conjoint technique to use.

Each conjoint technique has its advantages and limitations. In short, the decision to employ Choice-Based Conjoint (CBC) in this study was supported by the fact that CBC is distinguished from other techniques of conjoint analysis because it allows respondents to express preferences by choosing from sets of scenarios (or concepts) rather than rating or ranking them, which is what ACA and CVA offer (Orme, 2007b). In addition CBC is the most widely used conjoint technique around the word as it mimics the purchase process for products in competitive contexts (Orme, 2007b). CBC allows attributes interaction effects to be included in any conjoint model. The choice-based task is similar to what many architects do in the real design situation. Prioritizing different design scenarios or, in other words, choosing a preferred design scenario from a group of possibilities seems to be similar to what architects do in any design routine.

The number of attributes resulting from the semi-structured interviews with experts with experience in ward design (that is ten ward design criteria) initially suggested the appropriateness of ACA for this study. The reason for that is that ACA can include up to 30 attributes and typically involves 8 to 15 attributes, whereas the maximum number of attributes recommended for CBC studies is six. This is due to the confusion and information overload that more than six attributes may cause to respondents (Orme, 2007a). However, a recent development in the CBC software, (namely Partial-Profile CBC) allows the use of choice-based conjoint rather than rating-based approaches with a larger number of attributes.

In Partial-Profile CBC design only a subset of the total number of attributes is shown at any one time in each choice task, but in each survey all attributes and levels are randomly rotated across the tasks. This type of conjoint study requires a larger sample size compared with the sample size required for ACA and can include up to 30 attributes (Orme, 2007b).

CA studies can be administered in three ways: web-based, paper and pencil and stand-alone PC. The advantages of using web-based interviewing over the traditional ‘paper and pencil’ and CAPI-based (stand-alone PC) interviewing is not only avoiding the added cost and time required to reach the respondents, but also allowing the research to reach a wider range of respondents in different geographical locations. This achieves a better response rate as respondents can answer the questions in the time and place they choose and they may restart an incomplete survey where they left off. Data collected directly into a computer file can be analysed later by the analyst without the time and effort required to input the collected data in an appropriate computer file.

SSI Web v6.4 by Sawtooth Software was used for this study. It is a software system for writing questionnaires and conducting research studies over the internet and it is made up of five components: CiW, ACA/Web, CBC/Web, CVA/Web and MaxDiff/Web. For the aim of this study, two components were used to create the web-based questionnaire:

CiW was used to write the general questions (non-choice questions) and CBC/Web was used to create the choice-related tasks.

A series of procedures outlined in the SSI Web software package manual guided the following stage of this research.

8.3.1 Definition of attributes and levels

The first phase in any CA study is to define attributes of the study that can take different levels. In the current study, these attributes as stated above are: patients' privacy, infection control, nurses' observation, access to sanitary facility, view to outside, finishing and surfaces, control over the environment, social space, flexibility on the ward level, and staff travel distances.

Next, levels have to be assigned to each attribute. Desirable levels for a CA study are realistic and capable of being traded (San-Miguel et al., 2000). Table 8.1 shows the attributes and levels.

Attributes		Levels
1	Patients' privacy	High level of patient's privacy
		Moderate level of patient's privacy
		Low level of patient's privacy
2	Infection control	Maximum control of cross infection risk
		Moderate control of cross infection risk
3	Nurses observation	Good nurses observation
		Moderate nurses observation
		Poor nurses observation
4	Access to sanitary facility	Easy access to sanitary facility
		Moderate access to sanitary facility
		Difficult access to sanitary facility
5	View to outside	View to natural landscape
		View to an internal atrium
		No view to space outside ward
6	Finishing and surfaces	High quality finishing and surfaces
		Moderate quality finishing and surfaces
7	Control over the environment	The patient has a high level of control over the environment
		The patient has a moderate level of control over the environment
		The patient has a low level of control over the environment
8	Social space	Large space for social interaction
		Moderate space for social interaction
		Small space for social interaction
9	Flexibility on the ward level	The ward's design allows flexible layout (by partitioning)
		The ward's design does not allow flexible layout (by partitioning)
10	Staff Travel distances	Short travel distance
		Moderate travel distance
		Long travel distance

Table 8.1 – Attributes and Levels for Conjoint Analysis

Achieving a balance between levels across the attributes is desirable if possible but was not an easy task. Some attributes required more levels than others to cover the possible variation in the attribute. For example, 'view to outside' can be described in several levels as suggested by the literature (e.g. view to a car park, view to the sky only, view to the ground and sky, no view to outside, view to a natural landscape, etc) whereas 'flexibility on the ward level' can be described mainly in two states as flexible or not. However, an attempt was made to balance the levels across the attributes. The number of levels was no more than three and no less than two and each of these levels is mutually exclusive. Each hospital ward design criterion presented for the choice task was described using a single level from each attribute. In total 27 levels have been formulated to cover the ten ward design criteria. These attributes and its levels were input into the CBC/Web interface.

8.3.2 Study Design

In CBC a design refers to *'the sum total of the task descriptions across all respondents'* (Orme, 2007a, page 413). This involves making decisions regarding several issues related to the study design, including whether to use full or partial-profile CBC, whether to include 'None' option, whether to include interactions or prohibitions between levels of different attributes, the number of product concepts to display per choice task, how many choice tasks to present in the study, and decisions about holdout tasks. These issues are detailed in the following paragraphs.

First, the number of attributes of interest in this study suggests using partial-profile design rather than full-profile. Although the latter can accept up to ten attributes, it is recommended not to include more than six as explained earlier (Orme, 2007a). Hence, a decision to use partial-profile design was made.

Because partial-profile design presents only a subset of attributes in each choice task, it is assumed that the respondent can evaluate concepts holding all other attributes constant. This requires a particular attention from the research to the wording of the conjoint question in order to help the respondents to maintain a *ceteris paribus*[19] mind set (Orme, 2007a). Bearing this in mind, the conjoint question for this study was formulated as shown in Figure 8.1.

[19] *Ceteris paribus* is a Latin phrase, literally translated as "with other things the same." It is commonly rendered in English as "all other things being equal." (Source: http://www.wikipedia.org/)

In your professional opinion, which one of these two wards would be more beneficial for the patients? **Please assume that everything else is equal in the two wards.**

Figure 8.1 – The conjoint question

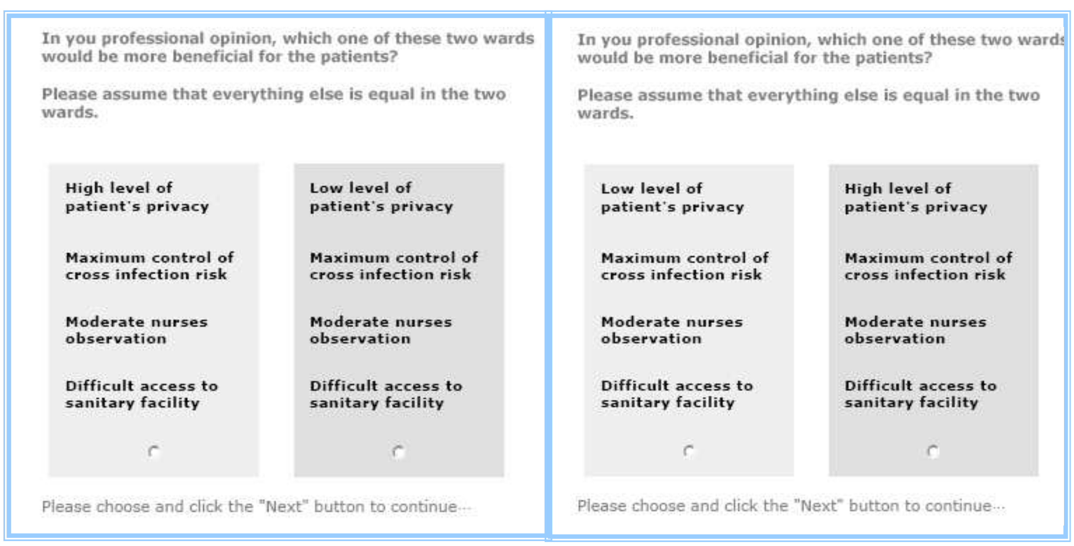
Second, the 'None' option can be included in CBC studies to give respondents the opportunity to express their dissatisfaction with the available choices. It is recommended to include a 'None' option in full-profile designs. In contrast, a 'None' option has shown to be problematic when it is included in partial-profile designs due to the significant variation of the 'None' weight dependent on the number of attributes shown in the tasks (Orme, 2007a). As a consequence, the 'None' option was not included in the current study. In addition, no attribute interactions were included nor prohibitions between attributes/levels as these were not likely to be relevant in this study.

Third, the researcher needs to decide how many concepts to display in each task. In the current study, two concepts with four attributes describing each one were presented in each choice task due to the relatively long text that describes each concept (i.e. levels). Including more than two concepts in each choice task would have required respondents to do more reading and process a relatively large amount of information in each choice task.

Fourth, a decision should be made regarding the number of choice tasks to be included in the survey. Johnson and Orme (1996) found that long CA interviews can provide as good quality information as the short ones. They recommended that at least 20 tasks can be included without degradation in data quality. Relying on this advice, 20 random choice tasks were included in the study and an additional 3 fixed holdout tasks were added. In total the study consists of 23 choice tasks. This number was reduced as a consequence of the feedback received from the pilot subjects. These indicated that that 23 choice tasks interview (in addition to the non-choice question) was a too long. Hence, the study was reduced to 15 random choice tasks, to which 3 fixed holdout tasks were added. That is 18 choice tasks in total.

Fifth, the researcher was required to define attributes and their levels in the fixed holdout tasks in contrast to the randomly generated tasks in which the software's algorithm determines the combination of attribute levels to be shown for each respondent (Orme, 2007a). Fixed holdout tasks are shown to each respondent and can be used to validate overall results, testing respondents' coherence and evaluating product concepts existing prior to the conjoined study (Zuin, 2002). In the current study, fixed holdout tasks were used to identify inconsistent respondents. This was done at two levels:

- Two holdout tasks were the same. The only difference was in the concepts' position. To explain, concept 1 in holdout task 1 was located as concept 2 in holdout task 2. The concepts in these tasks were different only in one attribute (i.e. patient's privacy). One concept achieves low level of patient's privacy and the other achieves high level of patient's privacy. As a consequence of this design, respondents were expected to choose concept 1 in holdout task 1 and concept 2 in hold out task 2. These two holdout tasks were inserted into the study as choice tasks numbers 4 and 16 respectively. Figure 8.2 shows these two holdout tasks.



Fixed holdout task 1 | Fixed holdout task 2

Figure 8.2 – Fixed holdout tasks number 1 and 2 (choice tasks number 4 & 16)

- Another hold out task was added as a second level of internal validity. This holdout task formulates the so-called 'dead brain question'. In this task the choice is relatively easy and obvious. In formulating this holdout task, two attributes were described as moderate (i.e. finishing and surfaces & social space) and the other two concepts (i.e. nurses' observation & control over the environment) were described using their positive levels in one concept and negative level in the other. As a consequence, respondents were expected to choose the concept that achieves the positive levels. This holdout task was inserted into the study as choice task number 10. Figure 8.3 shows this holdout task.

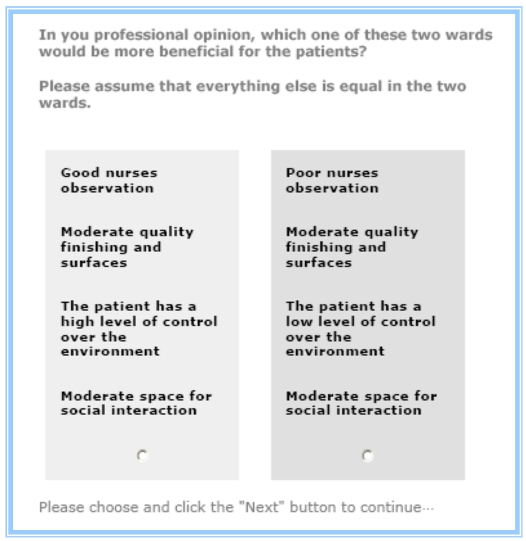
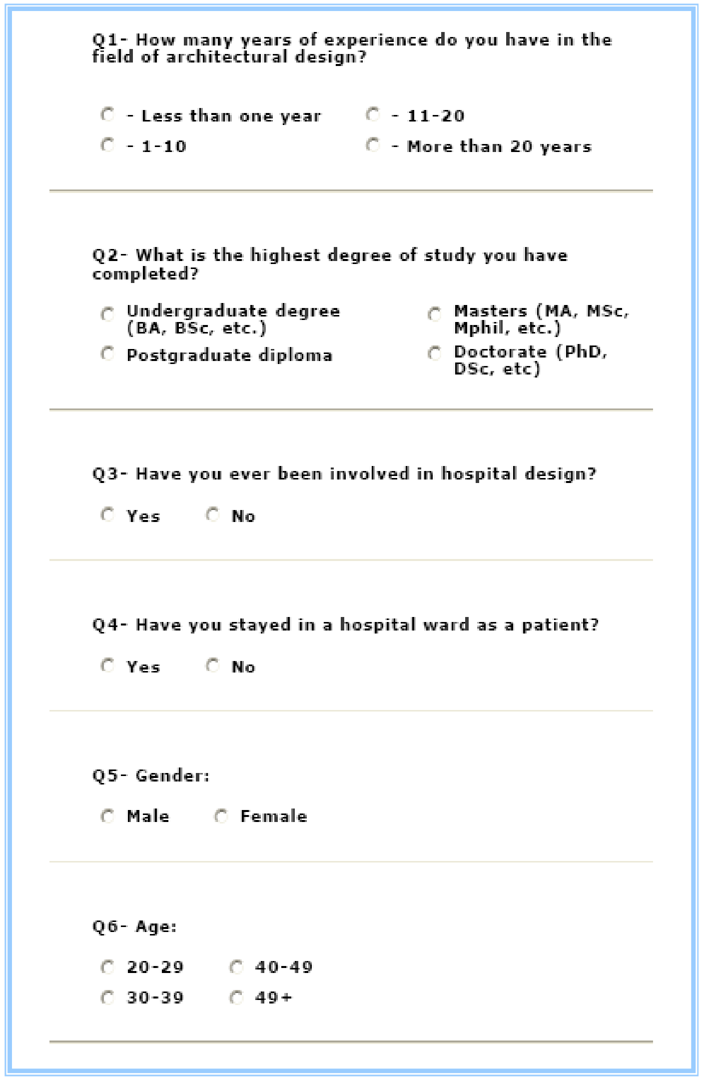


Figure 8.3 – Fixed holdout task number 3 (choice tasks number 10)

At this stage most of the decisions with regard to the CBC study have been taken, the remaining task was to add segmentation questions. SSI Web allows the user to include segmentation questions in the CBC survey, i.e. question that define different segments of respondents from the sample. The information collected can be used later to sort results into different categories of subjects and examine variation of preferences within them (Zuin, 2002).

A demographic six-question section was therefore included as a part of the survey. Hence, the survey consists mainly of two sections: personal information which includes six non-choice questions and the CBC in which the 18 choice questions are presented to the respondents. Figure 8.4 shows the demographic questions.



Q1- How many years of experience do you have in the field of architectural design?

- Less than one year
- 1-10
- 11-20
- More than 20 years

Q2- What is the highest degree of study you have completed?

Undergraduate degree (BA, BSc, etc.)
Postgraduate diploma
Masters (MA, MSc, Mphil, etc.)
Doctorate (PhD, DSc, etc)

Q3- Have you ever been involved in hospital design?

Yes
No

Q4- Have you stayed in a hospital ward as a patient?

Yes
No

Q5- Gender:

Male
Female

Q6- Age:

20-29
30-39
40-49
49+

Figure 8.4 – The demographic questions in the CBC study

After inserting the personal information questions into the survey, the questionnaire was previewed using the Local Web Server which is included in the software. This helped to take final decisions regarding the graphics and overall presentation of the questionnaire. The final structure of the questionnaire is shown in Table 8.2.

	Number
Attribute	10
Total of levels	27
Random choice tasks	15
Fixed holdout tasks	3
Total choice tasks	18
Profile (concept) per choice task	2
'None' option	Not included
Attribute interactions	-
Prohibitions	-
Attributes per profile	4
Segmentation questions	6

Table 8.2 – Partial-profile CBC study final structure

The pilot study which was carried out with 5 colleagues in the School of the Built Environment at Heriot-Watt University showed that the questionnaire in its final structure took on average of about 10 minutes to finish. This is consistent with Johnson and Orme (1996) who found that the average interview time for 20 choice tasks is under 7 minutes. Thus, 10 minutes seemed to be sufficient for the current study (18 choice tasks + 6 demographic questions + introduction and explanatory text).

8.3.3 The efficiency of the study

The next phase in establishing a CBC study is to decide how many unique versions of the questionnaire to field. This is directly related to the efficiency of the study design in estimating the part worth utilities. This can be checked using the Test Design module that is integrated in the software.

Optimally efficient CBC design is that design which can estimate part worth utilities with optimal accuracy. In other words, the minimum possible standard errors of the estimates are achieved by this design. The software offers two test design procedures: Test Design (Frequencies and OLS Efficiency) and Advanced Test (Logit Report of Simulated Data, and D-Efficiency).

The first Test Design procedure counts the number of times each level occurs within the design. The more equal the number of levels within each attribute the more efficient the design. In addition, the relative standard error for each level is calculated using ordinal least squares (OLS) based on the number of observations. This, then, compared to the ideal standard error, which is what the standard error would be if the design were precisely optimal, is used to calculate the efficiency of the design. The manual of the software recommends using the median of the efficiency of all levels - rather than the mean - as an overall estimation of design efficiency. As a consequence, a good design is that in which the levels in each attribute occur an equal number of times and achieves the highest median of efficiency.

The Advanced Test Design procedures estimates the aggregate standard error based on the number of tasks and sample size. So the researcher needs to determine the number of respondents. Then, the software simulates random respondent answers and calculates the standard error of main effects (i.e. utilities) of these dummy answers. According to the manual of the software, the rule of thumb in this context is that standard errors for main effects should be no larger than about 0.05. In addition, D-efficiency can be calculated based on the Advanced Test Design which *'summarizes how precisely this design can estimate all the parameters of interest with respect to another design, rather than how well the design can estimate the utility of each level of each attribute'* (Orme, 2007a, page 418).

The Test design and Advanced Test design procedures were run for the current study to determine the number of versions that achieved the most efficient design. This was done for 5, 10, 20… 100 versions. The number of respondents was expected to be 200. Median OLS Efficiency and maximum Aggregate Standard Error for these designs are shown in Figure 8.5.

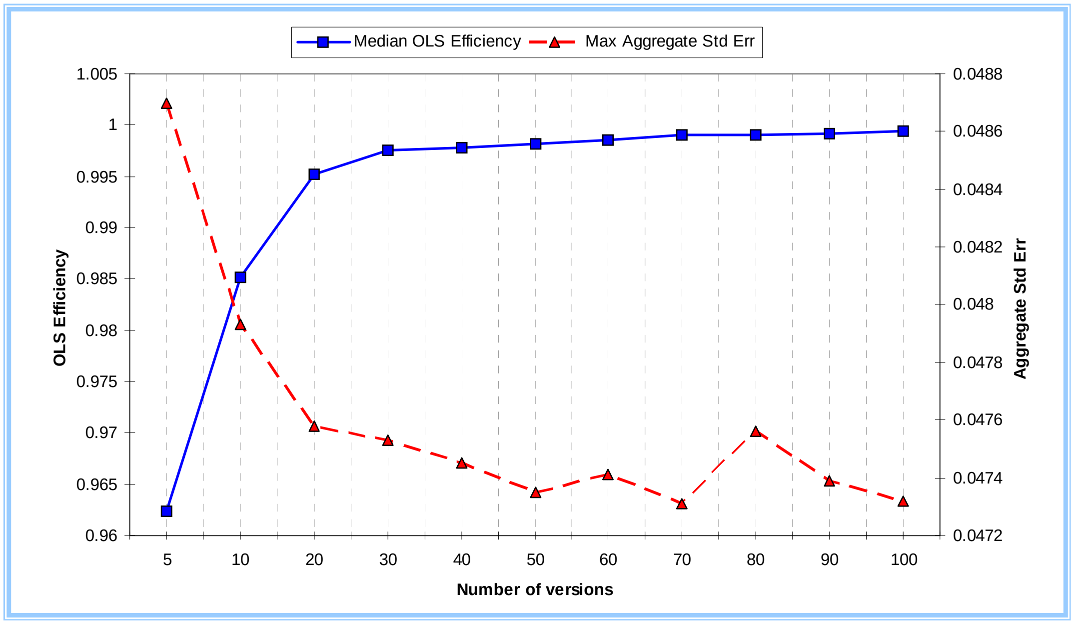


Figure 8.5 – CBC design efficiency

Designs with 20 versions or more achieve more than 99.5% OLS efficiency, whereas all designs achieve an acceptable maximum Aggregate St error. However, designs with 70 and 100 versions achieve the least Aggregate St Error. Hence, the comparison is between these two designs. In order to check which design to chose, the Frequencies of levels occurrence within each attribute were checked and D-efficiency was calculated. Table 8.3 shows a comparison between these two designs.

	70 versions design	**100 versions design**
Frequencies test	Levels in each attribute occurs exactly the same number of times (Optimally balanced)	There are variations in levels occurrence in two attributes (number 3 and 7)
Median OLS efficiency	99.90%	99.94%
Maximum Aggregate St Error	0.04731	0.04732
Strength of the design (D-efficiency is the ratio of these values)	599.92	599.89

Table 8.3 – Comparison between 70 versions and 100 versions CBC designs

The frequencies test showed that the design with 70 versions is more balanced than the design with 100 versions. The two designs are statistically indistinguishable in terms of all other measures of efficiency (OLS efficiency, Aggregate St Error and D-efficiency). As consequence, the design with 70 versions was fielded.

8.3.4 The sample and administering the study

Initially, the Royal Institute of British Architects (RIBA) was contacted in order to obtain a list of email addresses of the registered architects; this was not possible because of the policy of the institute. Instead, email addresses of 4000 chartered architects registered with RIBA were collected manually from the online RIBA Member Directory[20] and input into an Excel file. The decision to invite such a large number of respondents to take the survey was supported by a previous observation of the author that architects in general are extremely busy and previous research which showed that architects do not have a strong conception of research in architectural practices or in their professional practices based on in-depth interviews with architects from Scotland (Jenkins et al., 2005). These two reasons suggested a low response rate should be expected. In addition, architects who have not been involved in hospital projects may not be interested in taking part in the current study.

Collecting architects' emails involved searching the '*Surname*' field in the database using the alphabet letters from A to Z. For each letter, email addresses were chosen randomly. An attempt was made to balance between numbers of email addresses which were copied from each letter; however, this was not possible for some letters where few email addresses were available.

Then, 4020 usernames and passwords were generated using SSI/Web (20 username and password were added to allow testing and piloting of the survey when it went on-line). These were input in the same Excel file which formulates the database which contains each email address and its unique username and password. Assigning respondent passwords is particularly important given the fact that placing a survey on the web makes it available to people that have not been invited to take the survey, and respondents may try to take the survey multiple times. In addition, username and password allow respondents to restart an incomplete survey where they left off.

[20] http://members.riba.org/memdir/

The next stage was uploading the survey on the Web. This study was uploaded on the server of the School of the Built Environment at Heriot-Watt University by the IT technicians in the department who can access the server. When the survey became live on the web, the researcher tested it and conducted a 5-subjects pilot study to ensure that the CBC questionnaire worked properly and data was being stored correctly.

The last stage was to invite respondents to take the survey. Due to the large number of the invited respondents, it was not possible to write individual emails for each one with his/her unique username and password. Instead, a free marketing software was used called Email Marketing Pro 2.0. This type of package allows the user to send personalized emails in bulk. The Excel file which contains the email addresses of the respondent, usernames and passwords was imported into Email Marketing Pro and an email inviting respondents to take the survey was written in the software which is shown in Appendix K.

Then, the software assigns each email address to its unique username and password provided in the database and sends the emails. After two weeks a reminder email was sent to the respondents who had not yet taken the survey. The study was left live on the web for about two months. Appendix L shows one version of the study as it was presented on the web.

8.4 Choice Based Conjoining Analysis

In total 4000 emails were sent inviting architects to take the survey. However, about 12.5% (496 emails) were undeliverable because some email addresses were incorrect or could not be reached by the delivery software. In addition, some architects were out of their offices for a holiday or had changed the company they used to work for. Hence, the total number of emails received by the intended recipients was about 3500.

Although the efficiency of the current study was designed based on the assumption that 200 completed responses could be achieved, only 119 completed responses were received; of which 11 responses were invalid: 9 respondents answered the holdout tasks number 4 and 16 differently, and another 2 respondents failed to answer the holdout task number 10 (the dead brain question) correctly. As a consequence, the total number of valid responses was 108. This reduction in the sample size does not affect the OLS Efficiency of the design (99.9%) because it does not depend on the sample size; whereas, it increases the Aggregate St Error for the three-level attributes to 0.06. Accepting this means that the three-level attributes will be estimated with slightly lower precision than the two-level attributes.

The ideal solution would have been to collect more data, but because of the time limitation of the current study, it was not possible to run a second stage to increase the responses number. Hence, the analysis was run using the 108 responses.

The data collected was downloaded from the web into SSI Web, then choice data were exported to a *.CHO file, which is the default format of CBC data, and the non-choice questions were exported into *.CVS file. This format allows the analysis using the two CBC analysis packages which were used in this study. The first is CBC/HB (Hierarchical Bayes Estimation for CBC Data) and the second is SMRT (Sawtooth Software Market Research Tools). CBC/HB estimates the individual-level utilities whereas SMRT is a companion software system to SSI Web that can be used for analyzing the results of CBC/Web studies.

Following this description of the methodology and experimental design of the conjoint tasks, this thesis proceeds to the analysis of the data obtained. The analysis of CBC data followed closely the sequence proposed in the software's manuals.

8.4.1 Demographic questions

As a part of the current study, respondents were asked six demographic questions in which they provided a series of data summarised in Table 8.4 below. This was done using the Tables programme that is integrated into SMRT.

Demographics		Frequency	Percentage
How many years of experience do you have in the field of architectural design?	Less than one year	0	0
	1-10	13	12%
	11-20	33	30.6%
	More than 20 years	62	57.4%
	Mean = 3.45	St. Deviation = 0.702	
What is the highest degree of study you have completed?	Undergraduate degree (BA, BSc, etc.)	18	16.7%
	Postgraduate diploma	58	53.7%
	Masters (MA, MSc, Mphil, etc.)	29	26.9%
	Doctorate (PhD, DSc, etc)	3	2.8%
	Mean = 2.16	St. Deviation = 0.726	
Have you ever been involved in hospital design?	Yes	70	64.8%
	No	38	35.2%
	Mean = 1.35	St. Deviation = 0.480	
Have you stayed in a hospital ward as a patient?	Yes	76	70.4%
	No	32	29.6%
	Mean = 1.30	St. Deviation = 0.459	
Gender	Male	91	84.3%
	Female	17	15.7%
	Mean = 1.16	St. Deviation = 0.366	
Age	20-29	2	1.9%
	30-39	28	25.9%
	40-49	19	17.6%
	49+	59	54.6%
	Mean = 3.25	St. Deviation = 0.908	

Table 8.4 – CBC study sample breakdown (n = 108)

This offers a demographic profile of respondents which can be used later for the segmentation analysis.

8.4.2 Counting analysis of choice tasks

There are two different ways to analyse the choice data using SMRT software: Counting and Logit analysis. The one reported here is the counting analysis.

The counting program reports proportions ranking from 0 to 1 indicating the percent of times each attribute level was chosen when it was displayed, accompanied by the chi-square to test the differences between levels of each attribute. The resulting values are ratio data and can only be compared within each attribute. Only the random tasks are analysed in this stage. Counting analysis reports by default one-way (main effect) of attributes levels on choices and two-way probabilities of choice when a combination of two attribute levels are displayed. Table 8.5 shows the results of counting analysis for one-way or main effects only.

Attributes	Levels	Counts	Within Att. Chi-Square	D.F.	Significance
Patients' privacy	High level of patients' privacy	0.64	49.91	2	P< 0.01
	Moderate level of patients' privacy	0.55			
	Low level of patients' privacy	0.31			
Infection control	Maximum control of cross infection risk	0.73	140.75	1	P<0.01
	Moderate control of cross infection risk	0.27			
Nurses observation	Good nurses observation	0.73	109.73	2	P<0.01
	Moderate nurses observation	0.55			
	Poor nurses observation	0.23			
Access to sanitary facility	Easy access to sanitary facility	0.66	86.92	2	P<0.01
	Moderate access to sanitary facility	0.59			
	Difficult access to sanitary facility	0.24			
View to outside	View to natural landscape	0.74	111.46	2	P<0.01
	View to an internal atrium	0.53			
	No view to space outside ward	0.23			
Finishing and surfaces	High quality finishing and surfaces	0.55	7.79	1	P<0.01
	Moderate quality finishing and surfaces	0.45			
Control over the environment	The patient has a high level of control over the environment	0.60	23.85	2	P<0.01
	The patient has a moderate level of control over the environment	0.53			
	The patient has a low level of control over the environment	0.37			
Social space	Large space for social interaction	0.50	9.22	2	P<0.01
	Moderate space for social interaction	0.57			
	Small space for social interaction	0.43			
Flexibility on the ward level	The ward's design allows flexible layout (by partitioning)	0.54	4.66	1	P<0.05
	The ward's design does not allow flexible layout (by partitioning)	0.46			
Staff Travel distances	Short travel distance	0.59	19.61	2	P<0.01
	Moderate travel distance	0.53			
	Long travel distance	0.38			

Table 8.5 – CBC counting analysis (n = 108)

The most frequently chosen level for each attribute is the first level with significant differences in choices across all attributes. This is not surprising given the fact that levels within each attribute are on an ‘ordinal’ scale; in other words, level one is always better than level two and so on. However this does not mean that level one is twice as better as level two. The exception to this monotonic relationship is attribute 8 ‘Social space’ in which the second level ‘Moderate space for social interaction’ is the most chosen one. This is in keeping with other environmental preference studies in which a U-shaped function where the highest preference is for a medium level is obtained.

As mentioned earlier, the study included two fixed holdout tasks. The results obtained for these tasks confirm the results above. Holdout tasks 4 and 16 showed significant difference for choice on both levels of patients’ privacy with higher preference for level 1 ‘High level of patient’s privacy’ (X^2 = 71.7, df = 1, p<0.01). In addition, holdout tasks 10 showed significant differences for choices on both levels of the two attributes examined ‘nurses observation’ and ‘control over the environment’ (X^2 = 104.04, df = 1, p<0.01).

The next stage in counting analysis is to check all two-way tables generated by the counting programme between levels of each two attributes. It was anticipated that there could be an interaction effect between the two attributes Patients’ privacy and Nurses observation, but this effect has been shown to be not significant (X^2 = 3.73, df = a, p>0.05). Table 8.6 shows the counting analysis and Chi-square for the only pair of attributes that showed to interact significantly (i.e. Infection control x Nurses Observation).

Infection control	**Nurses Observation**	**Counts**
Maximum control of cross infection risk	Good nurses observation	0.92
Maximum control of cross infection risk	Moderate nurses observation	0.73
Maximum control of cross infection risk	Poor nurses observation	0.51
Moderate control of cross infection risk	Good nurses observation	0.49
Moderate control of cross infection risk	Moderate nurses observation	0.29
Moderate control of cross infection risk	Poor nurses observation	0.06
Interaction Chi-Square	9.16	
D.F.	2	
Significance	p < .05	

*Table 8.9 – Counts for the interacted attributes: Infection control * Nurses observation (n = 108)*

In spite of the intuitive measure of the impact of each attribute level on overall choice that counts provide, counting analysis does not give a clear picture of preferences and it should not be used as a final base for decisions, rather, estimating utilities using one of the three widely used methods (i.e. Aggregated Logit, Latent Class and Hierarchical Bayes estimation of utilities) can result in a more robust understanding of the phenomenon under question. One of the drawbacks associated with counting analysis is the distortion in counts proportion as a result of random imbalance in the design (e.g. the number of times each level was displayed in the survey) particularly if it is associated with a small sample size (Orme, 2007a).

8.4.3 Utilities estimation

The default method for utilities estimation in SMRT is Aggregated Logit. It uses a multinomial logit analysis method to estimate part worth utility which is a measure of relative desirability or worth. Higher utility means more preferred levels which have a large positive impact on influencing respondents' choice.

In this method of utility estimation the value produced for each level is the average utility value for all respondents. Combining data from individuals may obscure important aspects of the data. As explained by Orme (2004, page 25), this is because of the following reasons:

- *"Since no utilities were available for individual respondents, it was hard to use the choice data to develop market segments based on choice behaviour.*
- *In an aggregate analysis, the logit model assumes that the only variability among respondents is random, indistinguishable from response error. If there really are distinct segments, consisting of groups of respondents who are relatively similar to one another but who differ from group-to-group, then the aggregate model will not be appropriate."*

Latent Class (LC) and Hierarchical Bayes (HB) estimation of utilities were employed in conjoint studies to address these limitations. LC estimation of utilities attempts to group respondents into clusters based on the probability of each respondent's utility value of belonging to each cluster. In other words, it allows the discovery of groups of individuals who respond similarly to choice questions, however, it fails to provide individual-level estimation (Orme, 2000). Contrary to LC, HB estimates utilities at the individual level. HB estimation of utilities has shown to produce more accurate and stable models as it improves the reliability and predictive validity of the model (Orme, 2000).

SMRT does not generate HB estimation of utilities; instead, CBC/HB software was used in this study for HB estimation. Then the resulting file was imported into SMRT and used in the market simulator. Based on the individual-utilities of each level in each attribute, SMRT calculates attributes' importance in the simulation output. As Orme (2007a, page 668), described, '*The importance of an attribute is defined as its weight, or the maximum influence it can have on product choice, given the range of attribute levels defined in the study*'. Figure 8.6 shows the average importance of each hospital ward design criterion included in the study as calculated using the HB estimation of utilities (the ten attributes scores sum to 100). Orme (2007a) suggested that attributes' importance which resulted from averaging the individual importance for respondents (based on HB utilities) is better than computing importance from average utilities (which is based on aggregated logit), especially when summarizing attribute importance for groups. As a consequence, this method was used in this thesis to calculate attributes' importance.

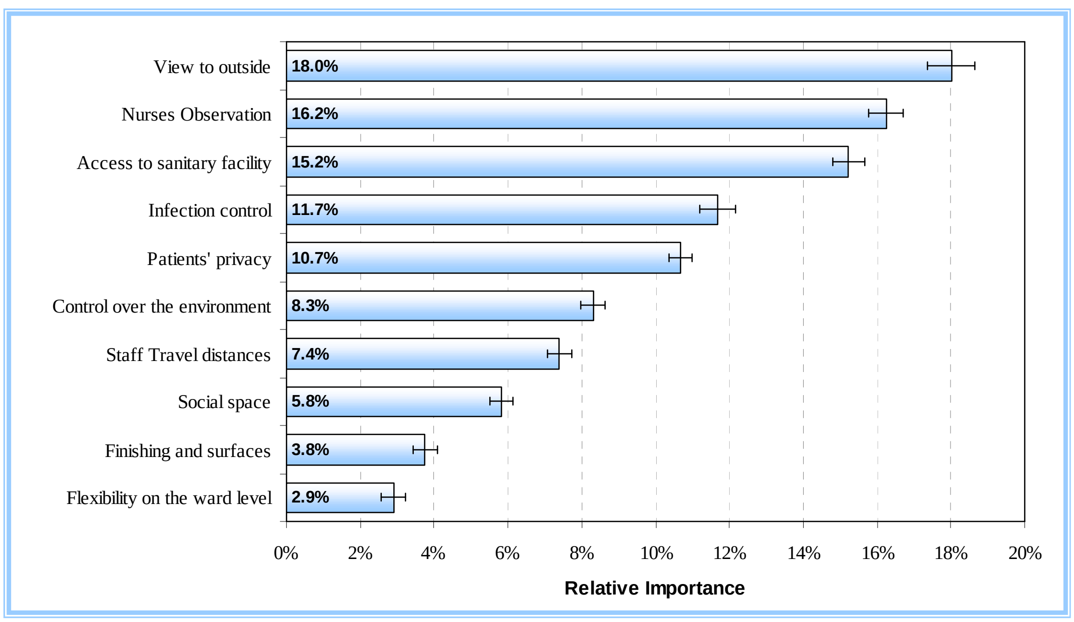


Figure 8.6 – Attributes' relative importance on rank order

View to outside has been shown to be the most important design criteria among the ten criteria considered in the study. Surprisingly, infection control was placed in the fourth place with a notable reduction in the relative importance (11.7%) compared with the first three attributes (view to outside: 18%, nurses observation: 16.2% and access to sanitary facility: 15.2%). A possible interpretation of this is that infection control has not been perceived as a top priority design function for architects, contrary to nurses' observation which was placed second on the importance scale. It can be argued that infection control and nurses observation are both related to patients' safety.

Architects prioritised patients' privacy in the fifth place when it is placed within other environmental constrains and design criteria associated with the design of hospital wards. Figure 8.7 shows the average conjoint utilities of patients' privacy levels (obtained from SMRT). In order to check if the differences between the utilities of privacy levels are significant, t-test was conducted using the individual-level utilities that resulted from HB analysis. This was done using SPSS. High level of patients' privacy is valued more highly than moderate level of patients' privacy with a significant difference ($t = 11.191$, $df = 107$, $p<0.01$). Similarly, moderate level of patients privacy was significantly preferred over low level of patients' privacy ($t = 21.067$, $df = 107$, $p<0.01$). The change from low level of patients' privacy to moderate level seems to be more important than the change from moderate to high level of patients' privacy.

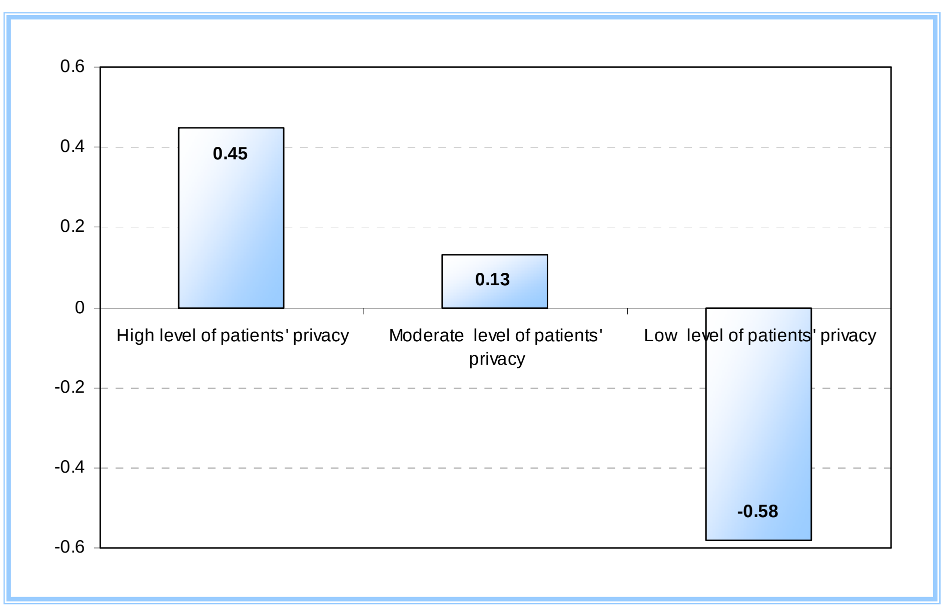


Figure 8.7 – Average conjoint utilities for patients' privacy

A comparison between the utilities of two levels in two different attributes could have a particular implication and advice for policy makers. To explain, if the differences between the utilities of levels 1 and 2 in attribute A is more than that for levels 2 and 3 in attribute B, this tells policy makers that improving attribute A to meet levels 2 in more important than improving attribute B to meet level 3.

Accordingly, it is useful in this context to compare the differences between the levels of patients' privacy and the differences between the levels of nurses' observation as this has been a major topic for the debate on single-bed rooms and multi-bed bays which was discussed in chapter 2. Similar comparisons are possible between each pair of attributes.

Figure 8.8 shows the average conjoint utilities of nurses' observation. Good nurses' observation is significantly preferred over moderate nurses observation ($t = 23.726$, $df = 107$, $p<0.01$) which is in turn significantly preferred over poor nurses observation ($t = 27.93$, $df = 107$, $p<0.01$).

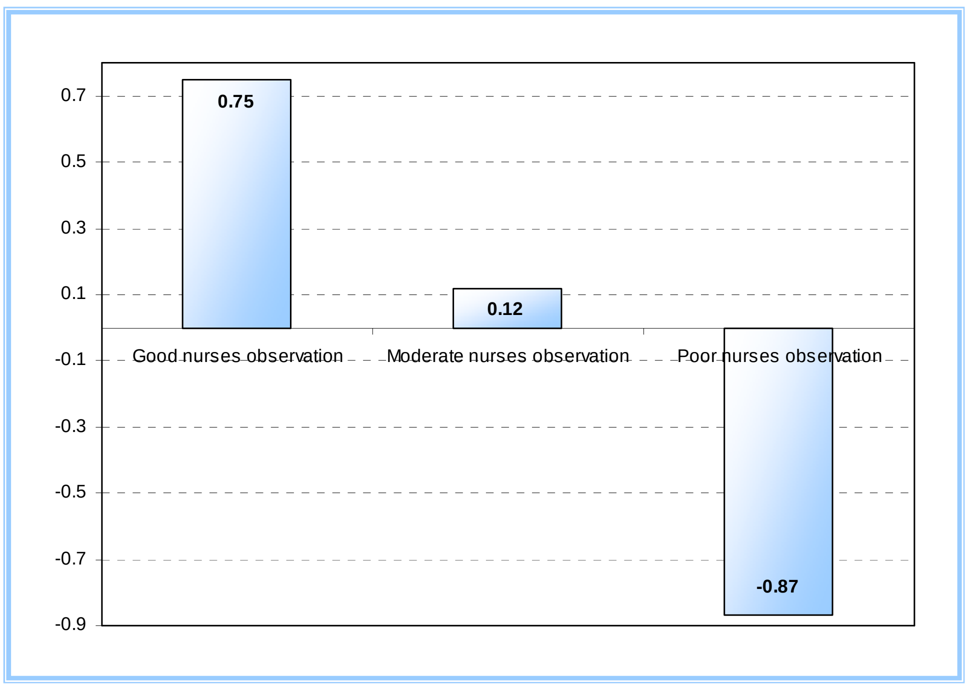


Figure 8.8 – Average conjoint utilities for nurses' observation

The changes between levels of nurses' observation (poor to moderate and moderate to good) are more important than the changes between levels of patients' privacy. This indicates that in general architects prioritise better nurses' observation over patients' privacy. However, this type of comparison does not tell about the significance of differences between these changes. Hence, two dummy variables were created in SPSS using the individual utilities. The first is the difference between the individual utilities between the two levels: Moderate nurses' observation and Poor nurses' observation (V1 = Level 2 - Level 3 of nurses' observation). The other is the difference between the two levels: High level of patients' privacy and Moderate level of patients' privacy (V2 = Level 1 – level 2 of patients' privacy). K-S test showed that these two variables are normally distributed (V1: K-S Z= 0.67, p = 0.76, n=108; V2: K-S Z= 0.48, p = 0.97n=108). Hence, a paired-samples t-test was run. There is a significant difference between the two variables (t= 14.2, df= 107, p<0.01). This indicates that the change in utilities from poor to moderate nurses' observation is significantly different from the change from moderate to high patients' privacy. Variable one was then compared to the change in the utilities between Moderate level of patients' privacy and Low level of patients' privacy. T-test showed that this difference is significant (t= 6.99, df= 107, p<0.01). To explain, achieving moderate nurses' observation was prioritized significantly higher than achieving high and moderate patients' privacy. This comparison is possible between each two pair of levels across all attributes.

Reflecting this on the debate on single versus multi-bed rooms results in an interesting interpretation. In spite of the widespread trend towards single bed rooms as discussed in chapter 2, architects still prioritise design criteria that support multi-bed bays (i.e. better nurses' observation) over design criteria that support single-bed rooms (i.e. patients' privacy). As a consequence, this suggests that in general multi-bed bays are preferred by architects. However, this interpretation involved a comparison between two design criteria only. This needs to be extended to involve all possible pair comparisons before a final conclusion can be drawn.

In this study cost variation was not included as a factor in the conjoint results associated with different design attributes. Further exploration of the conjoint data is possible in many ways, especially the individual-level utilities which can be analysed in more detail using SPSS or Latent Gold.

8.4.4 Segmented analysis

After the analysis of the data across all respondents, it is useful to analyse segments of the sample who are united by a common characteristic using the segmentation facilities offered by SMRT. Some of the demographic data which were collected in the first section of the survey were used in this segmentation analysis.

Although six segmentation questions were included in the questionnaire, the following analysis focuses on the segments based on two respondents' characteristics: previous experience of hospital design and previous experience of being a patient in hospital ward. The latter is particularly important given the discussion in the previous chapter which showed that previous experience of being a patient in a hospital ward affects notably how some experts in ward design valued patients' privacy. However, this was noted in the interviews with the Syrian experts only. Those who previously experienced staying in a hospital ward were expected to value patients' privacy higher than those who have not.

Figure 8.9 shows the results of the first segmented analysis using the question: Have you been involved in hospital design? (Yes, No), this is the average relative importance each group gave to each design criterion.

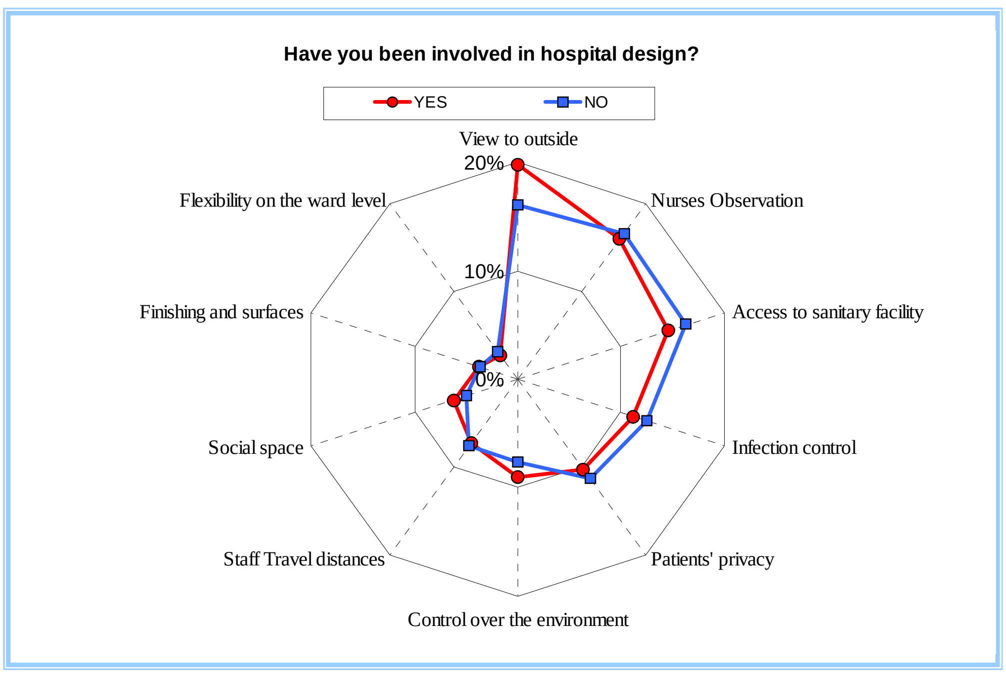


Figure 8.9 – Attributes' relative importance in relation to previous experience of hospital design

View to outside was considered as the most important design criterion by the architects who have been involved in hospital design with a noticeable drop in importance value of the second important criteria (i.e. nurses observation), while architects without previous experience in hospital design rated nurses observation as the most important criterion. However, access to sanitary facility and view to outside are only marginally less important than nurses' observation for those architects. Both groups rated flexibility on the ward level as the least important criterion. Patients' privacy was rated as the fifth important design criterion by both groups. However, Architects who stated not having been involved in hospital design valued patients' privacy slightly higher than those who had (Yes: 10.32, No: 11.36). It can be argued that the information available with regard to hospital and ward design (e.g. guidelines) have not contributed positively to improve architects' awareness of the importance of patients' privacy in hospital ward environments.

Figure 8.10 shows the results of the second segmented analysis using the question: Have you stayed in a hospital ward as a patient? (Yes, No). Again, this is the average relative importance each group gave to each design criterion.

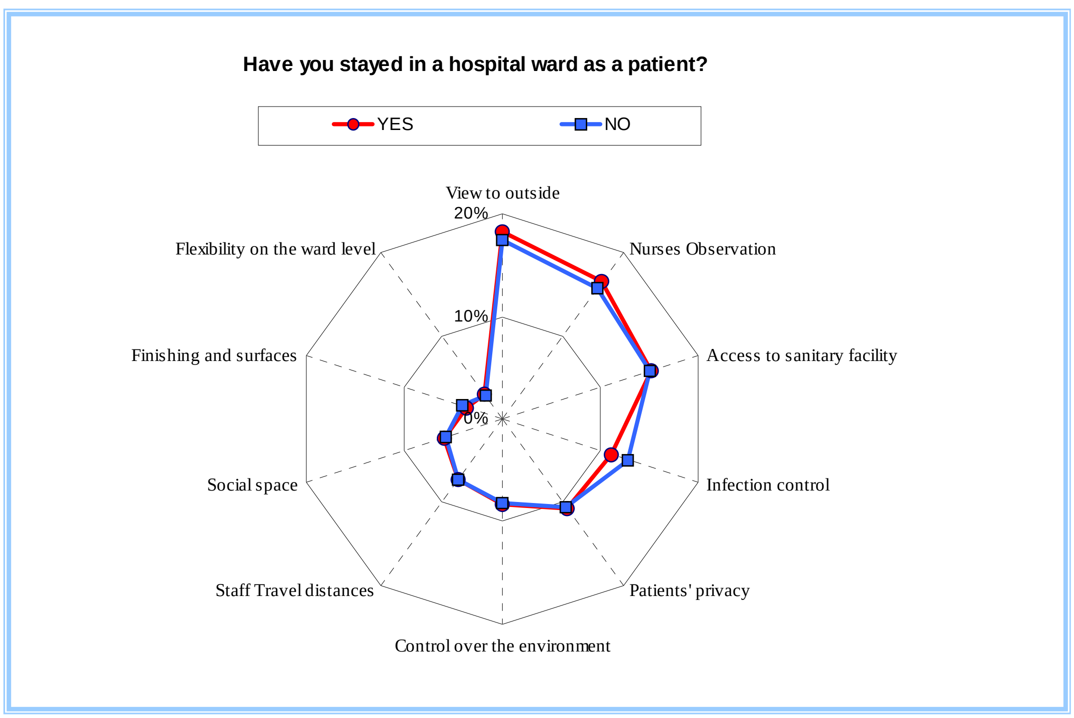


Figure 8.10 – Attributes' relative importance for previous experience of being a patient in a ward

Both groups seem to follow the same trend in preference for the attributes of interest. This segmented analysis does not show any noticeable differences in attributes' importance between the two groups as the differences between the two groups are mostly marginal. View to outside was rated as the most important attribute by the two groups and flexibility on the ward level as the least important one. The highest variation seems to be in the importance of infection control. Patients' privacy was rated as the most fifth important design criteria by the two groups. Contrary to the expectations which were based on the results of the interviews with experts on hospital design, previous experience of being a patient in a hospital ward does not change, or significantly affect, architects' perception of the importance of patients' privacy in ward settings. Moreover, chapter six showed that people with experience of being patients in hospitals are more likely to have lower privacy preferences than those who have not been in a hospital previously.

The previous segmented analysis has utilised the average of the relative importance for each attribute. This type of data does not provide information about the significant differences between the two groups in terms of attributes' importance. Alternatively, the individual relative importance (i.e. the relative importance each respondent gave to each attribute) was calculated using MS Excel to check if the differences between the groups are significant or not using the Mann-Whitney U test, Table 8.10.

		Patients' privacy	**Infection control**	**Nurses observation**	**Access to sanitary facility**	**View to outside**	**Finishing and surfaces**	**Control over the environment**	**Social space**	**Flexibility on the ward level**	**Staff Travel distances**
Experience of hospital design	Mann-Whitney U	1016	1132	1194	1040	995	1281	1169	961	1190	1224
	Wilcoxon W	3501	3617	3679	3525	1736	3766	1910	1702	3675	3709
	Z	-2.020	-1.274	-.875	-1.866	-2.155	-.315	-1.036	-2.374	-.901	-.682
	Asymp.Sig (2-tailed)	.043*	.203	.382	.062	.031*	.753	.300	.018*	.368	.495
Experience of being a patient in a ward	Mann-Whitney U	1197	980	1033	1188	1142	1062	1211	1201	1111	1153
	Wilcoxon W	1725	3906	1561	1716	1670	3988	1739	4127	1639	1681
	Z	-.128	-1.588	-1.231	-.188	-.498	-1.036	-.034	-.101	-.706	-.424
	Asymp.Sig (2-tailed)	.898	.112	.218	.851	.619	.300	.973	.920	.480	.672

**significant at the 0.05 level*

Table 8.10 – The differences between two segments of the sample (experience of hospital design & experience of being a patient in a ward) in the relative importance of design criteria

Previous experience of being a patient in a hospital ward is not associated with differences in the importance values. However, experience of hospital design does affect the importance of patients' privacy, view to outside and social space. One interesting finding is that architects who have not been involved in hospital design have valued patients' privacy higher that those who have (Yes: mean rank = 50.01; No: mean rank = 62.76), as shown in Figure 8.11, which illustrates as well that those with experience of hospital design are more likely to be more confident about the most important design criterion from their point of view.

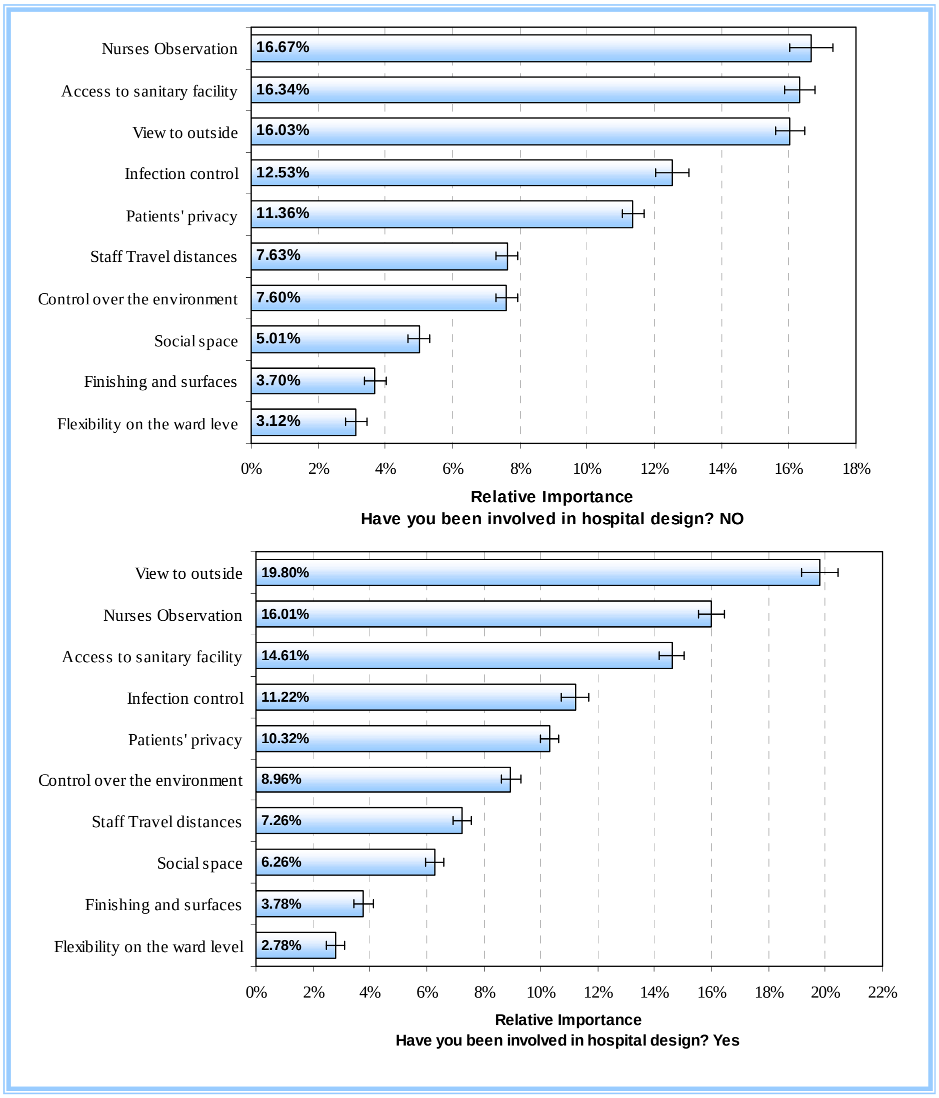


Figure 8.11 – Attributes' relative importance according to previous experience of hospital design

8.5 Discussion and Conclusions

Choice-based conjoint analysis has been shown to be an efficient method for measuring architects' preferences in hospital ward design criteria when different information is presented together. Its capability of quantifying the importance that architects give to different design criteria based on them making relative choices between alternative situations simulates what architects do in a real design routine. This was one of the main reasons for not using a multi-criteria decision making (MCDM) method, which was presented in the early stages of this thesis as a possible method to be used, namely Analytical Hierarchy Process (AHP) (Saaty, 1980), since one of the method's software packages was available for the researcher (i.e. Expert Choice 2000). Although AHP has been used in many research papers and in different subjects, it has its drawbacks. One of the main limitations of AHP with regard to the context of the current study is that it is based on pair comparisons between each two criteria of interest rather than complex alternatives based on different criteria that formulate a situation. As a consequence choice-based conjoint analysis has proven to be useful in addressing objective number four of this thesis. In addition, the segmented analysis offered the possibility to investigate the preferences of different strata of the sample and individual-level estimation of utilities using HB allowed further investigation using other statistical techniques (using SPSS).

The web-based approach by which the study was administered was supported by the assumption that this approach may increase the response rate and help to reach the target sample. However, one of the limitations associated with this study is the relatively low response rate. Although this study would have achieved a lower error in utility estimation if 200 responses had been completed, it is still highly efficient (at 99.9%) with the achieved 108 completed responses. Orme (2006) found that sample size for conjoint studies in marketing research is generally more than 150, however he recommended a sample size of between 30 to 60 for investigation work, which this study amply exceeds.

The results of the conjoint analysis showed that architects' first priority is to create a good view to outside when they design a hospital ward (this is true with regard to the ten design criteria considered in this study). On the other hand, they value flexibility on the ward level the least among the ten attributes. Patients' privacy was valued as the fifth in the importance scale. In addition, the general prioritization for nurses' observation over patients' privacy suggests a general preference for multi-bed bays rather than single-bed rooms in spite of the trend for single-bed rooms. This raises the significance of improving the environmental conditions in multi-bed ward environment especially patients' privacy.

Reading the guidelines that are related to ward design has not increased the value that architects give to patients' privacy within the other constrains associated with ward design. A possible interpretation of this is that the available guidelines do not provide a framework to assess design proposals in terms of patients' privacy which can be understood and used by architects. This emphasises the importance of the findings reported in chapter seven which linked one facet of privacy in hospital wards (i.e. locational preference for privacy) to a quantitative description of spatial environments (VGA measures), which was shown to be a promising approach to formulating the bases for a wider framework by which different facets of privacy in hospital wards can be assessed. This requires a study on a wider scale.

Chapter Nine:

Conclusions

9.1 Introduction

Research examining the relationships between the architectural design and people preferences and needs in hospital settings has focused on the effect of the physical environment on the healing process. However, little attention has been given to the role of spatial location as one facet of privacy. This is in spite of the wide recognition of the importance of patients' privacy for the physical, mental, emotional and spiritual well-being of patients, especially in multi-bed wards. In addition, it would seem that there is no comprehensive measure or framework to assess people's privacy and preferences in this situation nor information to guide designers.

This study is the first instance exploring the impact of the spatial layout on the subjective experience of space in multi-bed wards, i.e. locational privacy. The study has three features: first, it employed a quantitative tool from Space Syntax, namely Visibility Graph Analysis, to assess the impact of the layout, which is both important and under the control of architects or designers, on people's locational preference for privacy. Second, it explored the users' (potential and actual patients) opinions about their privacy preferences as a contribution to the planning and design of the ward environment by the architects and medical staff. Within this it is also explored cultural and demographical differences. And finally, it provided an insight into professional architects' priorities of ward design criteria, which may help policy makers to develop hospital design regulations and guidelines.

This last chapter merges the main findings of the previous chapters and links them to the main objectives of the thesis. It also summarizes further findings which have resulted from the research process. Following this, the research limitations, recommendations for future research and contribution of this research are presented.

9.2 Conclusions

The thesis's main emphasis has been developed from the literature review. This was carried out as a first stage of this research to gather essential knowledge about the topic, justify the research direction and define the research approach.

In reviewing the literature on hospital design, in chapter one, it became evident that while achieving the clinical functions in a hospital environment is paramount there has been a tendency to move from utilitarian design to a more 'humanized' hospital environment, the physical environment that is responsive to the end-users' needs and preferences. This has been reflected in the historical development of hospital design in the UK as well as in different recent proposals and approaches to design, e.g. patient first approach; healing environments; patient's control over the environment and evidence-based design. The emphasis here is that the process of hospital design should give an opportunity for patients, as the targeted end-users of hospitals, to define a future vision for their hospitals. Public engagement can be of vital importance in providing a renewed sense of the spatial design in hospital settings.

Within this context, the literature suggests patients' privacy as a central concept, especially in open wards. The importance of patients' privacy has been emphasised in most guidelines and regulations that are related to the internal design of hospital environments (see chapter two). Hospital wards seem to be the most relevant department with regard to patients' privacy preferences, as patients spend most of their time in wards and are articulate about their surrounding physical environment. This was supported by the findings in chapter five, which showed that people are aware of their privacy needs in hospital wards and, equally importantly, a better level of privacy was found to be the main reason for people's choices of wards they wished to stay in.

As a consequence, the concept of privacy was reviewed in the human-environment relationships literature and the importance of providing an adequate level of privacy for patients in open ward was surveyed. This showed that privacy is a multi-faceted basic human need which associates with effective individual and group functioning. It has been shown to encompass universals and specific aspects. For example, demographics, cultural backgrounds and previous experience of space were linked to variability with respect to different facets of privacy (see chapter three). In terms of the relationship between privacy and the physical environment, privacy was seen as a function of the five senses among which visual privacy was identified as crucially linked to the spatial design of an environment. This is due to the fact that our visual system is significantly restricted by the organization of that environment. This suggests that people adjust their location in space according to their privacy preferences. As a consequence, it was hypothesised that locational preference for privacy is directly linked to the spatial arrangement of an architecturally bounded configuration. This seems to be more significant in an open ward environment where patients are likely to experience lack of control over their environment and, probably, a violation of their visual privacy. This is consistent with the finding reported in chapter five. It was found that visual privacy was considered as crucial in multi-bed wards by the participants in comparison to auditory privacy. Activities in open wards that may cause violation of visual privacy were considered as potential sources of stress and nuisance for patients significantly more than those activities which may cause a violation of auditory privacy.

In spite of the former findings of the literature review in the field of hospital design and environmental psychology, as well as the findings of this research, it seems that there are no frameworks or design guidelines that link the spatial design of hospital wards and patients' preferences for locational privacy, nor information about designers' awareness of the importance of patient's privacy as a ward design criterion. This led to the formulation of the thesis's objectives which were met as follows:

I. *To explore the relationships between people's preferences for locational privacy in multi-bed wards, and the corresponding spatial attributes calculated by space syntax.*

The complex nature of the concept of privacy in general and its interrelationship with the spatial design of open wards in particular, pose unique methodological problems for the researcher. The type of methodologies traditionally employed in research related to privacy, i.e. survey, questionnaires and interviews, prove inadequate for the current research. There has been a lack of environmental measures such as the impact of the layout that are both important and under the control of architects. In addition, models dealing with physical environments as facilitators of visually conveyed information are essentially local, i.e. visual/exposure model and isovist (see chapter three). On the other hand, the evidence from space syntax is that the global spatial structure is a prime determinant of human-environment relationships. This suggested space syntax as a potential approach by which the first objective of this thesis could be addressed.

Reviewing the literature on space syntax and its associated analytical techniques suggested Visibility Graph Analysis (VGA) as an appropriate method for the current study (see chapter four). This was for two reasons: first, it can capture the spatial properties at a finer scale compared with other techniques such as axial lines. Second, it has demonstrated high efficiency in describing the relationship between some aspects of human-environment interaction in buildings, e.g. movement. As a consequence, six generic ward types of hospital open wards were analysed using VGA and spatial attributes were calculated at ward and bed levels for each case study. Subjects provided patterns of preferred and non-preferred locations for privacy. This was then analysed statistically as described in chapter six.

The findings of this study reveal a clear systematic relationship between the plan configuration of open wards and desired goal of ward design, i.e. privacy of patients. All the spatial attributes calculated by VGA significantly discriminated preferred from non-preferred locations. Two independent dimensions were found to underpin people's choices for locational preferences for privacy, which were best represented by two spatial attributes: Integration, which is a global measure, and Control, which is a local measure. This suggests that the relationships between spaces in the spatial structure as a whole do matter in this context as well as the relationships with the immediate surrounding spaces. This was confirmed by the analysis of variance which showed that significant choice locations are determined at the level of wards, beds within wards and ward-bed interactions.

It was found that at a ward level people's preference for greater privacy is for wards with lower integration and higher control values. However, within any ward the consistent choice for privacy was for the combination of lower integration and lower control locations. This was evidenced in all ward types except for control values in the radial ward type. The architectural design of the ward itself appeared to be the reason behind this variation. Locating patients in low visual control zones and at the same time creating a central zone that is visually dominant seemed to affect patients' sense of control negatively.

This particular finding seems to have direct implications for the architectural design of hospital wards. It suggests that locating a nurses' station in one central area with ultimate visual control over bed locations which in turn have significantly less visual control may result in reducing patients' sense of privacy. Rather the architectural design of an open ward should provide better balance between nurses' observation and patients' sense of visual control. This can be done with regard to control values by taking two steps: first, the nurses' stations should be distributed in the ward in different areas, and second, bed locations should have visual control over other spaces in the ward such as social space and circulation area. If the architectural design of an open ward achieves these two recommendations, the control values of nurses' zones and of bed location are likely to be more balanced without reducing the level of nurses' observation. This can reduce patients' sense of lack of visual control and, as a consequence, improve patients' experiences in terms of visual privacy in open wards as well as maintaining a good surveillance. However, this needs to be balanced with other requirements in the ward settings, e.g. nurses travel distance.

Further evidence suggested integration as the best predictor of, and strongest discriminator between, preferred and non-preferred locations across the six case studies as well as at the individual wards' level. This in turn supports the space syntax's claim that the global spatial structure is crucial to understand the human-environment relationships.

It would seem then that in terms of manipulation of the spatial properties, integration and control are relevant to people's spatial preferences for privacy. However, when it comes to prediction, integration is the only relevant spatial attribute and hence may be more useful in assessing design proposals in terms of locational preferences for visual privacy.

Given the former findings and the findings of the literature review (in chapter three), which suggested a link between aspects of privacy and demographics, cultural background and previous experience of space; the second objective of the thesis was formulated as follows:

II. To assess the effect of the spatial attributes of the layout (i.e. multi-bed wards) on the identification of subgroups of people with different privacy preferences.

The findings from the series of analyses, in chapter six, that involved demographics, cultural backgrounds and previous experience of hospital wards as well as the spatial attributes, supported the effectiveness of using the spatial attributes, i.e. integration and control, to capture spatial differences across one aspect of special preference, namely locational privacy.

The results suggested a universal preference for spatial location of privacy across culture, age and gender and a specific significant difference in locational privacy as a result of previous experience of hospital wards (see chapter six). From the architectural perspective, this does not suggest a universal design but rather it suggests a universal spatial structure which corresponds to this particular preference. This, however, in turn needs to be balanced with other environmental constraints associated with the design of hospital wards.

It was found that people are likely to overestimate their privacy needs in hospital wards before having hospital experience. People who experienced being patients in a ward choose as their preference beds with higher integration values (i.e. less privacy) than those preferred by people without experience as a patient, and the disliked beds they identify have lower integration values (i.e. more privacy) than those disliked by people without experience as a patient.

In summary, systematic findings with respect to plan configurations are not only important in themselves but also they provide the context within which detail design choices can be made (in this case to increase or decrease privacy) to reinforce spatial properties inherent in the basic design itself. In addition, they may capture the variation with regards to different variables i.e. demographics, cultural background and previous experience of space.

However, the possibility of applying such proposals in the design process of hospital open wards is pretty much related to the available guidelines and regulations that are related to hospital ward design criteria. These are usually written by experts in the related subject. Accordingly, the third objective of this thesis was:

III. To identify criteria of hospital ward design at two levels: formal ward design criteria and the criteria that seem to be important to experts in ward design.

A comprehensive survey of the available regulations and guidelines in the UK with regard to hospital design in general and ward design in particular revealed the availability of a wide range of aspects that have been dealt with in detail as reported in chapter seven. Amongst these are NHS toolkits (i.e. AEDET, ASPECT, IDEAs and NEAT), which appeared to provide a comprehensive source of ward design criteria which includes design criteria that are related to both the architectural design and patients' environment.

NHS toolkits were surveyed and analysed. In total, 128 design criteria were identified. These were then classified to establish a hierarchy of design criteria in a way that these design criteria can be presented in more accessible manner to architects. Due to the large amount of design criteria collected, a filtering system was proposed. Design criteria were filtered qualitatively against five aspects in a hierarchical manner: hospital architectural, then ward design, then ward spatial arrangements, then privacy and finally visual privacy. The resulting tool, which was reported on in chapter seven, may be used by architects as a decision making aid in the design process of hospital wards. In addition, it may help NHS Trusts to prioritize their requirements in the briefing stage of a hospital project.

Out of the available ward design criteria, ten criteria were seen to be important by experts with experience in ward design from the UK. These were: patients' privacy and dignity, infection control, good observation, access to sanitary facility in a dignified way, good view to outside, good finishing and surfaces, giving the patient the control over the environment, creating enough social space, flexibility on the ward level and short travel distances.

It was found that ward design criteria that are related to patients' safety - i.e. infection control and nurses observation - are more likely to be perceived by experts as the most important criteria. In general, design criteria related to patients' psychological needs and preferences were considered as important. Particularly view to outside was seen as crucial for patients' well-being.

Experts showed reasonable awareness of the relationships between patients' privacy and the architectural design of a hospital ward. Patients' privacy was found to be highly important for experts as a ward design criterion. In fact, this has been reflected in the related guidelines and regulations in which patients' privacy has been widely emphasised.

Given the fact that design process involves prioritizations and trade-offs between the different design criteria by architects and the complex clinical function of hospital wards, the fourth objective of this thesis was:

IV. To explore architects' priorities in relation to ward design criteria, in order to evaluate their awareness of the importance of patients' privacy in hospital wards.

This study is the first instance, that the researcher is aware of, that uses conjoint analysis (CA), the technique that has been used widely and developed in marketing research context, to estimate subjective trade-offs that architects make during a design process. Choice based conjoint analysis (CBC) was found to be an effective technique to explore architects' prioritization of different design criteria, (or a particular design criterion such as patients' privacy), when they are placed within other environmental constrains and other design criteria associated with the design of hospital wards. The reason for this seems to be that CBC simulates what architects do in a design process, which involves some mix of rationalisation, intuition and preference before arriving at a decision.

The ten ward design criteria, which were seen as important by experts, were used for the conjoint study. View to outside was found to be the most important ward design criterion. In other words, in the ward design process architects are likely to strive to design wards that provide a pleasant view to patients as a top priority, even if this requires delivering a lower level of other design criteria. In fact, this was reflected earlier not only in the opinion of experts who considered view to outside as an important design criterion but also in the literature which suggested that views to a pleasant landscape are likely to contribute positively to the healing process and patients' satisfaction (see chapter two).

One unexpected inconsistency between experts' views and architects' prioritization is the importance of infection control as a ward design criterion. While experts considered infection control as the most important ward design criterion along with nurses' observation, it was given the fourth place on the importance scale by architects, whereas nurses' observation was seen as the second most important design criterion after view to outside. It would seem then that architects concerned with a ward's architectural design may not perceive infection control as an important ward design criterion under their control. It can be argued that infection control seems to be related to ventilation and cleanliness strategies in wards rather than being an architectural function. Nevertheless, this is related to the hospital planning at the early stages.

The results have shown that patients' privacy was prioritised in the fifth place by architects among the ten design criteria considered in this study. This reflects a reasonable awareness among architects of the role of architectural design in providing opportunities for patients' privacy. However, improving patients' privacy from low to moderate was considered to be more important than from moderate to high. This in turn indicates that in spite of the wide emphasis in the guidelines on providing the best possible level of patients' privacy in ward settings, architects still underestimate its importance for patients. This was supported by the segmentation analysis which showed that patients’ privacy was prioritised in the fifth place by both groups of architects, those who have been involved in hospital design previously and as a result read the related guidelines, and those who have not. The current guidelines in ward design, in spite of the frequent emphasis on patients’ privacy, do not seem to improve architects’ awareness of the importance of patients’ privacy in wards. This may be related to the absence of a framework that is based on adopting a spatial design, which architects can deal with fluently, to address patients’ privacy preferences.

The findings related to the first and second objectives take a step forward towards establishing a framework by which design proposals can be assessed against aspects of visual privacy in open wards, using a language that can be understood by architects. However, being an exploratory study, this thesis does not aim to achieve a coherent framework in this context; rather it proposes the possibility of doing this. In particular it presents space syntax theory and its particular technique, namely Visibility Graph Analysis, as a promising method, that is useable and comprehensible by architects. This may stimulate design proposals that meet people’s psychological needs and preferences that are related to the architectural design of building (in this case locational preference for privacy in open wards).

Analytical techniques such as space syntax are not necessarily generative within the complex design process. Conceptual ideas on design can of course arise from many rational and non rational sources. However, while the source of ideas for design may be opaque (even to the designer), there is broader agreement on the need for transparent methods for evaluating design proposals. It is here where space syntax is probably most useful to provide feedback on the consequences of design proposals for subsequent evaluation and modification.

9.3 Further Findings

This section summarizes further findings which have resulted from the research process in addition to findings related to the author's interest. This can be split into the following two subsections:

- *Single versus multi-bed wards*

The use of single-bed rooms versus multiple occupancy rooms in acute care environments has been the subject of long-standing debate in both academia and practice. In spite of the wide emphasis in the literature on the advantage of single-bed rooms over multi-bed bays for patients, it would seem that it is not something which has been universally agreed upon.

The strong trend towards 100% single-bed hospitals has been supported by the claims that single-bed rooms are better for patients in terms of infection control, creating therapeutic environments, and providing a better level of patient's privacy, as well as to NHS Trusts in terms of reducing recovery time with no associated extra cost in both capital and running cost. The debate, however, extended to include a wider scope, e.g. nurses' observation, fall prevention, space for family support, noise level, etc. However, most of these studies did not include a comparison with a control group. A more recent literature suggested that the claims of the impact of single-bed rooms on patients' outcomes are based on personal opinion rather than evidence. For details see chapter two.

While providing a better level of patients' privacy has been seen as one of the main advantages of single-bed rooms, it was found in this research that people are likely to overestimate their privacy needs in hospital wards before having hospital experience. Admittance to a hospital ward has shown to lower people's preference for privacy to achieve, probably, a better sense of community and less isolation, which in turn may support the provision of multi-bed bays in addition to single-bed rooms (see chapter six). This was supported further by a finding in chapter five that experience of being a patient in a hospital ward was found to improve the attitude towards multi-bed wards.

Mixed results are apparent in the literature in terms of patients' preference for single- and multi-bed wards. Some results of this research may support the proposition that there are a significant proportion of people who prefer to stay in multi-bed bays. For example, it was found that older people and people from a European cultural background, in contrast to those from Arabic culture, have been shown to be more prepared to be accommodated in multi-bed bays (see chapter five).

According to the literature, the provision of a better level of patient privacy is one of the main advantages of single-bed rooms, whereas good nurses' observation is associated with open wards. Accepting this as comparison criteria, both experts in ward design (in chapter seven) and architects (in chapter eight) were found to place more importance on nurses' observation over patients' privacy, which suggests a general preference for multi-bed wards. However, this needs to be balanced with other design criteria supported by each type of ward before a final decision can be made. For example, infection control was considered by architects to be more important than both criteria - i.e. nurses' observation and patients' privacy - whereas experts considered infection control as more important than patients' privacy but as important as nurses' observation.

Given the former evidence from the literature and the current research, the author does not deny the advantages of single-bed rooms for the well being of patients as well as the social and safety reasons behind multi-bed wards. Whether to recommend the use of single- or multi-bed wards for the benefit of patients, a wider scale study would need to be conducted involving control trials before policy makers can arrive at a final decision. Until then, the author can see the benefit behind the proposition of the provision of 75% single-bed rooms with four multi-bed bays providing a balance.

- *Hospital design in Syria*

Being a Syrian architect and driven by his own interest and previous observation, the author conducted a special study within the context of this research to provide an insight into aspects of hospital design in general and ward design criteria in particular within the Syrian context.

It was found, in chapter seven, that in a country like Syria, where the research culture is under development, the available information sources and guideline documents are insufficient in terms of hospital design. This has resulted in less attention being given to human needs and preferences in hospitals, particularly in wards, and predominantly utilitarian hospitals being designed and built. Experts in hospital design perceived wards as a response to the clinical functions required in these wards and disregarded design criteria that are related to creating healing environments by responding to people's needs and preferences in hospital settings. The reason behind that is, most probably, a complex matrix of social, economic and educational factors.

In spite of its importance, researching aspects of patients' privacy does not seem to be a priority in the current condition of the Syrian healthcare system and facilities. In fact the healthcare system needs to be reviewed in the Syrian context in a systematic manner which takes into account political, social, economic and environmental effects. This may start from the demographical study of the population to identify the types and numbers of healthcare building required, to the description of detailed design criteria that can be literally used within the limitations imposed on the Syrian context.

Nevertheless, such a system is available in Syria but, however, it needs to be updated with new knowledge and technology, and here is where learning from others' experience, such as the UK's, can provide inputs to the development of healthcare buildings in Syria. This requires in the first instance the will of policy makers to influence change by dedicating the required funds and time to allow experienced multidisciplinary teams, preferably from the Syrian context, to conduct such a large study. This could propose potential solutions that may contribute to the development of healthcare facilities and produce best practice guidance in healthcare building design that is responsive to the Syrian context.

9.4 Research Limitations and Further Research

This research has spanned a wide variety of research areas including hospital design; environmental psychology; privacy theories; spatial analysis techniques and space syntax. Hence, a wide range of suggestions can be drawn from the thesis. However, research projects have some limitations in general. These can be related to many factors, such as: time and funds available; the methods employed for data collection and/or analysis; researcher's interest and background; and, more importantly, the large number of variables associated with research questions which in most cases, especially in social research, make it more difficult for the researcher to produce coherent solutions for the proposed problem(s). Nevertheless, research may provide an insight into a phenomenon in order to allow a better understanding of the reasons for a problem without going further towards practical solutions.

Bearing this in mind, the following bullet points summarize the main limitations of the current research and the corresponding main recommendations for further research:

- This research has focused on one aspect of privacy – locational privacy – but privacy has been shown to be a multi-faceted concept. These findings now need to be extended to studies involving environmental simulations and three-dimensional awareness of space as experienced by hospital users. In addition, the inter-relationships between aspects of visual and auditory privacy in terms of the architectural design require further investigation.

- Although this study has reported a systematic relationship between people's subjective judgments on spatial location for privacy and measures of plan configuration, the investigation was limited to one type of building, i.e. hospital open wards. Further research examining different types of buildings (e.g. open-plan offices) is needed before the results of this research can be generalized in the architectural context.

- Being an exploratory study, no claim is made about the representativeness of the samples (i.e. case studies, people, experts and architects) included in this research for generalisation to the wider population. More research is therefore required before this generalisation can take place. In particular, only two broader cultures (European and Arabic) were considered. In fact, the investigation of universals/differences across different cultures regarding privacy is an interesting area for further research.

- In this research, hospital wards were analysed as spatial configurations. No specific attention was given to the spatial design of the hospital as a whole. As discussed in section 4.3.3, the issue of boundary definition in space syntax literature is still questionable as far as the author is concerned. A potential area for further research is the variation on spatial attributes values as a consequence of different boundary definitions i.e. the whole hospital.

- One practical limitation associated with the use of space syntax is that space syntax techniques and software packages are available for academic and non-commercial use only. Any use for commercial purposes, consultancy or informing a design process should be made through Space Syntax Ltd (SSL). This may limit the ability of the proposed model in this thesis to be used widely by architectural firms.

- Although this research has not been designed to address the issue of the use of single- versus multi-bed wards in hospital, it did provide a significant insight into this topic. However, this seems to be an interesting area for further research given the debate in the literature with respect to the perceived advantages of single-bed rooms over multi-bed bays. A related possibility for further research in this context is the interplay between the architectural design of hospital wards on the one hand and aspects of surveillance and privacy on the other.

- Further research into the different aspects of healthcare facilities in the Syrian context would have practical value. Social, economic, environmental and educational factors need to be investigated to throw light on potential solutions for the current problems associated with healthcare building design in Syria.

In addition to the opportunities for extending the findings of this research outlined above, new areas of research were identified as a result of the research process and the multidisciplinary nature of its approach. These areas are summarised as follows:

Firstly, the exploration of the differences in preferences for locational privacy in relation to the spatial environments between architects and the end users of hospitals (i.e. patients) seems to be an important area for investigation which has practical implications for policy makers. In other words, regulations and guidelines on hospital design in general, and ward design in particular, should close the gap between these two stakeholders' perceptions. Architects, who are key decision-makers in the production of the spatial environment, need guidance and information on how to design wards that are responsive to people's preferences and needs. Hospital ward design would benefit if regulations and guidelines could align designers' perception with people's preferences.

Secondly, research dealing with differences between various groups of patients in terms of types of illnesses and privacy preferences and needs in hospital wards, is an area worth investigating. This may help policy makers to produce different recommendations and guidelines for hospital ward design based on illness types.

Lastly, little is known about the type and function of privacy required in hospital wards. Hence, valuable areas for research could be: firstly, investigating the types and functions of privacy that are required by the patients in hospital wards and secondly, establishing links between them (i.e. which type serves which function). This may provide a deeper insight into patients' needs in hospital wards while enriching our understanding of the nature of privacy and its relationship to the physical environment. This in turn may lead to the formulation of more coherent privacy theories.

9.5 Research, Theory and Design

The questions of whether research can be considered as architectural research and whether its findings can inform a theory and/or have implications for architectural design, are not easy to answer. This seems to be related to the contribution of research findings to knowledge, theory, methodology and learning. In this last section an attempt is made to locate the findings of this research within the context of this debate.

Groat and Wang (2002) identified seven strategies to investigate the connections between human experience and built form or, in other words, seven perspectives from the research methods literature that are applicable for architectural research and architects, aiming at achieving a link between design and theory. Any single strategy or a combination of these can be used to address a research question. The authors produced a framework in a diagram format that helps researchers to clarify the nature and contribution of the research findings as shown in Figure 9.1a.

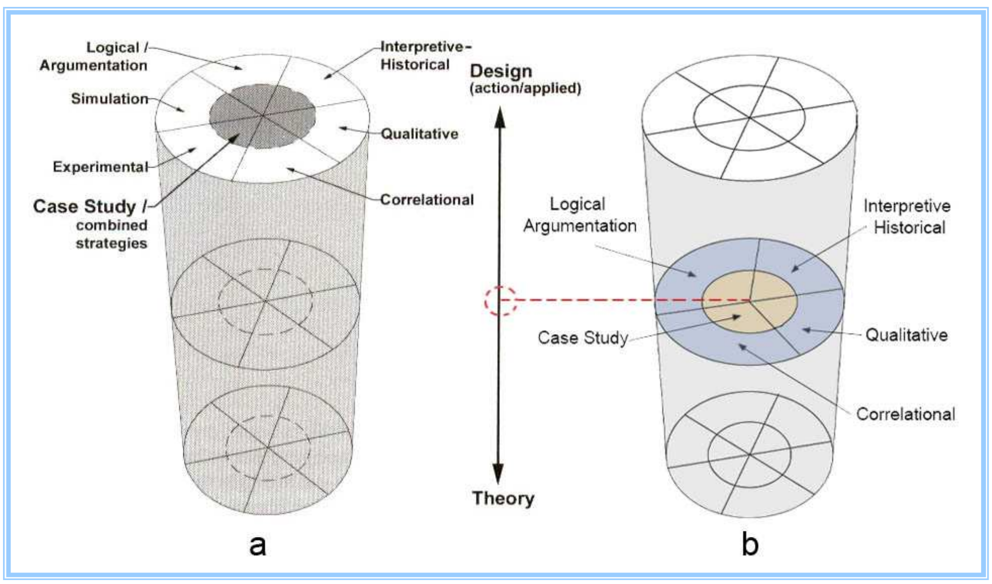


Figure 9.1 –a: A conceptual framework for research methods by Groat and Wang (2002), b: The contribution of this research

Following this framework, this research has employed methods that are related to five perspectives out of the seven proposed as shown in Figure 9.1b. These are: Case studies through the generic ward design types chosen for this study; Logical Argumentation strategy through the use of space syntax which formulates a conceptual system to capture social-cultural values in a mathematical way; Qualitative strategy through questionnaires and semi-structured interviewing; Correlational strategy through the various statistical analyses carried out and relationships found; and finally, Interpretive-Historical strategy though two approaches: first, in the literature survey, policy analysis and the historical development of ward design, and second taking into account the social-cultural factors i.e. demographics and cultural background, and complex context which may affect the phenomenon under question. In doing this, the study contributes to the methodology by introducing a combination of methods by which other aspects of human-environment relationships may be understood. In addition, the research proposes new techniques which are usually used in other fields and applies them successfully to the area of interest of this thesis, i.e. Latent Class to space syntax and Conjoint Analysis to the subjective prioritization found in architectural contexts.

In Figure 9.1b the contribution of this research is placed in the middle of the cylinder indicating its equal input to theory and design. Bearing the limitations reported in the previous section in mind, this thesis formulated a framework by which design proposals of hospital open wards can be evaluated against subjective design criteria, i.e. locational privacy, based on the manipulation of the spatial arrangements by architects from the early stages of the design process. However, further research is needed before these findings can be integrated in a framework that could become an accessible method for architects. In addition, this thesis provided a structured insight into aspects of hospital ward design to help architects and NHS Trusts to identify their priorities from the early stages of a hospital project and to help policy makers develop the available guidelines and regulation based on the architects' prioritization and perception of the importance of different hospital ward design criteria. However, the link between theory and design in terms of the findings of this thesis is a subject of further research. This is an issue that has concerned mainly researchers who came from an architectural background (including the author). More focus on the design implications of research findings may fill the gap between theory and design in the context of architectural design.

Research questions can be addressed in many different ways. One theoretical assumption behind the thesis is that the mixed methods approach which has been used here has several advantages. Firstly the methods used cross the qualitative/quantitative boundary and provide new insights from different research perspectives. Secondly different quantitative methods have been used to address aspects of preference and importance. Some of these methods are relatively new (e.g. Latent class analysis and Hierarchical Bayesian analysis within the Conjoint framework) and offer a more flexible and sensitive methodological approach towards identifying individual differences. And finally the well developed theoretical background in space syntax provides measures of the environment which open up new and interesting potential links with subjective domains within environmental psychology. There have been calls for more studies of this type which bridge the two. In this thesis an attempt has been made to apply these methods to an understanding of privacy.

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Appendices

List of Appendices

APPENDIX A

Abstracts of the papers published from this work.

Spatial attributes of hospital multi-bed wards and preferences for privacy

Chaham Alalouch and Peter Aspinall
Heriot-Watt University, Edinburgh, UK

Abstract

Purpose – The purpose of this article is to explore the relationship between measures of the plan configuration of buildings (in this case multi-bed wards), and subjective judgements on spatial locations for privacy.

Design/methodology/approach – Measures of plan configuration from six generic ward designs have been made using space syntax software (visibility graph analysis and depth map). Subjective judgements have been assessed by means of a questionnaire.

Findings – Participants' chosen locations for privacy have been shown to have a systematic relationship with spatial properties of the ward plans. At a ward level the designs with low integration and high control were chosen. At the bed location lower values of integration and control were selected.

Research limitations/implications – In this study one facet of privacy (i.e. spatial location) has been investigated. These findings now need to be extended to studies involving environmental simulations, visibility and three-dimensional awareness of spaces as experienced by hospital users. In addition further analysis will be carried out at an individual design level and the possibility of subgroups of people with different preferences will be explored.

Practical implications – Space syntax has a complicated theoretical and methodological approach to spatial measures. Many designers or architects may not be prepared to try to understand the implications.

Originality/value – At a general level there is little in the literature on the implications of plan form for the subjective experiences of people in buildings. At a specific level about privacy in wards, no evidence could be found that these systematic findings have been reported before.

Keywords Privacy, Hospitals, Hospital beds

Paper type Research paper

1. Introduction

Privacy is one of the basic human needs that relates to effective individual and group functioning and its converse, lack of privacy can result in a range of problems (Altman, 1975; Vinsel *et al.*, 1980). While it is not easy to assess privacy because of its complex nature, it has been measured in terms of preference, behaviour, need and expectation (Gifford, 2002). In general a distinction is often made between people's privacy preferences (Walden *et al.*, 1981), and privacy as a basic human need (Smith, 1982).

From both perspectives the frequent loss of privacy in the hospital setting is widely recognized (Annas, 1981; Matiti and Trorey, 2004) and in addition the respect of this right in hospitals is known to be important for patients' physical, mental, emotional and spiritual well-being (Woogara, 2001). As a consequence, in a review by (Leino-Kilpi *et al.*, 2001) a patient's privacy has been recognized as one of the important concepts in nursing and health care ethics (Yura and Walsh, 1988; Thompson *et al.*, 1994; Back and

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On Locational Preferences for Privacy in Hospital Wards

Chaham Alalouch, Peter Aspinall and Harry Smith

Heriot-Watt University, Edinburgh, UK

Abstract

Purpose – To explore preference for privacy among people with different demographic and cultural backgrounds. In particular the study investigates the effect of age, gender, previous experience of space and cultural background on people's chosen spatial location for privacy in multi-bed wards.

Design/methodology/approach – A group of 79 subjects were asked to complete a questionnaire on privacy and to select preferred and disliked locations on plans of hospital wards. Spatial data was provided by space syntax analysis (VGA). Possible subgroups in the data were investigated by tests of difference and latent class analysis applied to those spatial attributes which appeared to be relevant to people's preferences on locations for privacy.

Findings – The results showed that privacy regulation encompasses universal and specific aspects across cultures, age, gender and previous experience of space. Specifically, the results suggest a universal preference for spatial location of privacy across culture, age and gender and a specific significant difference for spatial location of privacy as a result of previous spatial experience. In addition, the VGA integration measure was found to be a highly significant discriminator between preferred and disliked locations for privacy.

Research limitations – There are two particular limitations requiring further study. Firstly this study investigated only one facet of privacy i.e. spatial location. More investigation is required to explore the inter-relationships between spatial location and other facets of privacy, primarily that of intervisibility. Secondly only two broader cultures (European and Arabic) were considered.

Practical limitation – Ideally it would have been of benefit if a greater number of the people sampled with direct experience of hospital wards.

Originality/value – At a general level this study supports the notion that there are universal and specific aspects to privacy. At a specific level the research links physical aspects of spatial location (i.e. visibility graph analysis measures) into this discussion.

Paper Type: Research paper

Keywords: Privacy, Preferences, Cross-culture, Space Syntax, VGA, Hospital ward design.

APPENDIX B

Questionnaire used in this research - The English version.

Questionnaire

Privacy in Hospital ward

(People's aspects to place)

2005

The following questionnaire was designed around the ideas in environmental psychology on people's aspects to place, aiming to understand people's preferences, values, needs and expectations regarding to privacy in hospital wards.

Code No: ………

A. Personal Information:

- Occupation : ------------------------------------
- Age : ------------------------------------
- Sex : ------------------------------------
- Nationality : ------------------------------------

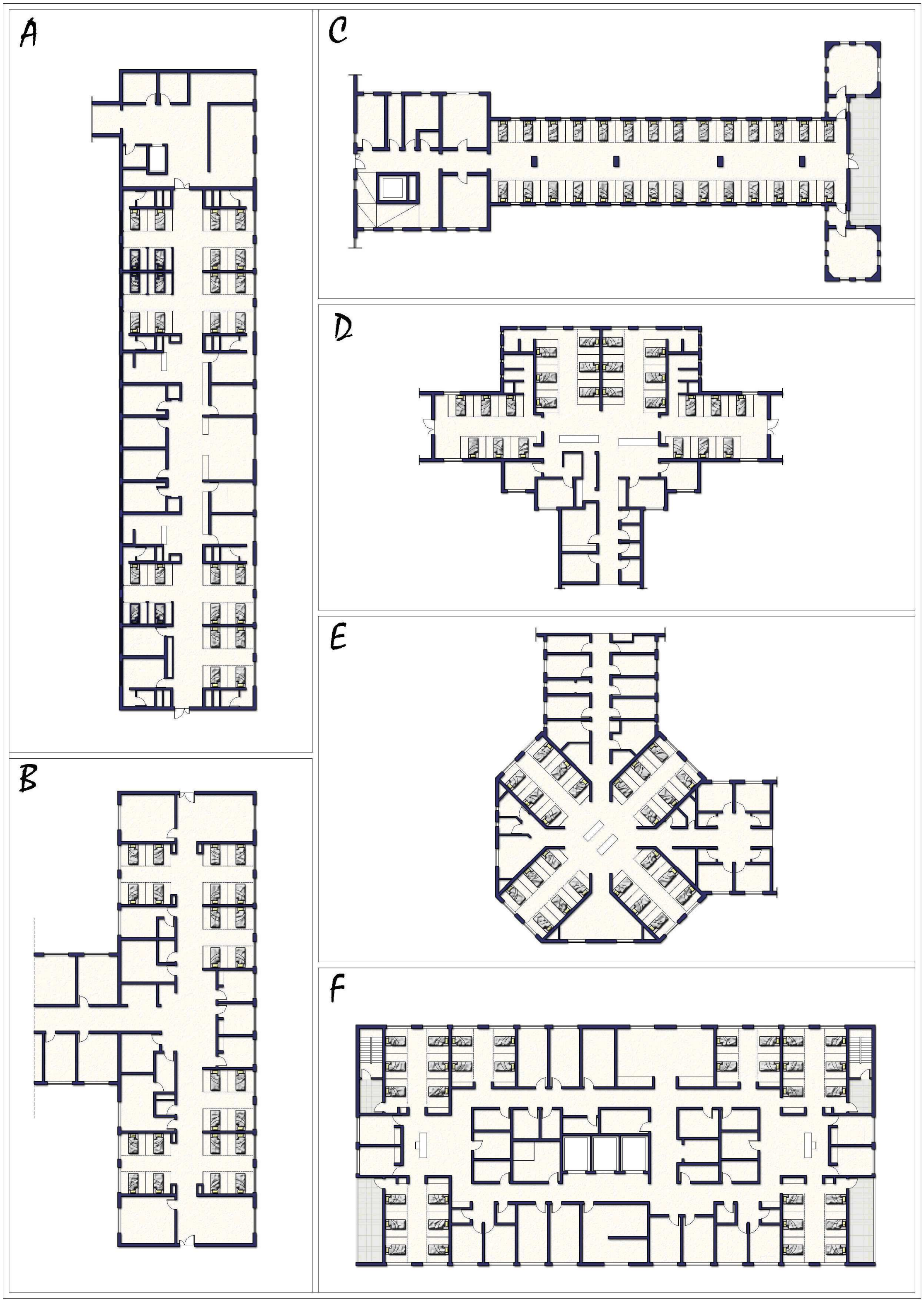
B. Hospital ward design:

1- Suppose you are a patient in a hospital ward, which ward would you prefer to stay in?

☐ Single-bed room ☐ open ward

2- Have you stayed in a hospital ward as a patient?

☐ Yes ☐ No


A
B
C
D
E
F

3- If you had to stay in a hospital in an open ward, which type of open wards shown in the previous page would you most prefer? Please rank them from 1 to 6 (1 is the most preferred one).

Ward type:	A	B	C	D	E	F
Preferred ward:	☐	☐	☐	☐	☐	☐

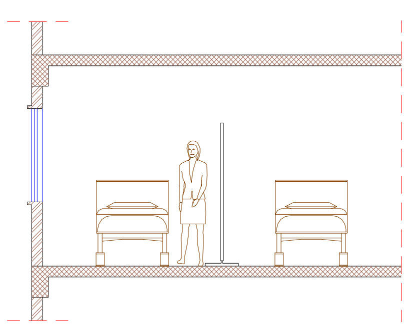
4- Please, give reasons for your choice.

…………………………………………………………………………………………….

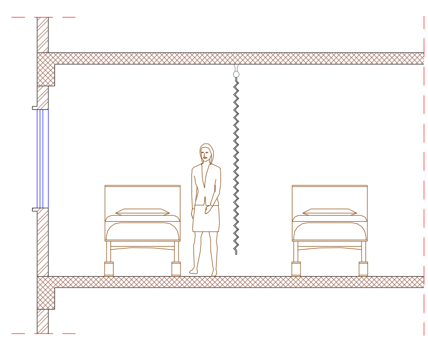
…………………………………………………………………………………………….

5- With respect to the privacy, <u>for each of the wards</u>, please choose on the diagram shown in previous page the bed you would <u>prefer</u> by using (√) and the bed you would <u>dislike</u> by using (X).

6- Which type of screening would make you more comfortable if you are occupying a bed in an open ward?



☐ Fixed screen



☐ Curtains

C. Activities carried out in the space:

7- With respect to privacy, please indicate how <u>bothersome</u> each of the following would be in an open ward.

	Not at all	Not very	Fairly	Very
- Using the bedpan.	☐	☐	☐	☐
- Going to the toilet.	☐	☐	☐	☐
- Speaking with the doctor about your medical record.	☐	☐	☐	☐
- Regular nurses job (pulls rate, temperature, injection, etc.)	☐	☐	☐	☐
- Medical check by the doctor.	☐	☐	☐	☐
- Other patient speaking to you.	☐	☐	☐	☐

D. perceptions and attitudes towards the place:

Please consider these statements and tick the box that indicates your opinion.

8- Regarding the nurses monitoring of patients, an open ward is safer than Single-bed room.

☐ Strongly agree ☐ Agree ☐ Neither ☐ Disagree ☐Strongly disagree

9- Single-bed room helps the patient to recover faster than an open ward.

☐ Strongly agree ☐ Agree ☐ Neither ☐ Disagree ☐Strongly disagree

10- Open wards help to maintain the morale among the patients.

☐ Strongly agree ☐ Agree ☐ Neither ☐ Disagree ☐Strongly disagree

11- In open wards, the best bed for a patient is the one which can not be seen well by the nurses.

☐ Strongly agree ☐ Agree ☐ Neither ☐ Disagree ☐Strongly disagree

12- Patients in an open ward could overhear personal information about each other.

☐ Strongly agree ☐ Agree ☐ Neither ☐ Disagree ☐Strongly disagree

13- It is embarrassing to be a patient in an open ward.

☐ Strongly agree ☐ Agree ☐ Neither ☐ Disagree ☐Strongly disagree

E. Environmental Conditions:

14- If you have previously stayed in an open ward as a patient, how did you find the following environmental conditions?

- Temperature	☐ Too hot	☐ Hot	☐ Just right	☐ Cold	☐ Too cold
- Light level	☐ Too Bright	☐ Bright	☐ Just right	☐ Dark	☐ Too dark
- Humidity	☐ Too high	☐ High	☐ Just right	☐ Low	☐ Too low
- Noise	☐ Too loud	☐ loud	☐ Just right	☐ Quiet	☐ Too quiet
- Acoustic privacy	☐ Too high	☐ High	☐ Just right	☐ Low	☐ Too low
- Visual privacy	☐ Too high	☐ High	☐ Just right	☐ Low	☐ Too low

End of the Questionnaire

-- Many Thanks -------------------------------------

APPENDIX C

Questionnaire used in this research - The Arabic version.

استبيان

الخصوصية في غرف المرضى

(فهم الناس للمكان)

2005

لقد صمم هذا الاستبيان انطلاقا من الأفكار في علم النفس المعماري حول احساس الناس بالمكان، هادفا إلى فهم تفضيلات الناس وقيمهم و حاجاتهم و توقعاتهم بالنسبة للخصوصية في المشافي.

الرقم: ....

أ) معلومات شخصية

المهنة: ------------------------------------

العمر: ------------------------------------

الجنس: ------------------------------------

الجنسية: ------------------------------------

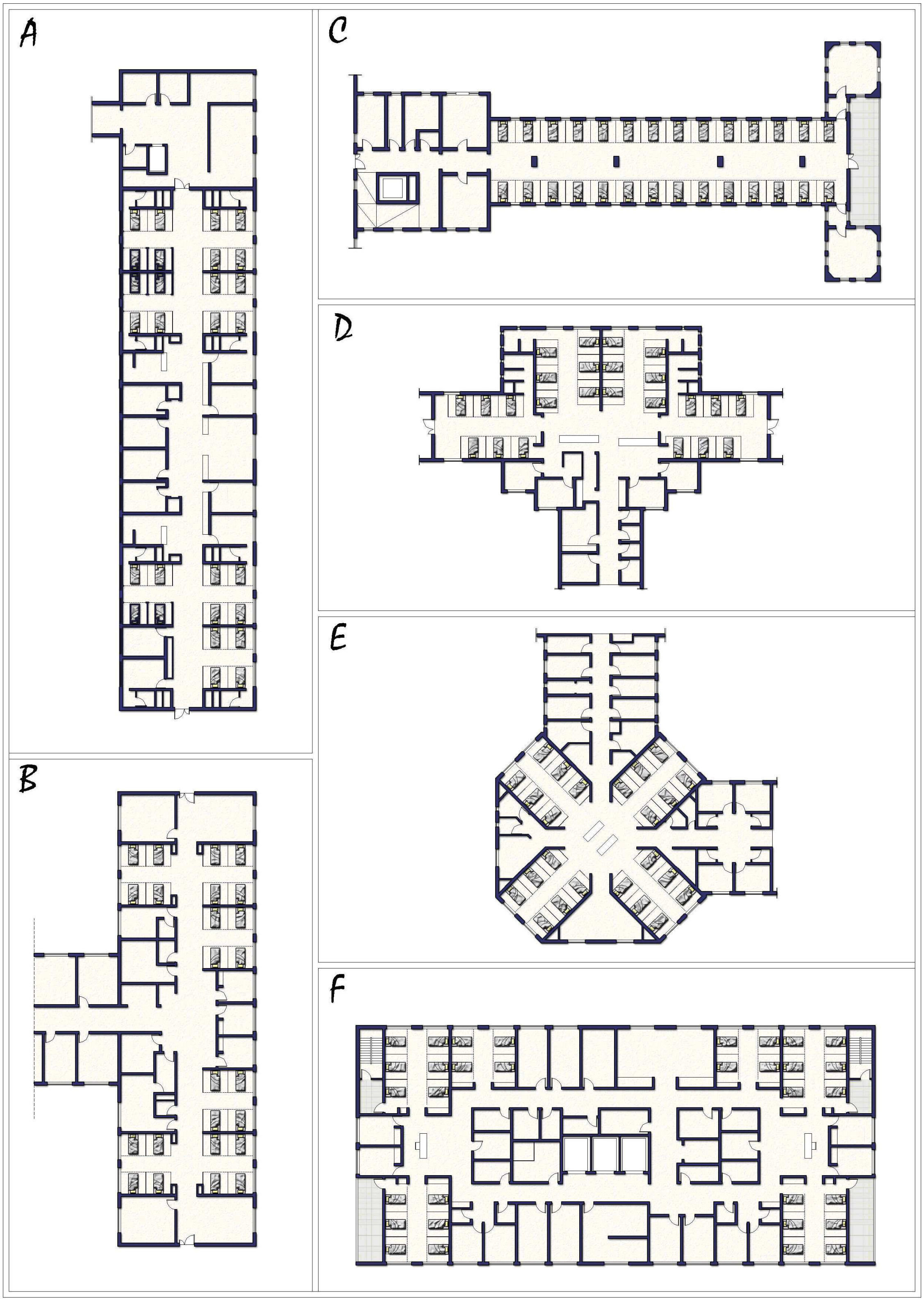
ب) تصميم غرف المرضى

1- إذا كنت مريضا (لاسمح الله) مقيما بشكل مؤقت في مشفى، هل تفضل المكوث في :

□ غرفة مفردة　　　　□ جناح متعدد الأسرة

2- هل مكثت في جناح متعدد الأسرة من قبل كمريض؟

□ نعم　　　　□ لا


A
B
C
D
E
F

4- لو كان عليك المكوث في جناح متعدد الأسرة في مشفى، أي جناح من الأجنحة متعددة الأسرة الظاهرة في الصفحة السابقة تفضلها بشكل أكبر؟ رتب الأجنحة من الأكثر تفضيلا (رقم 1) ألى الأقل تفضيلا (رقم 6).

الجناح متعدد الاسرة :	F	E	D	C	B	A
ترتيب الأجنحة حسب التفضيل :	☐	☐	☐	☐	☐	☐

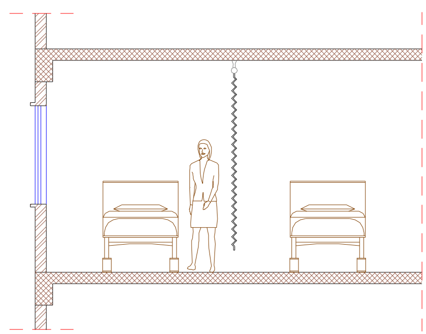
5- لو سمحت، أوضح أسباب اختيارك.

....

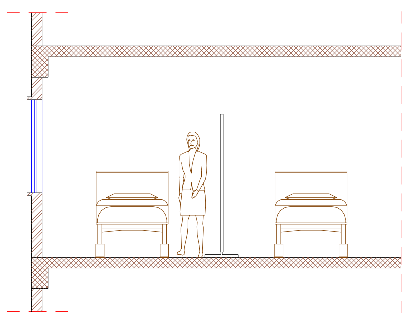
....

6- مع مراعاة الخصوصية في المشافي، لكل جناح متعدد الأسرة من الأجنحة الظاهرة في الصفحة السابقة، أشر على المخطط إلى أكثر سرير تفضله بإشارة (√) و إلى أكثر سرير لا تفضله بإشارة (X) .

7- أي نوع من نوعي الفصل بين سريرين ستجعلك مرتاحا أكثر لو كنت تشغل سرير في جناح متعدد الاسرة في مشفى؟



☐ ستارة متحركة



☐ فاصل ثابت

جـ) الفعاليات في الفراغ:

9- مع مراعاة الخصوصية، كم ستكون مزعجة لك كل من الفعاليات التالية لو كنت مريضا في جناح متعدد الأسرة في مشفى؟

	مزعج جدا	مزعج	مزعج قليلا	ليس مزعجا
- استخدام مبولة المرضى.	☐	☐	☐	☐
- الذهاب إلى دورة المياه.	☐	☐	☐	☐
- الحديث مع الطبيب عن حالتك الصحية.	☐	☐	☐	☐
- عمل الممرضات التقليدي (قياس نبض، حقن إبر، قياس درجة الحرارة)	☐	☐	☐	☐
- المعاينة الطبية من قبل الطبيب.	☐	☐	☐	☐
- حديث المرضى الآخرين معك.	☐	☐	☐	☐

د) فهم الناس للمكان:

الرجاء قراءة الجمل التالية و اختيار الاجابة التي تعبر عن رأيك:

11- الأجنحة متعددة الاسرة أكثر أمانا بالنسبة لمراقبة الممرضات للمرضى من الغرفة المفردة.

☐غير موافق بشدة ☐غير موافق ☐حيادي ☐موافق ☐موافق بشدة

12- الغرف المفردة تساعد على شفاء المرضى أكثر من الأجنحة متعددة الأسرة.

☐غير موافق بشدة ☐غير موافق ☐حيادي ☐موافق ☐موافق بشدة

13- الأجنحة متعددة الأسرة تساعد على رفع الروح المعنوية لدى المرضى.

☐غير موافق بشدة ☐غير موافق ☐حيادي ☐موافق ☐موافق بشدة

14- في الأجنحة متعددة الأسرة، أفضل سرير للمريض هو السرير الذي لا تراه الممرضاة بشكل جيد.

☐غير موافق بشدة ☐غير موافق ☐حيادي ☐موافق ☐موافق بشدة

15- المريض في جناح متعدد الأسرة يمكن أن يسمع بالصدفة معلومات شخصية عن مريض غيره.

☐غير موافق بشدة ☐غير موافق ☐حيادي ☐موافق ☐موافق بشدة

16- إنه من المحرج المكوث في جناح متعدد الأسرة.

☐غير موافق بشدة ☐غير موافق ☐حيادي ☐موافق ☐موافق بشدة

هـ) الشروط البيئية:

17- أذا سبق وأن مكثت في جناح متعدد الأسرة في مشفى، كيف وجدت الظروف البيئية التالية:

- درجة الحرارة: ☐ مرتفعة جدا ☐ مرتفعة ☐ مناسبة ☐ منخفضة ☐ منخفضة جدا

- الإنارة: ☐ معتم جدا ☐ معتم ☐ مناسب ☐ مضيء ☐مضيء جدا

- الرطوبة: ☐ مرتفعة جدا ☐مرتفعة ☐ مناسبة ☐ منخفضة ☐ منخفضة جدا

- الضجيج: ☐ مرتفع جدا ☐ مرتفع ☐ مناسب ☐ منخفض ☐منخفض جدا

- خصوصية الحديث: ☐ مرتفعة جدا ☐ مرتفعة ☐ مناسبة ☐ منخفضة ☐منخفضة جدا

- خصوصية الرؤيا: ☐ مرتفعة جدا ☐ مرتفعة ☐ مناسبة ☐ منخفضة ☐منخفضة جدا

نهاية الاستبيان

-- شكرا جزيلا --

APPENDIX D

The coding book.

Coding Book

The coding book for all questions in the questionnaire.

Question NO	Variable NO	Variable name	Variable Label	Coding details/Value labels
1	1	PIN1OC	Occupation	1 = Student 2 = Teacher 3 = Engineering 4 = Others
2	2	PIN2AG	Age	1 = 21 - 30 2 = 31 - 40 3 = 41 - 50 4 = + 50
3	3	PIN3SX	Sex	1 = Male 2 = Female
4	4	PIN4NA	Nationality	1 = Arabic 2 = EU
5	5	HWD1WP	Suppose you are a patient in a hospital ward, which Ward would you Prefer to stay in?	1 = single-bed room 2 = open ward
6	6	HWD2SW	Have you Stayed in a hospital Ward as a patient?	1 = Yes 2 = No
7	7	HWD41Cnt	Most preferred ward Connectivity	The Connectivity value of the chosen ward
	8	HWD41IMR	Most preferred ward Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen ward
	8	HWD41ClC	Most preferred ward Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen ward
	9	HWD41Con	Most preferred ward Visual Control	The Visual Control value of the chosen ward
	10	HWD41Cnb	Most preferred ward Visual Controllability	The Visual Controllability value of the chosen ward
	11	HWD41Ent	Most preferred ward Visual Entropy	The Visual Entropy value of the chosen ward
	12	HWD41InH	Most preferred ward Visual Integration (HH)	The Visual Integration (HH) value of the chosen ward
	13	HWD41InP	Most preferred ward Visual Integration (P)	The Visual Integration (P) value of the chosen ward
	14	HWD41MnD	Most preferred ward Visual Mean Depth	The Visual Mean Depth value of the chosen ward
8	15	HWD42Cnt	Second preferred ward Connectivity	The Connectivity value of the chosen ward
	16	HWD42IMR	Second preferred ward Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen ward
	17	HWD42ClC	Second preferred ward Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen ward
	18	HWD42Con	Second preferred ward Visual Control	The Visual Control value of the chosen ward
	19	HWD42Cnb	Second preferred ward Visual Controllability	The Visual Controllability value of the chosen ward
	20	HWD42Ent	Second preferred ward Visual Entropy	The Visual Entropy value of the chosen ward
	21	HWD42InH	Second preferred ward Visual Integration (HH)	The Visual Integration (HH) value of the chosen ward
	22	HWD42InP	Second preferred ward Visual Integration (P)	The Visual Integration (P) value of the chosen ward
	23	HWD42MnD	Second preferred ward Visual Mean Depth	The Visual Mean Depth value of the chosen ward
9	24	HWD43Cnt	Third preferred ward Connectivity	The Connectivity value of the chosen ward

	25	HWD43IMR	Third preferred ward Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen ward
	26	HWD43ClC	Third preferred ward Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen ward
	27	HWD43Con	Third preferred ward Visual Control	The Visual Control value of the chosen ward
	28	HWD43Cnb	Third preferred ward Visual Controllability	The Visual Controllability value of the chosen ward
	29	HWD43Ent	Third preferred ward Visual Entropy	The Visual Entropy value of the chosen ward
	30	HWD43InH	Third preferred ward Visual Integration (HH)	The Visual Integration (HH) value of the chosen ward
	31	HWD43InP	Third preferred ward Visual Integration (P)	The Visual Integration (P) value of the chosen ward
	32	HWD43MnD	Third preferred ward Visual Mean Depth	The Visual Mean Depth value of the chosen ward
10	33	HWD44Cnt	Third disliked ward Connectivity	The Connectivity value of the chosen ward
	34	HWD44IMR	Third disliked ward Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen ward
	35	HWD44ClC	Third disliked ward Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen ward
	36	HWD44Con	Third disliked ward Visual Control	The Visual Control value of the chosen ward
	37	HWD44Cnb	Third disliked ward Visual Controllability	The Visual Controllability value of the chosen ward
	38	HWD44Ent	Third disliked ward Visual Entropy	The Visual Entropy value of the chosen ward
	39	HWD44InH	Third disliked ward Visual Integration (HH)	The Visual Integration (HH) value of the chosen ward
	40	HWD44InP	Third disliked ward Visual Integration (P)	The Visual Integration (P) value of the chosen ward
	41	HWD44MnD	Third disliked ward Visual Mean Depth	The Visual Mean Depth value of the chosen ward
11	42	HWD45Cnt	Second disliked ward Connectivity	The Connectivity value of the chosen ward
	43	HWD45IMR	Second disliked ward Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen ward
	44	HWD45ClC	Second disliked ward Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen ward
	45	HWD45Con	Second disliked ward Visual Control	The Visual Control value of the chosen ward
	46	HWD45Cnb	Second disliked ward Visual Controllability	The Visual Controllability value of the chosen ward
	47	HWD45Ent	Second disliked ward Visual Entropy	The Visual Entropy value of the chosen ward
	48	HWD45InH	Second disliked ward Visual Integration (HH)	The Visual Integration (HH) value of the chosen ward
	49	HWD45InP	Second disliked ward Visual Integration (P)	The Visual Integration (P) value of the chosen ward
	50	HWD45MnD	Second disliked ward Visual Mean Depth	The Visual Mean Depth value of the chosen ward
12	51	HWD46Cnt	Most disliked ward Connectivity	The Connectivity value of the chosen ward
	52	HWD46IMR	Most disliked ward Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen ward
	53	HWD46ClC	Most disliked ward Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen ward
	54	HWD46Con	Most disliked ward Visual Control	The Visual Control value of the chosen ward
	55	HWD46Cnb	Most disliked ward Visual Controllability	The Visual Controllability value of the chosen ward

	56	HWD46Ent	Most disliked ward Visual Entropy	The Visual Entropy value of the chosen ward
	57	HWD46InH	Most disliked ward Visual Integration (HH)	The Visual Integration (HH) value of the chosen ward
	58	HWD46InP	Most disliked ward Visual Integration (P)	The Visual Integration (P) value of the chosen ward
	59	HWD46MnD	Most disliked ward Visual Mean Depth	The Visual Mean Depth value of the chosen ward
13	60	HWD5RC	Reasons for the choice.	1 = Architectural design 2 = Space 3 = Privacy 4 = Accessibility 5 = Beds Number 6 = Services
14	61	HWD6APCnt	Ward A - Preferred bed Connectivity	The Connectivity value of the chosen bed
	62	HWD6APIMR	Ward A - Preferred bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	63	HWD6APClC	Ward A - Preferred bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	64	HWD6APCon	Ward A - Preferred bed Visual Control	The Visual Control value of the chosen bed
	65	HWD6APCnb	Ward A - Preferred bed Visual Controllability	The Visual Controllability value of the chosen bed
	66	HWD6APEnt	Ward A - Preferred bed Visual Entropy	The Visual Entropy value of the chosen bed
	67	HWD6APInH	Ward A - Preferred bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	68	HWD6APInP	Ward A - Preferred bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	69	HWD6APMnD	Ward A - Preferred bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
15	70	HWD6ADCnt	Ward A - Disliked bed Connectivity	The Connectivity value of the chosen bed
	71	HWD6ADIMR	Ward A - Disliked bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	72	HWD6ADClC	Ward A - Disliked bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	73	HWD6ADCon	Ward A - Disliked bed Visual Control	The Visual Control value of the chosen bed
	74	HWD6ADCnb	Ward A - Disliked bed Visual Controllability	The Visual Controllability value of the chosen bed
	75	HWD6ADEnt	Ward A - Disliked bed Visual Entropy	The Visual Entropy value of the chosen bed
	76	HWD6ADInH	Ward A - Disliked bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	77	HWD6ADInP	Ward A - Disliked bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	78	HWD6ADMnD	Ward A - Disliked bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
16	79	HWD6BPCnt	Ward B - Preferred bed Connectivity	The Connectivity value of the chosen bed
	80	HWD6BPIMR	Ward B - Preferred bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	81	HWD6BPClC	Ward B - Preferred bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	82	HWD6BPCon	Ward B - Preferred bed Visual Control	The Visual Control value of the chosen bed
	83	HWD6BPCnb	Ward B - Preferred bed Visual Controllability	The Visual Controllability value of the chosen bed
	84	HWD6BPEnt	Ward B - Preferred bed Visual Entropy	The Visual Entropy value of the chosen bed
	85	HWD6BPInH	Ward B - Preferred bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed

	86	HWD6BPInP	Ward B - Preferred bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	87	HWD6BPMnD	Ward B - Preferred bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
17	88	HWD6BDCnt	Ward B - Disliked bed Connectivity	The Connectivity value of the chosen bed
	89	HWD6BDIMR	Ward B - Disliked bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	90	HWD6BDClC	Ward B - Disliked bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	91	HWD6BDCon	Ward B - Disliked bed Visual Control	The Visual Control value of the chosen bed
	92	HWD6BDCnb	Ward B - Disliked bed Visual Controllability	The Visual Controllability value of the chosen bed
	93	HWD6BDEnt	Ward B - Disliked bed Visual Entropy	The Visual Entropy value of the chosen bed
	94	HWD6BDInH	Ward B - Disliked bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	95	HWD6BDInP	Ward B - Disliked bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	96	HWD6BDMnD	Ward B - Disliked bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
18	97	HWD6CPCnt	Ward C - Preferred bed Connectivity	The Connectivity value of the chosen bed
	98	HWD6CPIMR	Ward C - Preferred bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	99	HWD6CPClC	Ward C - Preferred bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	100	HWD6CPCon	Ward C - Preferred bed Visual Control	The Visual Control value of the chosen bed
	101	HWD6CPCnb	Ward C - Preferred bed Visual Controllability	The Visual Controllability value of the chosen bed
	102	HWD6CPEnt	Ward C - Preferred bed Visual Entropy	The Visual Entropy value of the chosen bed
	103	HWD6CPInH	Ward C - Preferred bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	104	HWD6CPInP	Ward C - Preferred bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	105	HWD6CPMnD	Ward C - Preferred bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
19	106	HWD6CDCnt	Ward C - Disliked bed Connectivity	The Connectivity value of the chosen bed
	107	HWD6CDIMR	Ward C - Disliked bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	108	HWD6CDClC	Ward C - Disliked bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	109	HWD6CDCon	Ward C - Disliked bed Visual Control	The Visual Control value of the chosen bed
	110	HWD6CDCnb	Ward C - Disliked bed Visual Controllability	The Visual Controllability value of the chosen bed
	111	HWD6CDEnt	Ward C - Disliked bed Visual Entropy	The Visual Entropy value of the chosen bed
	112	HWD6CDInH	Ward C - Disliked bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	113	HWD6CDInP	Ward C - Disliked bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	114	HWD6CDMnD	Ward C - Disliked bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
20	115	HWD6DPCnt	Ward D - Preferred bed Connectivity	The Connectivity value of the chosen bed
	116	HWD6DPIMR	Ward D - Preferred bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed

	117	HWD6DPClC	Ward D - Preferred bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	118	HWD6DPCon	Ward D - Preferred bed Visual Control	The Visual Control value of the chosen bed
	119	HWD6DPCnb	Ward D - Preferred bed Visual Controllability	The Visual Controllability value of the chosen bed
	120	HWD6DPEnt	Ward D - Preferred bed Visual Entropy	The Visual Entropy value of the chosen bed
	121	HWD6DPInH	Ward D - Preferred bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	122	HWD6DPInP	Ward D - Preferred bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	123	HWD6DPMnD	Ward D - Preferred bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
21	124	HWD6DDCnt	Ward D - Disliked bed Connectivity	The Connectivity value of the chosen bed
	125	HWD6DDIMR	Ward D - Disliked bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	126	HWD6DDClC	Ward D - Disliked bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	127	HWD6DDCon	Ward D - Disliked bed Visual Control	The Visual Control value of the chosen bed
	128	HWD6DDCnb	Ward D - Disliked bed Visual Controllability	The Visual Controllability value of the chosen bed
	129	HWD6DDEnt	Ward D - Disliked bed Visual Entropy	The Visual Entropy value of the chosen bed
	130	HWD6DDInH	Ward D - Disliked bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	131	HWD6DDInP	Ward D - Disliked bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	132	HWD6DDMnD	Ward D - Disliked bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
22	133	HWD6EPCnt	Ward E - Preferred bed Connectivity	The Connectivity value of the chosen bed
	134	HWD6EPIMR	Ward E - Preferred bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	135	HWD6EPClC	Ward E - Preferred bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	136	HWD6EPCon	Ward E - Preferred bed Visual Control	The Visual Control value of the chosen bed
	137	HWD6EPCnb	Ward E - Preferred bed Visual Controllability	The Visual Controllability value of the chosen bed
	138	HWD6EPEnt	Ward E - Preferred bed Visual Entropy	The Visual Entropy value of the chosen bed
	139	HWD6EPInH	Ward E - Preferred bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	140	HWD6EPInP	Ward E - Preferred bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	141	HWD6EPMnD	Ward E - Preferred bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
23	142	HWD6EDCnt	Ward E - Disliked bed Connectivity	The Connectivity value of the chosen bed
	143	HWD6EDIMR	Ward E - Disliked bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	144	HWD6EDClC	Ward E - Disliked bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	145	HWD6EDCon	Ward E - Disliked bed Visual Control	The Visual Control value of the chosen bed
	146	HWD6EDCnb	Ward E - Disliked bed Visual Controllability	The Visual Controllability value of the chosen bed
	147	HWD6EDEnt	Ward E - Disliked bed Visual Entropy	The Visual Entropy value of the chosen bed

	148	HWD6EDInH	Ward E - Disliked bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	149	HWD6EDInP	Ward E - Disliked bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	150	HWD6EDMnD	Ward E - Disliked bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
24	151	HWD6FPCnt	Ward F - Preferred bed Connectivity	The Connectivity value of the chosen bed
	152	HWD6FPIMR	Ward F - Preferred bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	153	HWD6FPClC	Ward F - Preferred bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	154	HWD6FPCon	Ward F - Preferred bed Visual Control	The Visual Control value of the chosen bed
	155	HWD6FPCnb	Ward F - Preferred bed Visual Controllability	The Visual Controllability value of the chosen bed
	156	HWD6FPEnt	Ward F - Preferred bed Visual Entropy	The Visual Entropy value of the chosen bed
	157	HWD6FPInH	Ward F - Preferred bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	158	HWD6FPInP	Ward F - Preferred bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	159	HWD6FPMnD	Ward F - Preferred bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
25	160	HWD6FDCnt	Ward F - Disliked bed Connectivity	The Connectivity value of the chosen bed
	161	HWD6FDIMR	Ward F - Disliked bed Isovist Maximum Radial	The Isovist Maximum Radial value of the chosen bed
	162	HWD6FDClC	Ward F - Disliked bed Visual Clustering Coefficient	The Visual Clustering Coefficient value of the chosen bed
	163	HWD6FDCon	Ward F - Disliked bed Visual Control	The Visual Control value of the chosen bed
	164	HWD6FDCnb	Ward F - Disliked bed Visual Controllability	The Visual Controllability value of the chosen bed
	165	HWD6FDEnt	Ward F - Disliked bed Visual Entropy	The Visual Entropy value of the chosen bed
	166	HWD6FDInH	Ward F - Disliked bed Visual Integration (HH)	The Visual Integration (HH) value of the chosen bed
	167	HWD6FDInP	Ward F - Disliked bed Visual Integration (P)	The Visual Integration (P) value of the chosen bed
	168	HWD6FDMnD	Ward F - Disliked bed Visual Mean Depth	The Visual Mean Depth value of the chosen bed
26	169	HWD7SC	Which type of Screening would make you more Comfortable if you are occupying a bed in an open ward?	1 = Fixed screen 2 = Curtain
27	170	ACS1BP	Using the Bedpan	1 = Not at all 2 = Not very 3 = Fairly 4 = Very
28	171	ACS2GT	Going to the Toilet	1 = Not at all 2 = Not very 3 = Fairly 4 = Very
29	172	ACS3SD	Speaking with the Doctor	1 = Not at all 2 = Not very 3 = Fairly 4 = Very
30	173	ACS4NJ	Regular Nurse Job	1 = Not at all 2 = Not very 3 = Fairly 4 = Very
31	174	ACS5MC	Medical Check	1 = Not at all 2 = Not very 3 = Fairly 4 = Very

32	175	ACS6PS	Other Patient Speaking to you.	1 = Not at all 2 = Not very 3 = Fairly 4 = Very
33	176	PAP1NS	Regarding the Nurses monitoring of patients, an open ward is Safer than Single-bed room.	1 = Strongly agree 2 = Agree 3 = Neither 4 = Disagree 5 = Strongly Disagree
34	177	PAP2HR	Single-bed room Helps the patient to Recover faster than an open ward.	1 = Strongly agree 2 = Agree 3 = Neither 4 = Disagree 5 = Strongly Disagree
35	178	PAP3MM	Open wards help to Maintain the Morale among the patients.	1 = Strongly agree 2 = Agree 3 = Neither 4 = Disagree 5 = Strongly Disagree
36	179	PAP4SN	In open wards, the best bed for a patient is the one which can not be Seen well by the Nurses.	1 = Strongly agree 2 = Agree 3 = Neither 4 = Disagree 5 = Strongly Disagree
37	180	PAP5OI	Patients in an open ward could Overhear personal Information about each other.	1 = Strongly agree 2 = Agree 3 = Neither 4 = Disagree 5 = Strongly Disagree
38	181	PAP6EO	It is Embarrassing to be a patient in an Open ward.	1 = Strongly agree 2 = Agree 3 = Neither 4 = Disagree 5 = Strongly Disagree
39	182	ENC1TE	Temperature	1 = Too Hot 2 = Hot 3 = Just right 4 = Cold 5 = Too cold 999 = Not Applicable
40	183	ENC2LL	Light level	1 = Too bright 2 = Bright 3 = Just right 4 = Dark 5 = Too Dark 999 = Not Applicable
41	184	ENC3HU	Humidity	1 = Too high 2 = High 3 = Just right 4 = Low 5 = Too Low 999 = Not Applicable
42	185	ENC4NS	Noise	1 = Too loud 2 = Loud 3 = Just right 4 = Quit 5 = Too quit 999 = Not Applicable
43	186	ENC5AP	Acoustic privacy	1 = Too high 2 = High 3 = Just right 4 = Low 5 = Too Low 999 = Not Applicable

44	184	ENC6VP	Visual privacy	1 = Too high 2 = High 3 = Just right 4 = Low 5 = Too Low 999 = Not Applicable

APPENDIX E

An answer tree predicting preferred from non-preferred bed location for each individual ward.

- Ward A

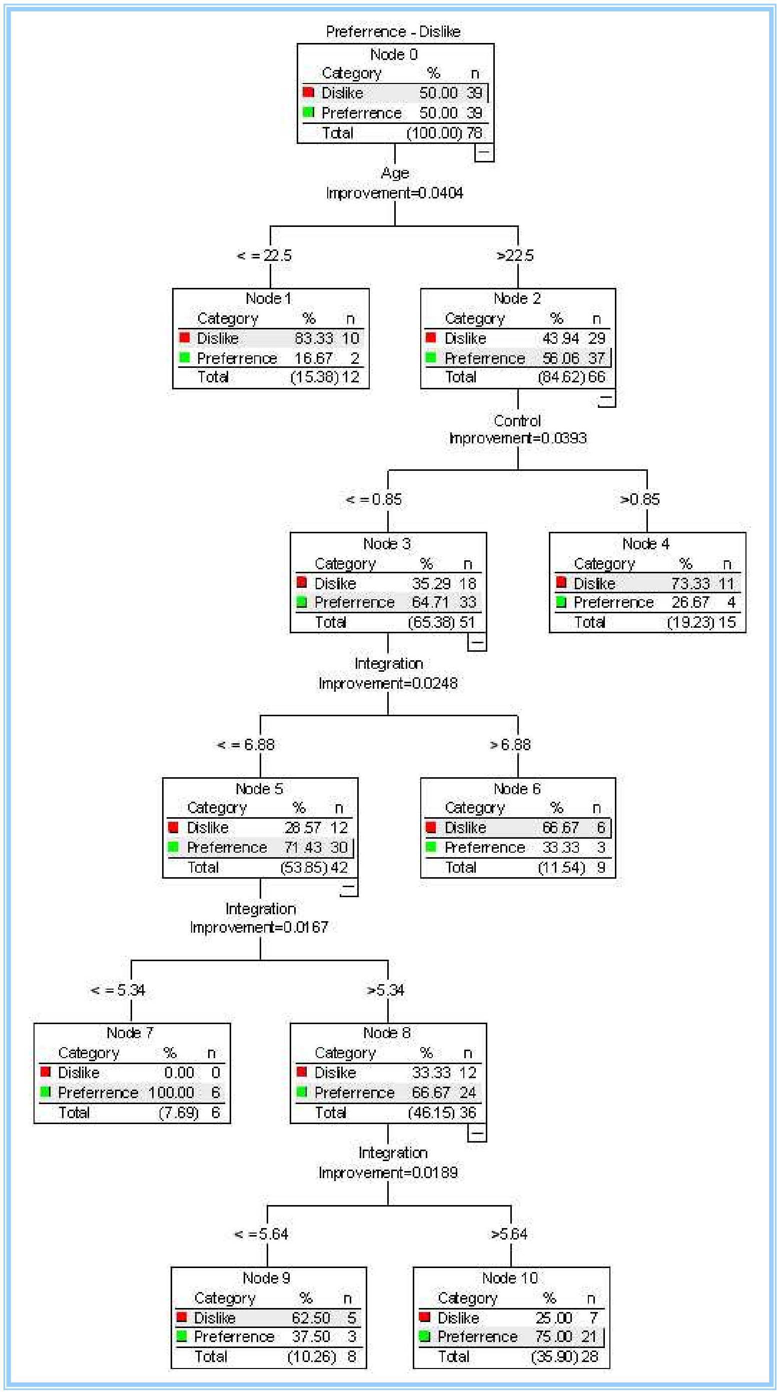


Figure E.1- A regression tree predicting preference in ward A

- Ward B

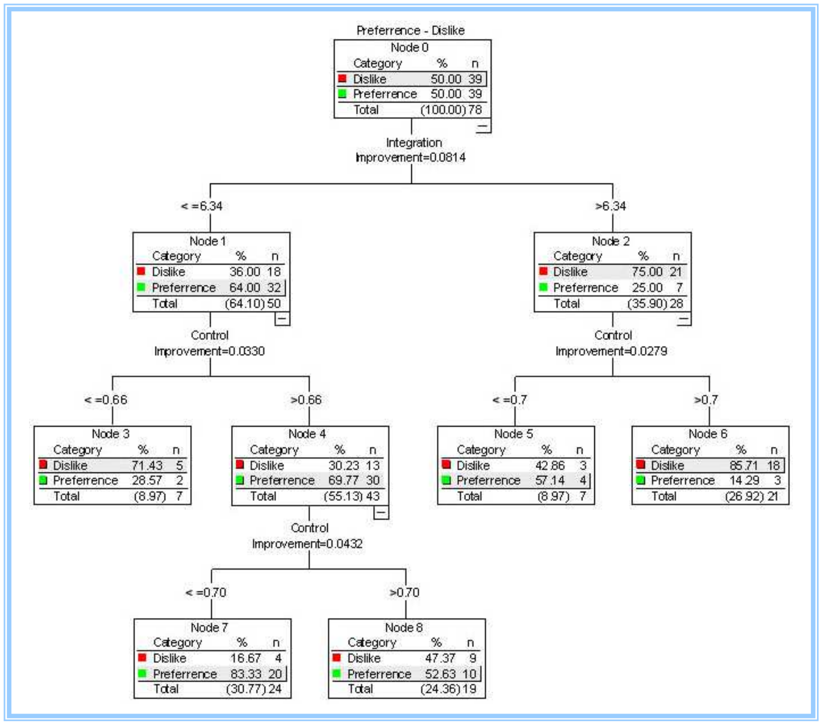


Figure E.2-A regression tree predicting preference in ward B

- Ward C

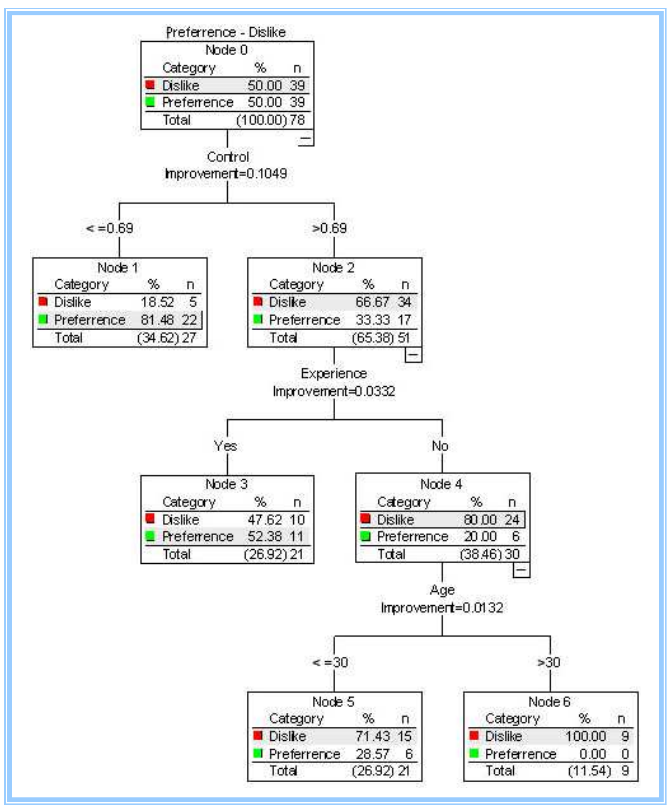


Figure E.3-A regression tree predicting preference in ward C

- Ward D

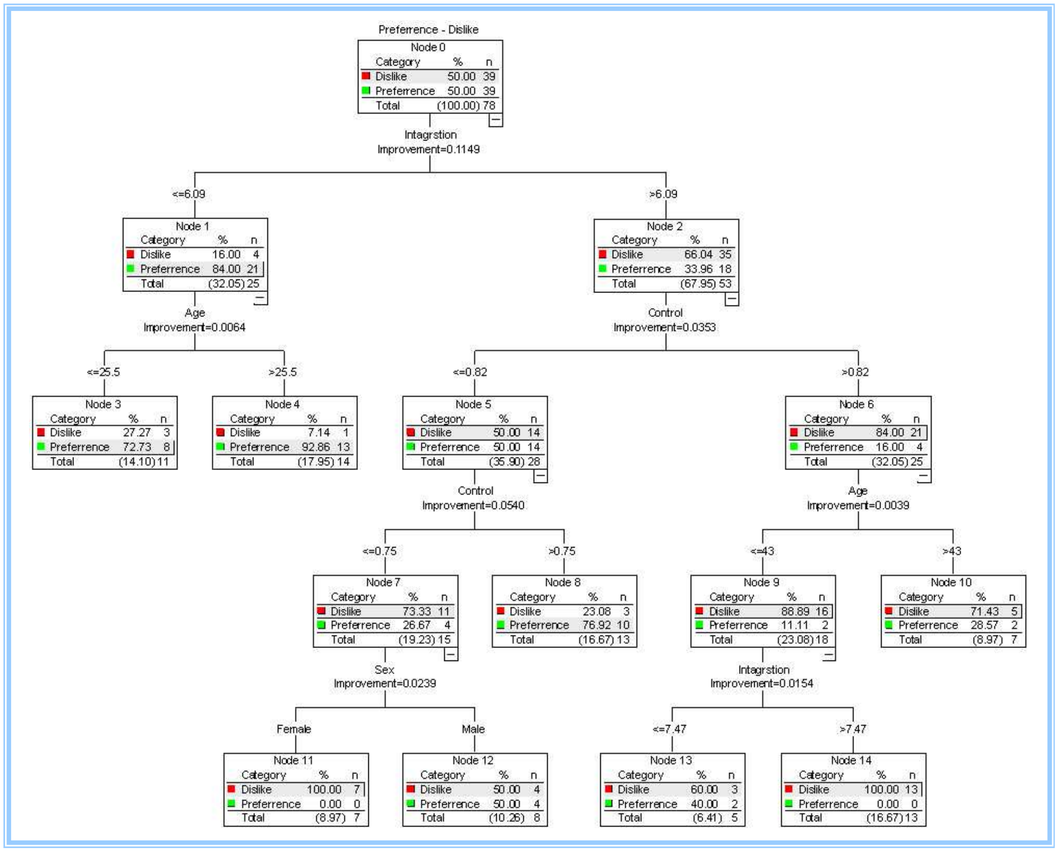


Figure E.4-A regression tree predicting preference in ward D

- Ward E

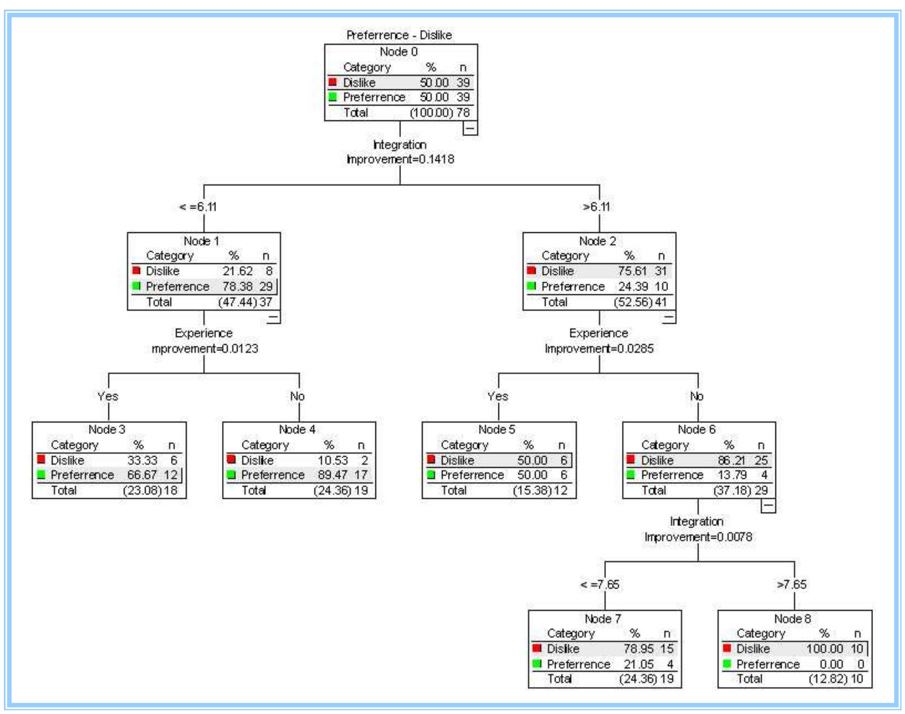


Figure E.5-A regression tree predicting preference in ward E

- Ward F

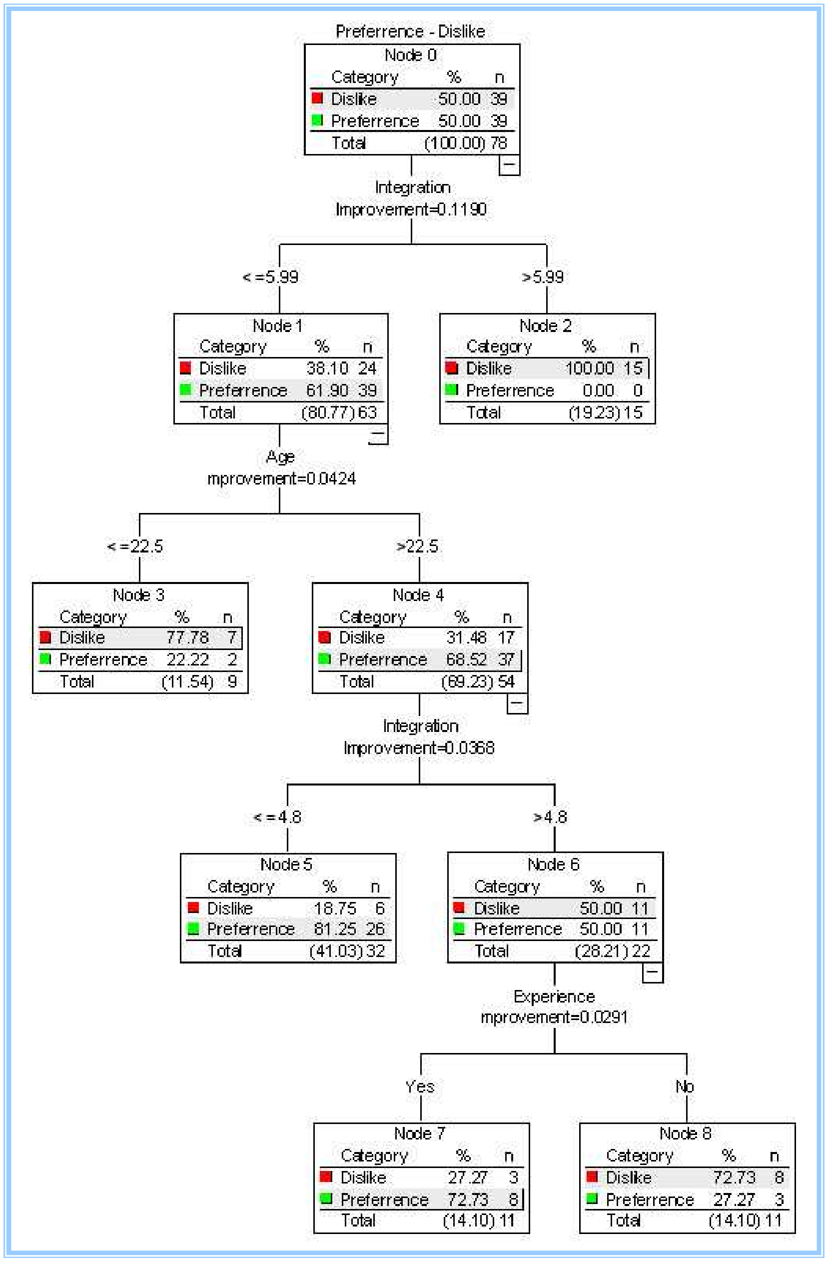
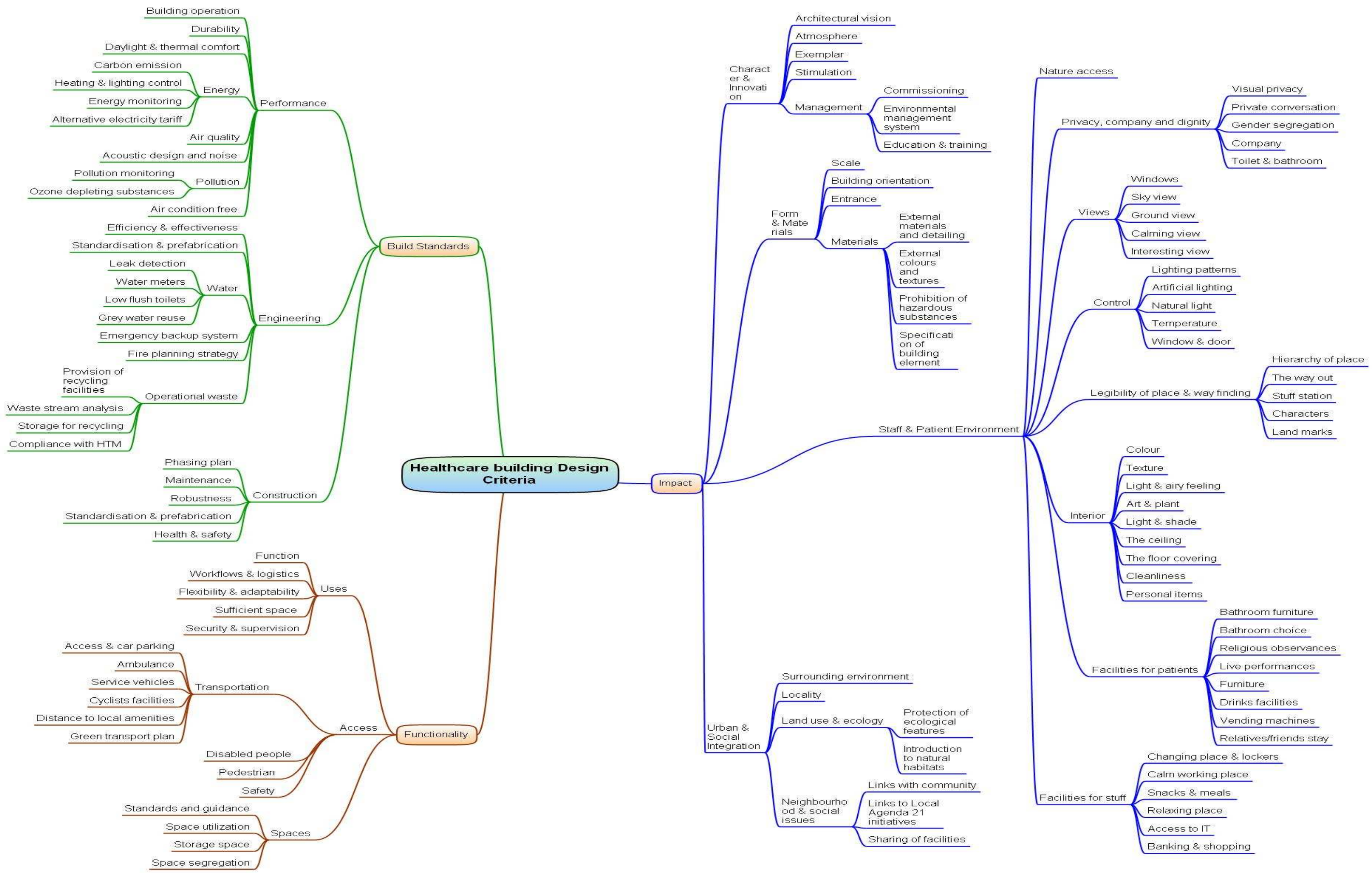


Figure E.6-A regression tree predicting preference in ward F

APPENDIX F

Healthcare building design criteria based on the four NHS toolkits: AEDET: Achieving Excellence Design Evaluation Toolkit, ASPECT: A Staff and Patient Environment Calibration Tool, IDEAs: Inspiring Design Excellence and Achievements and NEAT: NHS Environmental Assessment Tool.


Healthcare building Design Criteria
Build Standards
Performance
Building operation
Durability
Daylight & thermal comfort
Energy
Carbon emission
Heating & lighting control
Energy monitoring
Alternative electricity tariff
Air quality
Acoustic design and noise
Pollution
Pollution monitoring
Ozone depleting substances
Air condition free
Engineering
Efficiency & effectiveness
Standardisation & prefabrication
Water
Leak detection
Water meters
Low flush toilets
Grey water reuse
Emergency backup system
Fire planning strategy
Operational waste
Provision of recycling facilities
Waste stream analysis
Storage for recycling
Compliance with HTM
Construction
Phasing plan
Maintenance
Robustness
Standardisation & prefabrication
Health & safety
Functionality
Uses
Function
Workflows & logistics
Flexibility & adaptability
Sufficient space
Security & supervision
Access
Transportation
Access & car parking
Ambulance
Service vehicles
Cyclists facilities
Distance to local amenities
Green transport plan
Disabled people
Pedestrian
Safety
Spaces
Standards and guidance
Space utilization
Storage space
Space segregation
Impact
Charact er & Innovati on
Architectural vision
Atmosphere
Exemplar
Stimulation
Management
Commissioning
Environmental management system
Education & training
Form & Mate rials
Scale
Building orientation
Entrance
Materials
External materials and detailing
External colours and textures
Prohibition of hazardous substances
Specificati on of building element
Staff & Patient Environment
Nature access
Privacy, company and dignity
Visual privacy
Private conversation
Gender segregation
Company
Toilet & bathroom
Views
Windows
Sky view
Ground view
Calming view
Interesting view
Control
Lighting patterns
Artificial lighting
Natural light
Temperature
Window & door
Legibility of place & way finding
Hierarchy of place
The way out
Stuff station
Characters
Land marks
Interior
Colour
Texture
Light & airy feeling
Art & plant
Light & shade
The ceiling
The floor covering
Cleanliness
Personal items
Facilities for patients
Bathroom furniture
Bathroom choice
Religious observances
Live performances
Furniture
Drinks facilities
Vending machines
Relatives/friends stay
Facilities for stuff
Changing place & lockers
Calm working place
Snacks & meals
Relaxing place
Access to IT
Banking & shopping
Urban & Social Integration
Surrounding environment
Locality
Land use & ecology
Protection of ecological features
Introduction to natural habitats
Neighbourho od & social issues
Links with community
Links to Local Agenda 21 initiatives
Sharing of facilities

Healthcare building Design Criteria			Source: AEDET	Source: ASPECT	Source: IDEAs	Source: NEAT	Consideration	Hospital architecture	Ward Design	Ward Spatial Arrangements	Privacy	Visual Privacy
Functionality	Uses	Function	√		√		The functional requirements and the relationships	√	√	√	x	x
		Workflows & logistics	√				The optimal arrangements of the workflows and logistics	√	√	√	x	x
		Flexibility & adaptability	√				The flexibility for the change and expansion and the adaptability in use	√	√	√	x	x
		Sufficient space	√		√		Sufficient spaces for the different activities and the workloads	√	√	√	x	x
		Security & supervision	√				The facilitation of control, security and supervision	√	√	√	√	√
	Access	Transportation	√		√	√	The provision of convenient and environmental friendly transportation system	√	x	x	x	x
		— Access & car parking	√			√	Good access from the public transport and adequate parking for staff and visitors	√	x	x	x	x
		— Ambulance	√				The provision of appropriate access for the ambulance vehicles	√	x	x	x	x
		— Service vehicles	√				The provision of segregated circulation from the public and staff access	√	x	x	x	x
		— Cyclists facilities				√	The provision of cyclist facilities for staff and visitors	x	x	x	x	x
		— Distance to local amenities				√	Closeness to public transport facilities and local amenities	x	x	x	x	x
		— Green transport plan				√	Encouraging the users to cycle or use public transport	x	x	x	x	x
		Disabled people	√				The appropriateness of access, parking and routs for disabled people	√	x	x	x	x
		Pedestrian	√				The way finding support, obvious and pleasant access and routes	√	x	x	x	x
		Safety	√				The appropriate lighting indicating paths, ramps and steps in the outdoor	x	x	x	x	x
	Spaces	Standards and guidance	√		√		The use of appropriate space standards and guidance	√	√	√	√	√
		Space utilization	√		√		Acceptable ratio of usable space to the total area	√	√	√	x	x
		Storage space	√		√		The provision of adequate storage spaces	√	√	√	x	x
		Space segregation	√		√		Achieving segregation between spaces when necessary	√	√	√	√	√
Impact	Character & Innovation	Architectural vision	√		√		Clarity of the architectural design vision and its appropriateness to the purposes of the building	√	x	x	x	x
		Atmosphere	√		√		Caring and reassuring atmosphere created by the building image	√	√	x	x	x
		Exemplar	√		√		Demonstrates an example of good architecture which influences the future design	√	√	x	x	x
		Stimulation	√		√		The variety and positive features in the design to make it interesting to look at	√	√	x	x	x
		Management				√	Targeting a better environmental performance through the management of the building	x	x	x	x	x
		— Commissioning				√	A comprehensive environmental management policy should include commitment from the highest level	x	x	x	x	x

		Environmental management system				√	The integration of environmental management system into the operational policy of the building	x	x	x	x	x
		Education & training				√	The dissemination of environmental management policy to staff	x	x	x	x	x
Form & Materials	Scale		√		√		Reflecting human scale and good proportions in the overall external form	√	x	x	x	x
	Building orientation		√		√		Well orientation to capture sunlight and to provide shelter from prevailing wind	√	√	x	x	x
	Entrance		√		√		Obvious entrance in a direct relationship with the arriving points	√	x	x	x	x
	Materials		√		√	√	The appropriate use of building materials	√	√	x	x	x
		External materials and detailing	√		√		High quality to enhance the design	√	√	x	x	x
		External colours and textures	√		√		Appropriate and attractive to articulate and enrich the building form	√	√	x	x	x
		Prohibition of hazardous substances				√	The hazardous substances on the environment should not be used	x	x	x	x	x
		Specification of building element				√	Attention should be given to the embodied energy of the different materials used in the building	x	x	x	x	x
Staff & Patient Environment	Nature access		√	√	√		Patients' access to nature outside and inside the building	√	√	√	x	x
	Privacy, company and dignity		√	√	√		The ability of patients to maintain their privacy and their interaction with others	√	√	√	√	√
		Visual privacy		√	√		Patients can chose to have visual privacy in bed area and changing area	x	√	√	√	√
		Private conversation		√	√		Patients can have private conversation	√	√	√	√	x
		Gender segregation		√	√		Gender segregation principles are reflected in the design	√	√	√	√	√
		Company		√	√		Patients have places where they can be with others	√	√	√	x	x
		Toilet & bathroom		√	√		Toilet & bathroom are located logically, conveniently and discreetly	√	√	√	√	√
	Views		√	√	√	√	The optimization of the patient, staff and public spaces with pleasant view	√	√	√	√	√
		Windows		√	√		Spaces where staff and patients spend time have windows	√	√	x	√	√
		Sky view		√	√		Patient and staff can easily see the sky	x	√	x	x	x
		Ground view		√	√		Patient and staff can easily see the ground	x	√	x	√	√
		Calming view		√	√		The view outside is calming	x	x	x	x	x
		Interesting view		√	√		The view outside is interesting	x	x	x	x	x
	Control		√	√	√		The ability of the patients to control their environment	x	√	√	√	√
		Lighting patterns		√			The appropriateness of the lighting patterns for day and night and for summer and winter	x	√	x	x	x
		Artificial lighting		√			Patients and staff can easily control the artificial lighting	x	√	x	√	√
		Natural light		√			Patients and staff can easily exclude the sun and day light	x	√	x	√	√
		Temperature		√			Patients and staff can easily control the temperature	x	√	x	x	x
		Window & door		√			Patients and staff can easily open windows and doors	x	√	x	x	x
	Legibility of place & way finding		√	√	√	√	The extent to which the design supports an intuitive way finding strategy and the extent to which the layout of the building is understandable by the users	√	√	√	x	x
		Hierarchy of place		√			There is a logical hierarchical structure of places in the building	√	√	x	x	x
		The way out		√			The way out is obvious	√	√	√	x	x
		Staff station		√			It is obvious where to find a member of staff	√	√	√	x	x

			Characters		√			Different part of the building have different characters and clear identity	√	√	x	x	x
			Land marks	√				Incorporating distinctive land marks into the design (art and sculpture)	√	√	x	x	x
		Interior		√	√	√		The interior of patients' spaces feel homely, warm and comfortable, interesting and support the healing process	√	√	x	x	x
			Colour		√	√		Variety of colour schemes which create warm and comfortable ambience co-ordinate for continuity and way finding	x	√	x	x	x
			Texture		√	√		Variety of textures	x	√	x	x	x
			Light & airy feeling		√	√	√	The interior feel light and airy	x	√	x	x	x
			Art & plant		√	√	√	The interior has the provision of art, plants and flowers	x	√	x	x	x
			Light & shade	√		√		Enhancing the three-dimensional space by the appropriate use of light and shade	√	√	√	x	x
			The ceiling		√	√		The ceilings are designed to look interesting	x	√	x	x	x
			The floor covering		√	√		Floors are covered with suitable materials	x	√	x	x	x
			Cleanliness		√	√		The interior looks clean, tidy and cared for	x	x	x	x	x
			Personal items		√			Patients can have and display personal items in their own space	x	√	x	x	x
		Facilities for patients		√	√	√		The provision of the important facilities for patient	√	√	√	√	√
			Bathroom furniture		√			Bathrooms have seats, handrails, non- slip floorings, shelf and reachable cloth hanger	√	√	x	x	x
			Bathroom choice		√			Patients can have the choice for bath/shower and assisted/unassisted bathroom	√	√	√	x	x
			Religious observances		√			There is a place where religious observances can take place	√	x	x	x	x
			Live performances		√			There is a place where live performances can take place	√	x	x	x	x
			Furniture		√			There are easy chairs, tables and desks in patients' space	x	√	√	x	x
			Drinks facilities		√			Patients have facilities to make drinks	√	√	√	√	√
			Vending machines		√			There are easily accessible vending machines for snacks	x	x	x	x	x
			Relatives/friends stay		√			There are facilities for patients' relatives/friends to stay overnight	√	√	√	√	√
		Facilities for staff		√	√	√		The provision of the important facilities for staff to lead their personal lives as well as their professional duties	√	√	√	x	x
			Changing place & lockers		√			Staff have a convincement place to change and securely store belonging and cloth	√	√	√	x	x
			Calm working place		√			Staff have a convincement place to concentrate on work without being on demand	√	√	√	x	x
			Snacks & meals		√			There are a convincement place where staff can speedily get snacks and meals	√	x	x	x	x
			Relaxing place		√			Staff can rest and relax in a place segregated from patients and visitors areas	√	√	√	x	x
			Access to IT		√			All staff have easy and convenient access to IT	√	√	√	x	x
			Banking & shopping		√			Staff have convincement access to basic banking facilities and can shop for essentials	√	x	x	x	x
	Urban & Social Integration	Surrounding environment		√				Height, volume and skyline of the building and its relation to the surrounding environment	√	x	x	x	x
		Locality		√				The building and the landscape contributes positively to the locality	√	x	x	x	x
		Land use & ecology					√	The appropriateness of land use and ecology protection	x	x	x	x	x
			Protection of ecological features				√	Ecological features present on the site should be maintained and adequately protected	x	x	x	x	x
			Introduction to natural habitats				√	The biodiversity of the land should be preserved	x	x	x	x	x
		Neighbourhood & social issues		√			√	The sensitivity of the building to its neighbourhood	√	x	x	x	x

			Links with community				√	The integration of the building in the wider community	x	x	x	x	x
			Links to Local Agenda 21 initiatives[21]				√	The link between the site an the local agenda 21 initiatives	x	x	x	x	x
			Sharing of facilities				√	The attempt of sharing the resources of the site with the local service providers and local community	√	x	x	x	x
Build Standards	Performance	Building operation		√				The building is easy to operate and clean	x	√	x	x	x
		Durability		√				The building will weather and age well	√	√	x	x	x
		Daylight & thermal comfort		√		√		The appropriate maximisation of the daylight and minimization of the solar gain	√	√	x	x	x
		Energy					√	The utilisation of energy efficient heating plant and lighting	x	x	x	x	x
			Carbon emission				√	Achieving reduction of carbon emission	x	x	x	x	x
			Heating & lighting control				√	An effective way to control heating and lighting	x	x	x	x	x
			Energy monitoring				√	The proper monitoring of energy through effective metering	x	x	x	x	x
			Alternative electricity tariff				√	The use of a "Green" tariff for electricity supply. The electricity tariff should have the majority of its supply from renewable or carbon neutral sources.	x	x	x	x	x
		Air quality		√				The optimization of the air quality for the building users	x	√	x	x	x
		Acoustic design and noise		√		√	√	Comfortable sound level, good sound insulation and enhancing the communication	√	√	√	√	x
		Pollution					√	The reduction and monitoring of the negative effect of the building on the environment	x	x	x	x	x
			Pollution monitoring				√	Monitoring the discharge and emissions to the air and water	x	x	x	x	x
			Ozone depleting substances[22]				√	The reduction of the use of ozone depleting substances	x	x	x	x	x
		Air condition free					√	Design building that does not need air conditioning if possible	√	√	x	x	x
	Engineering	Efficiency & effectiveness		√				Energy and power, telecoms and IT, hot water and steam, water and drainage, lighting, heating, ventilation, air conditioning system	x	x	x	x	x
		Standardisation & prefabrication		√				The optimum use of standardised and prefabricated engineering elements	√	x	x	x	x
		Water					√	The reduction of the demand for water	x	x	x	x	x
			Leak detection				√	Incorporation a proper leak detection system	x	x	x	x	x
			Water meters				√	Continues monitoring of water usage to identify high demand areas	x	x	x	x	x
			Low flush toilets				√	The use of low flush toilet systems	x	x	x	x	x
			Grey water reuse				√	The installation of grey water recycling system	x	x	x	x	x
		Emergency backup system		√				Emergency backup system that minimize disruption (medical gases, emergency generators, batteries, nurse call system, heating, lighting, hot water, cold water storage and telephones)	x	x	x	x	x
		Fire planning strategy		√				The incorporation of a clear fire planning strategy in the design	√	√	√	x	x
		Operational waste					√	The appropriate dealing with waste	x	x	x	x	x
			Provision of recycling				√	The provision of recycling facilities for staff and patients	√	x	x	x	x

21 Local Agenda 21 is a way for communities, individuals and organisations to move towards sustainable development in their area. All kinds of project work for LA21 is underway in local authorities, voluntary organisations, business and other groups.

22 Such as Hydrochlorofluorocarbons (HCFCs) which are used as refrigerants, in manufacture of some insulating materials and for fire fighting equipments.

	facilities										
	Waste stream analysis				√	Monitoring the waste	x	x	x	x	x
	Storage for recycling				√	The provision of storage for recycling for building use as well as local community	√	x	x	x	x
	Compliance with HTM				√	Compliance with the relevant Health Technical Memoranda	x	x	x	x	x
Construction	Phasing plan	√				The well organization of the various construction stages	x	x	x	x	x
Construction	Maintenance	√				The building can be readily maintained and the construction allows easy access to engineering system for maintenance	√	x	x	x	x
Construction	Robustness	√				The sufficient strength and integrity for the materials and component and the well detailed of the junctions between them	√	x	x	x	x
Construction	Standardisation & prefabrication	√				The optimum use of standardised and prefabricated construction elements	√	x	x	x	x
Construction	Health & safety	√				The health and safety requirements in the construction and operation process of the building	x	x	x	x	x

APPENDIX G

Practices with experience in hospital design in Edinburgh area, provided by: The Royal Incorporation of Architects in Scotland (RIAS).

RIAS CLIENTS' ADVISORY SERVICE

15 Rutland Square, Edinburgh EH1 2BE

24/07/2008

Thank you for your enquiry. Below is a list of practices which was generated by searching under the following skills and experience …**Hospitals**

I have also enclosed a copy of the RIAS Directory of Architects' Practices which contains details of over 570 practices across Scotland. The introduction gives guidance on working with your architect and the Practice Portfolio and Project Gallery sections contain examples of some of the practices' work. This information is also available online at **www.rias.org.uk/directory** where you can search under a range of criteria and any combination of over 150 skills and you can also use the live links to view the practices' own websites.

I hope you find this information helpful. We would ask you to let us know if you engage the services of an architect through this process and I wish you every success with your project.

June O'Hara
Membership Manager

3D Architects
11 Stafford Street
EDINBURGH
EH3 7BR
Tel 0131 225 4040
Fax 0131 225 4747
Email arch@edin.3dgroup.co.uk
Web www.3d-architects.com
Estb 1989
No of Architects 19 *Total Staff* 32
Principals
Charles Graham-Marr BArch Hons Dip Arch ARIAS RIBA
Calum MacDonald BSc Hons Dip Arch ARIAS RIBA
Barrie Turnbull BArch Hons Dip Arch ARIAS RIBA
Avril Cranston BSc Hons Dip Arch RIBA
Alex Donaldson BArch Hons ARIAS RIBA
Practice statement
3D provides a comprehensive design service to all our clients from offices in Glasgow, Edinburgh and Manchester.
The Practice has extensive expertise and experience in the successful delivery of projects within a wide range of sectors including retail, commercial, education, healthcare, leisure, residential, civic buildings, biotech, manufacturing and distribution.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Atkins
50 Melville Steet
EDINBURGH
EH3 7HF
Tel 0131 225 9301
Fax 0131 225 9837
Email info@atkinsglobal.com
Web www.atkinsglobal.com
Estb 1963
No of Architects 2 *Total Staff* 16
Principals
Peter Bruce BSc Arch BArch ARIAS
Ian Tempest BSc Hons BArch ARIAS RIBA FRSA MInstM
Practice statement
Atkins has three design offices in Scotland; Glasgow, Edinburgh and Aberdeen. We offer a comprehensive architectural service to our clients across all sectors throughout Scotland.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Bennetts Associates Architects
3 Boroughloch Square
EDINBURGH
EH8 9NJ
Tel 0131 667 7351
Fax 0131 662 1897
Email edin@bennettsassociates.com
Web www.bennettassociates.com
Estb 1987
No of Architects 11 *Total Staff* 12
Principals
Rab Bennetts BArch Hons Dip Arch RIBA
Denise Bennetts BArch Hons Dip Arch RIBA
John Miller BSc Dip Arch ARIAS RIBA
Practice statement
The Edinburgh office of an award winning UK practice with extensive experience of a wide range of buildings including commercial, educational and cultural.
Projects in Scotland Headquarters for BT at Edinburgh Park.
Gateway Centre for Loch Lomond National Park.
Medicentre in Inverness.
Laboratories and offices for Astronomy Technology Centre, Edinburgh.
Potterrow Development for University of Edinburgh.
Projects outwith Scotland
City Inn Hotel, Westminster, London.
City Inn Hotel, Amsterdam.
Awards
Ten RIBA Awards and numerous others.
Competitions
Languages

Camerons
16/4 Timberbush
Leith
EDINBURGH
EH6 6QH
Tel 0131 553 7959
Fax 0131 553 7984
Email edin@camerons.ltd.uk
Web www.camerons.ltd.uk
Estb 1963
No of Architects 4 *Total Staff* 13
Principals
Julie Slorach BArch Dip Arch ARIAS RIBA
Sam Coe BSc DA ARIAS RIBA MaPS
Mike Davidson BSc (Hons) BArch (Hons) ARIAS

RIAS Clients' Advisory Service (T) 0131 229 7545 / (E) cas@rias.org.uk / (W) www.rias.org.uk/directory

Fax 0131 220 1649
Email mail@edinburgh.hurdrolland.co.uk
Web www.hurdrolland.co.uk
Estb 1935
No of Architects 7 *Total Staff* 8
Principals
Alan Clyde BArch Hons ARIAS RIBA
Mike Rolland BArch Hons Dip Arch ARIAS RIBA
Ken Williamson BSc Hons Dip Adv Arch ARIAS RIBA
Practice statement
A national practice committed to design excellence and providing a professional service at a local level.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Hypostyle Architects
17 Bernard Street
EDINBURGH
EH6 6PW
Tel 0131 555 0688
Fax 0131 554 1850
Email edinburgh@hypostyle.co.uk
Web www.hypostyle.co.uk
Estb 2001
No of Architects 5 *Total Staff* 6
Principals
A Gerard Henaughen BSc(Hons) BArch ARIAS
Guy Maxwell BSc(Hons) BArch ARIAS RIBA
John Garrett BSc(Hons) BArch ARIAS RIBA
Keith Stewart BSc (Hons) BArch ARIAS
Practice statement
See Glasgow entry.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Jefferson Sheard Architects (UK) Ltd
26 Alva Street
EDINBURGH
EH2 4PY
Tel 0131 226 7179
Fax 0131 220 2252
Email gordon.benzie@jeffersonsheard.com
Web www.jeffersonsheard.com
Estb 1957
No of Architects 2 *Total Staff* 4
Principals
Gordon Benzie ARIAS RIBA
Campbell Mars
Michael F Conn
John McFarlane
Practice statement
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

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jm architects
64 Queen Street
EDINBURGH
EH2 4NA
Tel 0131464 6100
Fax 0131 464 6150
Email brian.thomson@jmarchitects.net
Web www.jmarchitects.net
Estb 1960
No of Architects 20 *Total Staff* 49
Principals
Peter Bowman ARIAS RIBA
Brian Thomson ARIAS RIBA
Ryan Fletcher ARIAS
Ron McFarlane
Lynn Algar
Practice statement
Design led award winning practice. Our approach enhances people's live, adds value and is sustainable.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Alan Jollie Associates
42 Redford Loan
EDINBURGH
EH13 0AX
Tel 0131 477 1848
Fax 0131 477 1848
Email alanjollie@blueyonder.co.uk
Web
Estb 1979
No of Architects 1 *Total Staff* 1
Principals
Alan Edward Jollie ARIAS
Practice statement
25 years in practice with experience in residential, nursing homes, offices and commercial projects.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Keppie Design Ltd
6 Bells Brae
Dean Village
EDINBURGH
EH4 3BJ
Tel 0131 220 3067
Fax 0131 220 3068
Email edinburgh@keppiedesign.co.uk
Web www.keppiedesign.co.uk
Estb 1995
No of Architects 10 *Total Staff* 26
Principals
Peter N Scott BSc (Hons) BArch ARIAS RIBA
T David Stark BSc (Hons) BArch ARIAS RIBA
Colin M Carrie BSc (Hons) BArch ARIAS RIBA
Martin P English BSc (Hons) Dip Arch ARIAS RIBA
John RW Miller BSc Arch BArch (Hons) ARIAS RIBA MaPS
David F Ross BArch Dip Arch (MSA) ARIAS RIBA
Andrew Pinkerton BSc (Hons) BArch ARIAS RIBA
Babak Sasan BSc (Hons) Dip Arch (Mack) ARIAS RIBA
Fiona M Storrier BSc (Hons) BArch ARIAS
Graham L McCorkindale MA (Hons) Dip Arch ARIAS
Peter Moran BSc (Hons) BArch
Charles Bell MBIAT
Geoff A Taplin BA BArch (Hons) ARIAS RIBA
Colin Burnet LLB CA
W Baxter Allan Dip TP MRTPI
Kenneth C Davie MA (Hons) Dip URP MRTPI
Gordon MacCallum DIP TP MRTPI
Fraser Low Dip Interior Design Credits MSCD
Practice statement
Leading edge quality design services in disciplines of architecture, planning, interior design and urban design.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Lewis & Hickey Ltd
1 St Bernard's Row
EDINBURGH
EH4 1HW
Tel 0131 343 6222
Fax 0131 332 7332
Email paul.mielel@lewishickey.com
Web www.lewishickey.com
Estb 1894
No of Architects 6 *Total Staff* 28
Principals
Paul Miele ARIAS RIBA MaPS
Colin Nicol ARIAS RIBA
Ken Ralston ARIAS RIBA
Mike Annand ARIAS RIBA MaPS
Practice statement
Other services available; safety management, project management, interior design, 3d visualisations, shop fit, research & development.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

McLaren Murdoch & Hamilton
2 West Coates
EDINBURGH
EH12 5JQ
Tel 0131 539 5000
Fax 0131 539 5011
Email mike.towers@mm-h.co.uk
Web
Estb 1967
No of Architects 9 *Total Staff* 13
Principals
MJ Towers FRIAS RIBA
WA Wallace ARIAS RIBA
Practice statement
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

The Morrison Partnership
242 Queensferry Road
EDINBURGH
EH4 2BP
Tel 0131 343 3114
Fax 0131 332 7836
Email
edin@themorrisonpartnership.co.uk
Web
www.themorrisonpartnership.co.uk
Estb 1983
No of Architects 4 *Total Staff* 8
Principals
George Morrison Dip Arch Hons (Abdn) ARIAS RIBA MaPS
Practice statement
Repeat business and referals our aim and reward for innovative and creative architectural solutions tempered by realism and financial awareness.
Projects in Scotland
Projects outwith Scotland
Awards
Midlothian Design Awards 2004 New Building Category - Highly Commended.
Competitions
Languages

Mottram Patrick Partnership
1 Burns Street
EDINBURGH
EH6 8DS
Tel 0131 554 7666
Fax 0131 554 8777
Email mottram.patrick@virgin.net
Web
Estb 1928
No of Architects 1 *Total Staff* 4
Principals
Graeme Maguire MA Hons Dip Arch ARIAS RIBA MaPS
Malcolm Hutchon BSc Dip Arch
Practice statement
Established practice with wide experience. Dedicated to satisfying clients requirements with a fast, friendly service.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Richard Murphy Architects
The Breakfast Mission
15 Old Fishmarket Close
EDINBURGH
EH1 1RW
Tel 0131 220 6125
Fax 0131 220 6781
Email
mail@richardmurphyarchitects.com
Web
www.richardmurphyarchitects.com
Estb 1991
No of Architects 10 *Total Staff* 21
Principals
Richard Murphy FRIAS RIBA
Practice statement
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Oberlanders Architects LLP
3rd Floor
62 George Street
EDINBURGH
EH2 2LR
Tel 0131 225 9070
Fax 0131 220 3783
Email mail@oberlanders.co.uk
Web www.oberlanders.co.uk
Estb 1983
No of Architects 16 *Total Staff* 18
Principals
David A Lawson FRIAS RIBA
Philip JS Macdonald ARIAS RIBA
Practice statement
Experienced, award-winning practice, delivering successful projects to clients in a variety of sectors.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Parr Architects Ltd
30 Roseburn Place
EDINBURGH
EH12 5NX
Tel 0131 476 7700
Fax 0131 476 7722
Email edinburgh@parrarchitects.com
Web www.parrarchitects.com
Estb 1956
No of Architects 7 *Total Staff* 19
Principals
Hugh Dykes BSc Arch Dip Arch ARIAS RIBA
Practice statement
Design based practice with experience of just about every building type there is, for every budget imaginable.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Reiach and Hall Architects
6 Darnaway Street
EDINBURGH
EH3 6BG
Tel 0131 225 8444
Fax 0131 225 5079
Email
tom.bostock@reiachandhall.co.uk
Web www.reiachandhall.co.uk
Estb 1965
No of Architects 19 *Total Staff* 43
Principals
Tom Bostock BArch Hons ARIAS RIBA
Neil Gillespie BArch Hons ARIAS RIBA
Andy Law Dip Arch ARIAS RIBA
Lyle Christie BSc BArch Hons ARIAS RIBA
Angus Wilson HNC
Practice statement
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Kenneth Reid Architects
The Design Place One
120-122 Thirelstane Road
EDINBURGH
EH9 1AS
Tel 0131 452 8590
Fax 0131 452 8591
Email kreid@kraarchitects.co.uk
Web www.kra-architects.co.uk
Estb 1994
No of Architects 4 *Total Staff* 8
Principals
Kenneth C Reid BArch Hons Dip Arch ARIAS RIBA
Practice statement
KRA, ten years of credentials, a wealth of experience and quality all the way.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Sinclair, Hay, Sutherland Partnership
9 Kingsknowe Park
EDINBURGH
EH14 2JQ
Tel 0131 444 0222
Fax 0131 444 0077
Email admin@shs-arch.co.uk
Web
Estb 1999
No of Architects 1 *Total Staff* 3
Principals
A Lyall Sutherland BArch (Hons) ARIAS
Phil Hay MaPS
Practice statement
Small, experienced partnership committed to quality & enjoyment in architecture. Fully CAD equipped.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

WS Architects
118 Hanover Street
EDINBURGH
EH2 1DR
Tel 0131 226 3338
Fax 0131 220 4136
Email admin@wsarchitects.co.uk
Web www.wsarchitects.co.uk
Estb 1954
No of Architects 4 *Total Staff* 5
Principals
Peter John McCormick BArch ARIAS RIBA
Kenneth Duncan Pye BArch ARIAS RIBA MaPS
Practice statement
Wide range of experience. Specialists in healthcare and residential. 35 Saltire and Civic Trust awards.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

Yeoman McAllister Architects
Waterside Studios
64 Coltbridge Avenue
EDINBURGH
EH12 6AH
Tel 0131 346 1145
Fax 0131 346 1189
Email
Web
Estb 1987
No of Architects 20 *Total Staff* 45
Principals
Murray N Yeoman BArch Hons Dip Arch ARIAS RIBA
J Brian McAllister BArch Hons Dip Arch ARIAS RIBA
Paul Harkin BArch Hons Dip Arch
Peter McMullan-Bell Dip Arch ARIAS RIBA
Practice statement
We are willing to challenge the prevailing mediocrity with the belief that design excellence need not prove more expensive.
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

---

zone architects
145 Lower Granton Road
EDINBURGH
EH5 1EX
Tel 0131 551 1973
Fax 0131 551 3469
Email info@zonearchitects.co.uk
Web www.zonearchitects.co.uk
Estb 2002
No of Architects 2 *Total Staff* 3
Principals
David Jamieson ARIAS RIBA
Suzanne Ewing
Practice statement
work consume home meet: reveal stretch colour collaborate: materialise play horizon invent
Projects in Scotland
Projects outwith Scotland
Awards
Competitions
Languages

APPENDIX H

Email sent to practices asking for information about their experience in hospital design

Dear Sir/Madam:

I am a PhD student at the School of the Built Environment at Heriot-Watt University. I am doing research concerning hospital ward design. In this stage of my research I am trying to identify the architectural practices and branches in Edinburgh which have been involved in hospital design.

Your practice has been listed in the database of The Royal Incorporation of Architects in Scotland (RIAS) which was generated by searching under the following skills and experience: HOSPITALS.

The research plan requires categorizing Edinburgh practices and branches according to their experience in healthcare buildings which involve accommodation for patients either short or long term.

In order to help me to do this, could you please provide me with the following information about your practice (in case of one-branch practice) or Edinburgh branch only (in case of multi-branches practice):
The number of healthcare buildings that contain accommodation for patients (wards) that your practice has been involved in, the type of each building (general hospital, community healthcare centre….. etc) and the size of each building (The number of beds).

You can use the attached table in Word format.

If you require further information on this research project or wish to discuss this please don't hesitate to contact me at address or phone number given below. In addition, my PhD supervisor Dr Harry Smith will be happy to provide any further information. You may contact him at 0131 451 4616 or by email at: h.c.smith@sbe.hw.ac.uk.
Many thanks for your co-operation.
I look forward to hearing from you.

Yours faithfully

Could you please provide the following information in the table below:

The number of healthcare buildings that contain accommodation for patients (wards) that your practice has been involved in, the type of each building (general hospital, community healthcare centre….. etc) and the size of each building (The number of beds).

The practice: …………………..			
NO	The name of the project	The type of the project	The size (Number of beds)
1			
2			
3			
4			
5			
6			

Once you filled the above table, could you please emailed back to me (ca21@hw.ac.uk).

Many Thanks for your co-operation.

Yours faithfully

Chaham Alalouch
PhD student, Heriot Watt University
School of the Built Environment
Sir William Arroll Building
Room 403
Edinburgh - EH14 4As
Phone: +44 - 131 451 8368
Mobile: +44 - 773 703 6222

APPENDIX I

A Summary of the semi-structured interviews carried out with experts in hospital design from the UK.

Interview 1:

The first expert to be interviewed is a director/partner of a practice which specialises in the design and realisation of healthcare buildings. He worked with the department of health as author of some new publications and with NHS as a member of their design review panel.

This expert initially ranked patients' privacy and dignity as the most important aspect in ward design. However, he later in the interview ranked infection control and good observation as more important than patients' privacy, because he thinks '*safety is something we can not compromise on*'. Moreover, he described privacy as a given for patients. He explained that the patient should have the privacy any way and nurses' observation should adjust around it. In addition, he thinks it is difficult to determine the least important aspect in ward design.

In addition to patients' privacy and dignity, infection control and good observation some other aspects of ward design were mentioned as important in this interview which are: access to sanitary facility in a dignified way, good view, good finishing and surfaces, giving the patient the control over the environment and creating enough social space.

He believed that patients' privacy should be considered from the early architectural sketches that it can not be fixed later. An example is one of his four-bed bay designs in which the patient does not directly face another person.

He thinks that there is a good social reason behind the multi-bed wards. However, he prefers four-bed bay more than six-bed bays. The reason for this preference is that in four-bed bays it is possible to adapt the design to allow a window for each patient.

In answering a question about the brief, he explained that the brief usually provides numbers about a particular project (i.e. number of beds and nursing clusters) and it refers to HBNs regarding the design aspects (HBN4 regarding ward design) which are the main information sources in addition to looking at examples and informal conversations with other people in the field.

Interview 2:

The second expert to be interviewed had 30 years healthcare experience in both private and public sector in different countries. He has authored and is assisting the NHS on a number of guidelines, HBN's, HTM's and workshops.

This expert's most important criterion of ward design is good observation and the least important is office support. He placed patients' privacy and dignity very high on the scale of importance.

He strongly agreed that privacy should be considered from the first stage of the design as that affects planning issues. An example he mentioned based on a practical design procedure in multi-bed wards is to locate the toilet in a place where patients can not see who is going in and out and to separate the shower from the toilet. However, he argued that single-bed rooms may achieve a better privacy.

An additional ward design aspect mentioned in this interview as important is flexibility on the ward level. In other words, offering a potential for creating sub-spaces into which the staff can expand. This expert mentioned two examples for this: first, offering offices which can be converted to overnight-stay rooms and second, a multi-bed room which can be converted to single rooms.

Regarding the information sources on ward design, he mentioned that the briefing does not provide more aspects of ward design but it provides what he called DNA signature of the hospital which dictates what the section of hospital will look like (e.g. T shape or Cross shape, 24 beds or 32 beds). However, he thinks there are a lot of combinations and permutations in ward design which are not shown in the document and not understandable by clinicians.

<u>Interview 3:</u>

The third expert to be interviewed is a director of a practice which specialises in healthcare buildings. He has long experience in medical architectural research and he is a consultant to NHS Estates for design and technical guidance.

In this expert's point of view, the privacy and dignity of patients are one of the most important aspects of ward design. On the other hand, he thinks offices are the least important in hospital wards because the concentration should be on the core clinical area to ensure that the clinical functions are easy to carry out with short travel distances even if that means loosing some offices or having them shared between more than one ward.

This expert argued that single-bed rooms are better than multi-bed bays for several reasons: they are better for privacy and dignity of patients, infection control, consultation, training, and teaching. Moreover, he thinks that it is a '*mistake in belief*' that single-bed rooms cost more in capital and revenue. He explained that in terms of the capital cost the number of single-bed rooms required is less than multi-bed ones because single-bed rooms are more efficient and flexible. And in terms of revenue cost there is no evidence that nursing people in single bed room is more expensive than nursing them in multi-bed bays.

He thinks that privacy can not be fixed by screening in multi-bed bays. He also thinks that using visual screens does not achieve the auditory privacy and creates an unequal environment. He added *'screening does not stop feeling of lose of privacy and dignity'*.

In answering a question about the briefing, he answered that the briefing does not provide more design criteria than those in the guidance which is an accumulation of results of research and knowledge based on long experience and good understanding of health care design. However, he added, there are other good information sources such as case studies around the world and updated literature review.

Interview 4:

The fourth expert to be interviewed was a director of healthcare in an international design practice with offices around Europe and America. Being in an international practice, allows him to bring influences from other countries and to build upon that.

This expert thinks that patients' privacy is a very important aspect in ward design. However, he finds it difficult to maintain privacy in multi-bed bays because the use of screens to separate patients may not allow some patients to benefit from the view. Hence, in a multi-bed ward privacy is compromised for other important aspects.

This expert rates the view to outside as the most important criteria of ward's design, he emphasised the importance of creating a relationship to outside spaces via distance and immediate view from the bed. He explained, a view to the ground is as important as the view to the sky and this combination can be achieved by bringing the window's sills down. On the other hand, he thinks there is no least important aspect in ward's design, as all design criteria are relatively important.

In this expert's point of view, single-bed rooms may improve the performance of the wards in terms of infection control, patients' privacy, patients' satisfaction, cleanliness and recovery time. Other important ward's design criteria mentioned in this interview are: The quality of the finishes and patients' ability to control their environment.

APPENDIX J

A Summary of the semi-structured interviews carried out with experts in hospital design from Syria.

Interview 1:

The first expert to be interviewed is an architect who is working for The Syrian Ministry of Health and responsible for checking and approving the architectural design of private hospitals.

This interviewee explained that there are no regulations regarding general hospital design (owned by public sector); however there is a document regulating private hospitals (owned by individuals) which has been issued in 1953. However, this document is quite poor architecturally and out of date. This expert summarized design criteria available in this document as the following: information about the minimum area of rooms and windows and recommendation for the provision of a toilet in each ward. According to the interviewee these criteria in addition to the provision of adequate area for bed movement are enough to design an acceptable ward.

This expert added that there are no guidelines to guide architects during the hospital design process. The main sources of information are the university textbooks, experience and doctors' requirements.

Although there is nothing in the available regulations regarding patient privacy, this expert thinks that patient's privacy is important and it could be improved by the architect.

Interview 2:

The second expert to be interviewed is an architect who designed a newly built hospital in Aleppo, Syria.

This expert agreed that there are no formal regulations regarding hospital design. However there are some guidelines from the Ministry of Health which are architecturally poor. The other sources of information in hospital design he usually refers to are: Neufert Architects' Data and Time Saver Standards. He believes that the information available on hospital design can be considered as the minimum information required for designing a hospital. Or information sources could improve hospital design in Syria.

On ward design level, he added that the psychological and physical condition of patients are both important, for example, a patient should see who is entering his space to achieve better visual privacy, which he thinks is an important issue for patients. Other important design criteria he mentioned are: the view, adequate area, the provision of a toilet in each ward, short travel distance between the bed and the toilet, and the correct use of colours and materials.

Interview 3:

The third expert to be interviewed was involved in several hospital projects and used to teach architectural design at Faculty of Architecture, Aleppo University, Syria.

Again, this expert confirmed that there are no regulations regarding hospital design. He added, staff working for ministry of health who are responsible of approving hospital designs have no experience and they stuck to an old fashion design style.

On the ward design level, he believes that it is important to consider the culture differences even between regions in the same country. He emphasized that it is essential to create adequate space to accommodate the different services required in different types of wards. This expert listed a number of detailed design aspects. These are: the provision of separate toilets for nurses and visitors in each ward; corridors within the ward should be wide enough; the use of an appropriate flooring material (e.g. linoleum) and reducing the number of tiles to the minimum.

This expert thinks that patient's visual privacy is required in special cases only, such as in case of the mental illness. He believes that it is better to allow the patients to communicate with each other rather than separating them even via curtains, so there is no visual privacy needed.

Interview 4:

The fourth expert to be interviewed was responsible for a refurbishment hospital project and he is teaching architectural design at Faculty of Architecture, Aleppo University, Syria.

This expert agreed that there are no regulations or guidelines to guide architects during hospital design process. The main sources of information are the personal experience and some hospital design references.

On ward design level, he thinks that the main design aspect is the provision of adequate areas to accommodate the functional use of wards and toilet. After achieving this, attention should be given to the provision of a space for the visitors. This expert emphasized the importance of the cleanliness in a ward environment. In addition, he thinks that patient's privacy is important.

Interview 5:

The last expert to be interviewed has designed several hospital projects in different areas in Syria and he is a lecturer at Faculty of Architecture, Aleppo University, Syria.

Again, this expert agreed that there are no formal regulations or guidelines concerns for hospital design. The main sources of information he usually uses are personal experience and some basic references in architecture such as Time Saver Standards. However, he added, the Ministry of Health provides basic information with regards to each individual project such as the number of beds required (i.e. the brief).

The most important design criteria in this expert's point of view are: the provision of sufficient area to accommodate all kind of activity that may be carried out in a ward, allowing natural lighting and ventilation, and designing spaces that are clear and readable. In response to a question about the visual privacy of patients, this expert argued that this particular aspect is at a lower level on the importance scale within a ward's environment and there is no need to use any kind of screening between patients including curtains in multi-bed wards. The reason for that in his opinion is that all patients are in the same condition.

APPENDIX K

The Email sent to a sample of architects inviting them to take the CBC survey.

Invitation to participate in a survey on hospital ward design

Dear Sir/Madam:

I am a PhD student at the School of the Built Environment, Heriot-Watt University in Edinburgh. I am undertaking a research project on hospital design with particular reference to hospital ward design criteria.

One of the methods I am using to address the research question is a web-based survey with architects and designers. The aims of this survey are: to gain insight into professionals' priorities of ward design criteria which may help policy makers to develop hospital design regulations and guidelines; and to evaluate professionals' awareness of the importance of particular ward design criteria. These criteria have been chosen based on in-depth interviews with a group of experts in hospital design in the UK.

Your participation in this study would be greatly appreciated. This questionnaire will not take long (about 10 minutes), as we understand you time commitments.

By clicking on the link below, the study's web page will open in your internet browser. You will be asked to type your user name and password. Please type the following unique user name and password:

User name:
Password:

http://www.sbe.hw.ac.uk/HWDC/HWDClogn.htm

Note: You may use the same username and password to restart an incomplete survey where you left off.

Your answers will be treated as anonymous and confidentially.

If you have any queries about this study please email me (Chaham Alalouch - ca21@hw.ac.uk) or my supervisor Dr Harry Smith (h.c.smith@sbe.hw.ac.uk).

Thank you in anticipation for your help.

Yours faithfully

Chaham Alalouch

APPENDIX L

The online CBC Survey. This appendix shows, as an example, only 4 choice tasks out of the 18 included in the original study.

Heriot-Watt University

School of the Built Environment

HERIOT WATT UNIVERSITY

Hospital Ward Design Criteria

Welcome to the Hospital Ward Design Criteria web survey

You are part of group of architects and designers who have been invited to give their opinion regarding hospital ward design criteria.Your participation is crucial for the study. We hope that you will enjoy and benefit from the reflection proposed here.

More information about the context and the methods of this study is provided at the end of the questionnaire. Alternatively, you can contact me by email (ca21@hw.ac.uk).

The questionnaire will not take long, as we appreciate the value of your time. This survey has been designed to take about (10) minutes and it consists of two sections: personal information and a section where you are asked to make choices on ward design features, which will enable us to undertake what is known as choice-based conjoint analysis.

If you decide to participate in this study, please type your user name and password which you can find in the email you received about this study and then click the "Next" button to continue...

User name:

Password:

Note: All answers are anonymous and confidential.

Next

Heriot-Watt University

School of the Built Environment

Hospital Ward Design Criteria

Thank you for agreeing to participate in this study

Please click the "Next" button to proceed to section One...

Next

0% 100%

Heriot-Watt University

School of the Built Environment

HERIOT WATT UNIVERSITY

Hospital Ward Design Criteria

Section One: Personal Information

The first section is about you and your experience. This information will be treated as anonymous and confidential and will not be passed on to third parties. It will be used in research publications only in aggregate form, without identifying individuals.

Please answer the questions below and click the "Next" button to proceed to the second section.

Q1- How many years of experience do you have in the field of architectural design?

- ○ - Less than one year
- ○ - 11-20
- ○ - 1-10
- ○ - More than 20 years

Q2- What is the highest degree of study you have completed?

- ○ Undergraduate degree (BA, BSc, etc.)
- ○ Masters (MA, MSc, Mphil, etc.)
- ○ Postgraduate diploma
- ○ Doctorate (PhD, DSc, etc)

Q3- Have you ever been involved in hospital design?

- ○ Yes
- ○ No

Q4- Have you stayed in a hospital ward as a patient?

- ○ Yes
- ○ No

Q5- Gender:

◯ **Male** ◯ **Female**

Q6- Age:

◯ **20-29** ◯ **40-49**
◯ **30-39** ◯ **49+**

End of section one, please click "Next" to proceed to the second section...

Next

0% 100%

Heriot-Watt University

School of the Built Environment

HERIOT WATT UNIVERSITY

Hospital Ward Design Criteria

Section Two: Choice-based Conjoint Analysis

Several criteria of hospital ward design have been considered in this section. In each question, two scenarios of ward design with different combinations of some of these criteria will be presented.

***Assuming that everything else is equal*, we will ask you to choose the ward which you think would be more beneficial for patients from your professional perspective.**

There are 18 independent questions. For each question, choose the ward you prefer and click the 'Next' button to continue. Do the same for each question, but do not think about or go back to the previous question.

The two wards may look similar but are not identical, so...

please read carefully

Next

0% 100%

Heriot-Watt University

School of the Built Environment

HERIOT WATT UNIVERSITY

Hospital Ward Design Criteria

In you professional opinion, which one of these two wards would be more beneficial for the patients?

Please assume that everything else is equal in the two wards.

Maximum control of cross infection risk	**Moderate control of cross infection risk**
Moderate nurses observation	**Good nurses observation**
View to an internal atrium	**View to natural landscape**
The ward's design allows flexible layout (by partitioning)	**The ward's design does not allow flexible layout (by partitioning)**
○	○

Please choose and click the "Next" button to continue...

Next

0% 100%

Heriot-Watt University

School of the Built Environment

Hospital Ward Design Criteria

In you professional opinion, which one of these two wards would be more beneficial for the patients?

Please assume that everything else is equal in the two wards.

High level of patient`s privacy	**Moderate level of patient`s privacy**
Moderate access to sanitary facility	**Easy access to sanitary facility**
Moderate space for social interaction	**Small space for social interaction**
Moderate travel distance	**Short travel distance**
○	○

Please choose and click the "Next" button to continue...

Next

0% 100%

Heriot-Watt University

School of the Built Environment

HERIOT WATT UNIVERSITY

Hospital Ward Design Criteria

In you professional opinion, which one of these two wards would be more beneficial for the patients?

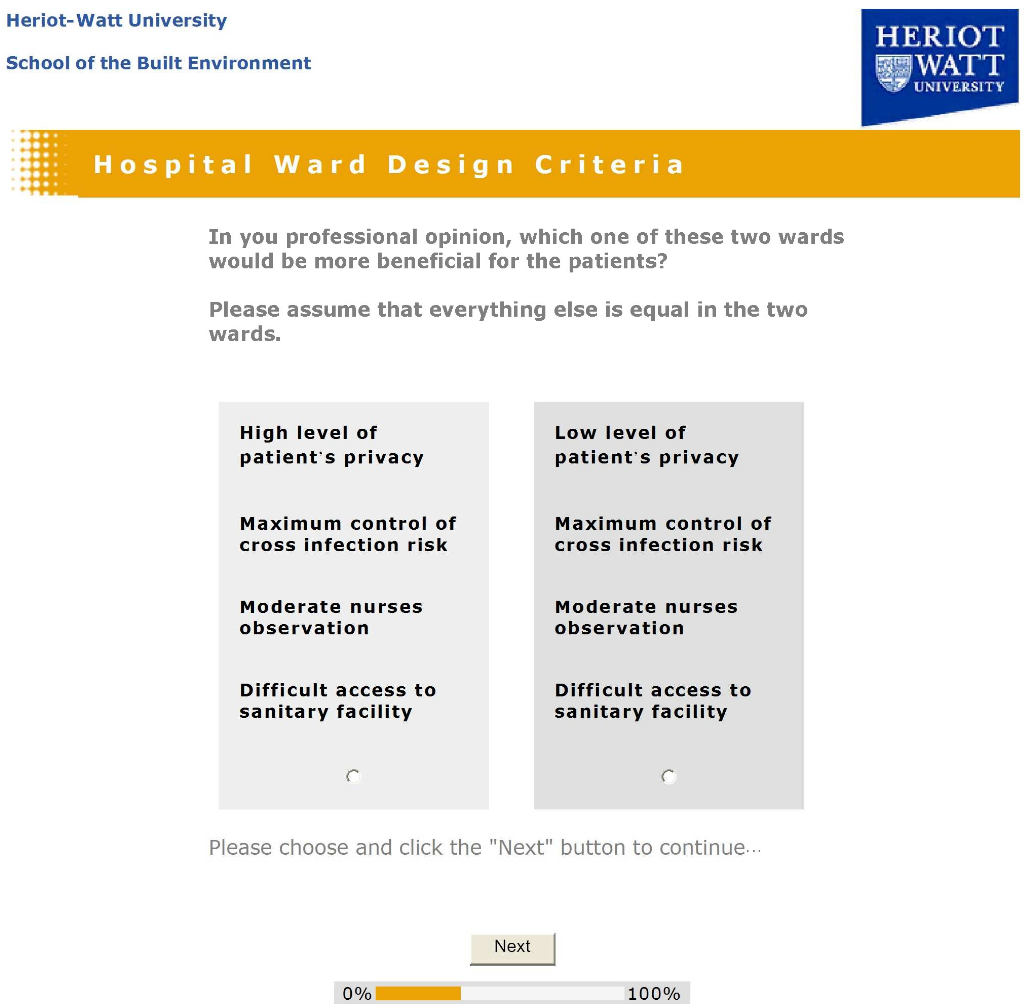
Please assume that everything else is equal in the two wards.

Moderate quality finishing and surfaces	**High quality finishing and surfaces**
The patient has a high level of control over the environment	**The patient has a moderate level of control over the environment**
The ward`s design allows flexible layout (by partitioning)	**The ward`s design does not allow flexible layout (by partitioning)**
Moderate travel distance	**Long travel distance**
○	○

Please choose and click the "Next" button to continue...

Next

0% 100%



Heriot-Watt University

School of the Built Environment

HERIOT WATT UNIVERSITY

Hospital Ward Design Criteria

In you professional opinion, which one of these two wards would be more beneficial for the patients?

Please assume that everything else is equal in the two wards.

High level of patient`s privacy	**Low level of patient`s privacy**
Maximum control of cross infection risk	**Maximum control of cross infection risk**
Moderate nurses observation	**Moderate nurses observation**
Difficult access to sanitary facility	**Difficult access to sanitary facility**
○	○

Please choose and click the "Next" button to continue...

Next

0% 100%

Heriot-Watt University

School of the Built Environment

Hospital Ward Design Criteria

This is the end of the questionnaire

Thank you for your interest, your help is highly appreciated

More explanation about the context and methods of this study is provided below.

Study Context

This Conjoint Analysis study is part of my PhD research on hospital ward design with particular reference to patients` privacy in open wards, at Heriot-Watt University. The aims of this conjoint study are: to gain insight into professionals` priorities in ward design criteria, which may help policy makers to develop hospital design regulations and guidelines; and to evaluate professionals` awareness of the importance of patients` privacy in hospital wards.

Conjoint Analysis (CA)

Conjoint analysis technique is a quantitative method which has been developed to measure human psychological judgments (i.e. importance or preferences) based on subjective information obtained from the respondents. It has been used widely in marketing research. Conjoint analysis is a `trade off` technique between different profiles with same attributes but in different levels.

Paper published from this research project

Alalouch, C. and Aspinall, P. (2007). "Spatial attributes of hospital multi-bed wards and preferences for privacy." Facilities, 25(9/10), p. 345-362.

http://www.emeraldinsight.com/Insight/viewContentItem.do;jsessionid=72FA75B1475E7304C6421C653EE5DCE7?contentType=Article&contentId=1614140

More about Conjoint Analysis

http://www.sawtoothsoftware.com/education/techpap.shtml

http://en.wikipedia.org/wiki/Conjoint_analysis_(in_marketing)

Contact: ca21@hw.ac.uk

0% 100%