BEDROOM LAYOUT BASED ON FENG SHUI CONCEPTION FOR SLEEP QUALITY IMPROVEMENT: CASE STUDY OF YOUNG FEMALE ADULTS IN MALAYSIA

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BEDROOM LAYOUT BASED ON FENG SHUI CONCEPTION FOR SLEEP QUALITY IMPROVEMENT: CASE STUDY OF YOUNG FEMALE ADULTS IN MALAYSIA

ABSTRACT

Feng Shui practices in a sleep environment have been criticised as myth over the years but in fact having its scientific origin that is not purely superstitious. This research intended to investigate whether the recommended *Feng Shui* approaches in bed arrangement is supportive to greater sleep efficiency and subsequently develop a design protocol for bedroom interior, specifically to young female adults in Malaysia. The research was conducted using a mixed methods triangulation approach. A self-report survey questionnaire was carried out to provide the human majority preferences in bed arrangement. Interviews to professional (interior) architects were also conducted to seek for their perceptions for the most ideal bedroom layout to boost sleep efficiency. Both survey and interviews were analysed using quantitative method. To reduce the validity problems in perception studies, case study by sleep experiments were then carried out using actigraphy monitoring system. The study delivered three findings in stages. Firstly, the most preferable bedroom arrangement was found to be identical to Form School *Feng Shui* model; and concurrently in compliance with the recommended bedroom *Feng Shui* rules in all situations. Secondly, the architect's perceptions of an ideal bedroom layout were predominantly determined as conforming to the recommended bedroom *Feng Shui* rules. Lastly, the bed arrangements according to favourable *Feng Shui* rules were validated as supportive to greater sleep efficiency among young female adults throughout the nights of experiments. Consequently, a design protocol for bedroom interior arrangement was developed based on the three research findings. The overall findings

supported that *Feng Shui* approaches in bed arrangement are scientific knowledge. It is expected to be valued as a contribution in sleep study and sleep environmental research, and as a foundation for future research in bedroom *Feng Shui*.

Keywords: bed arrangement, design protocol, *Feng Shui* conception, sleep quality.

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ABSTRAK

Amalan *Feng Shui* dalam bilik tidur telah dikritik sebagai mitos selama ini tetapi sebenarnya mempunyai asal saintifik yang bukan semata-mata karut. Kajian ini bertujuan untuk mengkaji sama ada cara-cara *Feng Shui* yang disyorkan dalam susunan katil dapat meningkatkan kecekapan tidur dan seterusnya membina sebuah protokol susunan dalaman untuk bilik tidur, khas untuk wanita dewasa muda di Malaysia. Kajian ini dijalankan dengan menggunakan kaedah penyelidikan bercampuran. Soal selidik telah dijalankan untuk menyiasat pilihan majoriti responden dalam susunan bilik tidur. Temubual kepada arkitek profesional juga telah dijalankan untuk menyiasat persepsi mereka bagi susun atur bilik tidur yang paling sesuai untuk meningkatkan kecekapan tidur. Kedua-dua soal selidik dan temuramah telah dianalisis dengan kaedah kuantitatif. Untuk mengurangkan masalah kesahan dalam kajian persepsi, kes kajian berdasarkan eksperimen tidur telah dijalankan dengan menggunakan sistem pemantauan actigraphy. Penyelidikan ini mencapai tiga hasil kajian secara berperingkat. Pertama, konsep susunan bilik tidur yang menjadi pilihan majoriti dalam semua keadaan didapati sama dengan konsep Form School *Feng Shui*; dan serasi dengan peraturan *Feng Shui* bilik tidur yang disarankan. Kedua, kebanyakan persepsi arkitek mengenai susun atur bilik tidur yang ideal telah disahkan sebagai mematuhi peraturan *Feng Shui* yang disyorkan. Ketiga, pengaturan katil mengikut peraturan *Feng Shui* telah disahkan menyokong kecekapan tidur di kalangan wanita dewasa muda di Malaysia. Seterusnya, protokol susunan

dalaman untuk bilik tidur telah dibina berdasarkan tiga hasil dalam kajian. Hasil kajian ini menyokong bahawa cara-cara *Feng Shui* dalam susunan katil merupakan pengetahuan saintifik. Ia dinilai sebagai sumbangan kepada bidang penyelidikan kualiti tidur dan bidang penyelidikan tempat tidur, dan sebagai asas untuk kajian dalam *Feng Shui* bilik tidur pada masa hadapan.

Kata kunci: susunan katil, protokol reka bentuk, konsep Feng Shui, kualiti tidur.

ACKNOWLEDGEMENTS

Along the years of preparing this dissertation, there were moments to be remembered and cherished. On my way to generate the research output, I have learned a lot of precious knowledge and get hold of significant experiences. Moreover, I have developed better relationships and greater skill of communication with a pool of experienced researchers, professional architects and also interior designers.

First and foremost, I would extend my sincere thanks to my supervisors, Dr. Sr. Mohd Suhaimi Bin Mohd Danuri, Professor Dr. Hamzah Abdul Rahman and Professor Dr. Wang Chen for their patience, guidance and constructive criticism throughout the research. Without their advice and assistance, my entire preparation for this research may not be so meaningful.

I would like to express my deepest gratitude to the six (6) young ladies who have importantly contributed their precious time to the sleep experiments. Besides, I would like to express appreciative thanks to the 405 respondents that participated in the questionnaire survey and 16 anonymous architects who entertained my interviews, for their honest responses and original information. I would also like to express my gratitude to the pool of Feng Shui masters and architects who had contributed their insights in the validation of final design protocols.

Last but not least, I would like to thank my husband Low Han Loong, my dearest sons Edward Low and Howard Low and my peers for their encouragement, supports and good humour throughout this research.

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BMI	Body Mass Index
ECG	Electrocardiogram
EDS	Excessive Daytime Sleepiness
EEG	Electroencephalogram
EMG	Electromyogram
EOG	Electro-oculogram
LO	Lights Out (beginning of sleep recording)
N	Narcolepsy
NREM	Non-Rapid Eye Movement (sleep)
PSG	Polysomnogram
QS	Quiet Sleep
REM	Rapid Eye Movement (sleep)
RLS	Restless Leg Syndrome
SE	Sleep efficiency
SEM	Slow Eye Movement
SL	Sleep latency
SPT	Sleep Period Time
TIB	Time in Bed
TMT	Total Movement Time
TREM	Total REM Time
TRT	Total recording time
TST	Total Sleep Time
TT	Total Time
TWT	Total Wake Time

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CHAPTER 1 – INTRODUCTION

1.1 Introduction

Chapter 1 delineates an overview of the entire research, presenting the introduction to the chapter and describes the research background, problem statements, research aims and objectives, research significance as well as the research scopes of study. A synopsis of research methodology has been discussed briefly to end this chapter. *Figure 1.1* delineates the framework of this chapter.

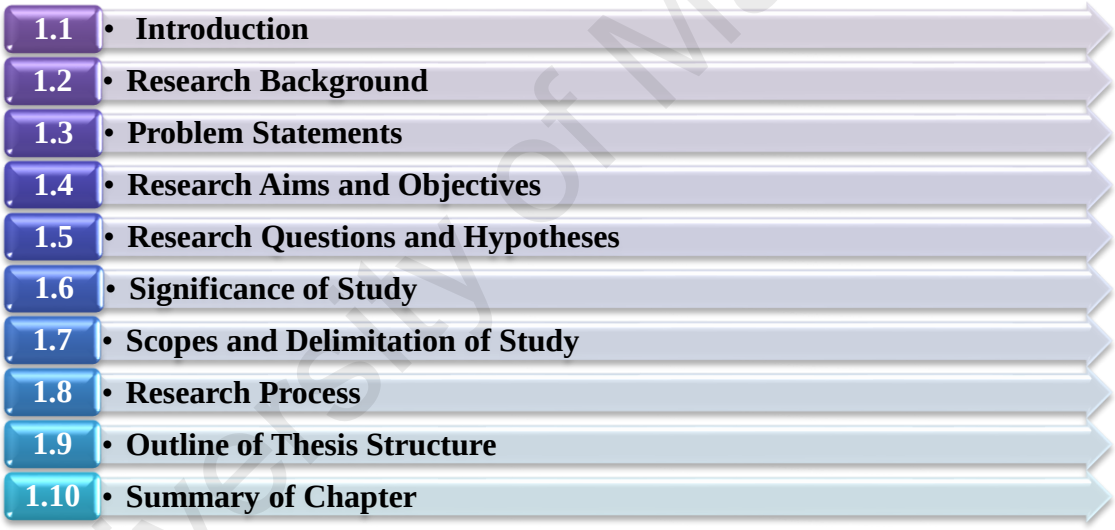


Figure 1.1: The structure of Chapter 1.

1.2 Research Background

Interior planning and design are mainly intuitive practices based on designers' experiences and inventive thoughts. It has no regulations of its own but a functional supportive design is truly demanded. Its surface jobs sound like an art but in fact involving scientific disciplines in supporting place making that is important for human well-being,

particularly in a sleep environment. Thus far, the codes of practice for interior arrangement have not been formulated.

Improving the sleep environment is actually improving a third of our life. In a sleep environment, the nature of interior arrangement involves creativity, sensibility and logical system for the importance of human comfort and well-being. When thinking about human well-being from an (interior) architectural perspective, both the objective conditions of the built environment as well as the human subjective experiences are the concerns. These are also concerns that are key to environmental psychology (Petermans and Pohlmeyer, 2014). Hence, interior arrangement is referred as a multidiscipline process that bridging art, science and humanity to reflect social, functional and aesthetic considerations, which is similar to the application of *Feng Shui*.

From the past review, apart from personal emotions, lifestyle and individual health conditions; sleep quality appears to be influenced partly by sleep environmental factors. However, over the years, research were massively attentive to human comforts such as air and light quality, acoustics and several others that connecting to individual nocturnal sleep quality. Bedroom interior arrangement has never been documented as one of the contribution to sleep problems in most circumstances.

Bluyssen (2008) referred the interaction of air, light and sound with the form and materiality of architectural space is the core of architectural thoughts for a healthy and comfortable indoor environment. Hence, the way of how the bed is organised may affects human physical comforts and emotional health especially when the threats of noise, smell; cold wind and flickering light from the external are directly channelled to the bed. Other than providing comforts, it is possibly a non-pharmacologic factor in managing sleep problems.

Besides, the extent to which *Feng Shui's* goal in pursuing coexistence between human and nature, offer a framework in approaching modern architecture. As zooming into

micro environment, *Feng Shui* and architectural design are both sharing the same goal i.e. to promote wellness and harmony of the space for all users. In a sleep environment, the critical goal of its interior arrangement is to create physical surroundings that are 'psychologically supportive' (Tanner & Langford, 2003) and supportive to comfortable conversation and visually balanced composition (Merrell, Schkufza, Li, Agrawala, & Koltun, 2011). This concept is most probably in compliance with the ideal *Feng Shui* concept for a bedroom interior.

Alike the Western science of architecture, *Feng Shui* applied for a sleep environment focuses on the basic needs for human comfort being, aesthetic and place making. According to Lynch (2003), *Feng Shui* is probable a design instrument that is more integrated than those currently employed by the design professions. It possesses supportive values for physical and mental well-being in a practical way rather than strictly superstition. These days, architects are getting more interests on the application of *Feng Shui* concepts into building design, especially in the last century, largely in interior design (Leyten, 2008). Ow et al. (2006) emphasized the significance to incorporate *Feng Shui* knowledge into interior design system for both customised interior design and furniture placement functions. Rossbach (as cited in Mak, 2011, p.2) brought *Feng Shui* immediately into interior design conception through her book of *Interior Design with Feng Shui* published in 1987 and its fame developed eternally since in America.

Meanwhile, the consequences of not complying *Feng Shui* practices in a sleep environment were often over exaggerated. In addition, the post-modern *Feng Shui* practitioners used to employ *Feng Shui* instruments such as animal statues, colours and paintings and etc. for a bedroom. However, those are believed to engage with commercialised technique because there are doubts on how a lifeless instrument, can stimulate the dwelling *Qi* or energy. Thus these are the uncertainties which may lead to inaccurate *Feng Shui* knowledge practice.

In fact, *Feng Shui* approaches have been subconsciously practiced by most people in the past and present. Many *Feng Shui* restrictions in bed arrangement are found to be logical in terms of psychological analysis as they are generally countering noise, lighting disruption, impact of aggressors and etc. These *Feng Shui* thoughts are likely to afford most users' desired paradigm in the sleep environment as proven by Hong, Abdul-Rahman & Wang's (2016) study. *Feng Shui* rules in bed placement are perceived as supportive to healthier emotions and better sleep quality.

Although there are some guiding principles originated from practitioners to empirical data concerning how a healthy sleep environment should be built and designed, *Feng Shui* approaches were hardly convinced as one of the important reference in the academic researchers' perspective. The academic researchers, Mak & Ng (2005) have validated the *Feng Shui* approach based on Form School theory was concurrent with modern architects' thoughts in both Hong Kong and Sydney, for both external landform and also interior layout of buildings. In view of the fact that modern practices and knowledge of Western and Eastern architects on building environment studies are concurrent with Form School concepts, it is strongly believed that the similar research can be reproduced by applying the same concept into the sleep environment.

As a result, a systematic assessment for Feng Shui knowledge in the sleep environment is critical for public recognition. An intensive study in bedroom *Feng Shui* is required to substantiate the connection between bed positions and sleep quality via scientific methods in order to benefit the users in long term basis. We are therefore probing to see whether the *Feng Shui* thoughts is present as the foremost humankind needs in a sleep environment rather than other bedroom functional requirements from multiple perspectives.

This research firstly employed questionnaire survey to investigate the human perceptions on their most preferable bedroom interior arrangement in different prearranged scenarios based on *Feng Shui* approaches. The respondents' choices were

then compared with the ideal model based on Form School *Feng Shui* concepts and the common bedroom *Feng Shui* rules in bed arrangement. Concurrently, the subjective sleep quality evaluation and psychological impacts attributed to their choices of arrangements were explored.

Secondly, semi-structured interviews were designed for contemporary architects of multicultural backgrounds to seek for their perceptions in design procedures and design criteria of a bedroom interior. During the interview session, each interviewee was invited to produce a bedroom layout drawing (with predetermined basic components) which is ideally comfort for sleep activity based on their proficiency of more scientific derivation. The architects' drawings were then served as the basis of scientific model to be compared with the ideal bedroom *Feng Shui* model.

Subsequently, case studies by sleep experiments were conducted for young female adults. The experiments employed wrist actigraphy and Pittsburgh Sleep Quality Index (PSQI) to evaluate human sleep quality in different prearranged scenarios based on *Feng Shui* approaches. The sleep quality indicators such as sleep efficiency (SE) and Pittsburgh sleep quality index (PSQI) were used to determine whether the recommended *Feng Shui* conception is supportive to better sleep quality.

Lastly, a set of bedroom design protocol with embedded scientific elements in *Feng Shui* was established. The new protocol was developed based on the results of questionnaire survey, interviews to architects and sleep experiments. The model of such design protocol shall be equipped with clear and logical flow of stages in seeking an ideal bed arrangement in different bedroom scenarios.

This research performs an interdisciplinary research, bridging the gaps between interior configuration, *Feng Shui* ideas and human well-being in a sleep environment. It intends to reinforce the empirical basis of *Feng Shui* theories applied into a sleep environment. The core attention in this research is to develop a design protocol for

bedroom interior, by adopting the blending ideas of *Feng Shui*, sleep-wake ratio, architectural insights and human perceptions. The rationale of this research has no intention to restrict the freedom of arts and arrangement in architectural design perspective but urges the significance of applying this ancient *Feng Shui* knowledge as an alternative approach for designing a bedroom interior.

1.3 Problem Statements

Problem statements are referred to statements with conflicts or controversy, showing research gaps between what is required and what is observed. As the world is teeming with many unresolved problems, seeking a suitable subject for research shall be highly dependent on a few criteria such as personal interest, significance of the issues and the depth of study.

In this research, *Feng Shui* knowledge in a sleep environment does provides lively interest to the author and hence the arisen problems in this topic will be an invaluable incentive to persevere. Besides, the gaps between sleep environment design and *Feng Shui* thoughts conveyed a significant relationship which is worth to be investigated as compared to other trivial problem which has already been done elsewhere. About the coverage of research area, a more detailed study is preferred rather than a superficial one. Only specific issues within the set area of investigation are highlighted.

The research problem for the existing study come from various sources such as modern literature, classical *Feng Shui* theories, personal and practical experience. Personal and practical experience is a valid source of evidence for writing problem statements as supported by research methodology guides from Fischler (2014), SOAS University of London (n.d.) and New York University (2006). Table 1.1 shows problem statements describing an existing issues or gaps which require to be addressed and outline what is to be investigated in this study.

Table 1.1: Problem statements shall imply solutions to the issues and establish a context for the audience.

Problem Statements	Source of Evidence	Deficiencies in the Evidence	Audience
Due to a lack of a properly documented *Feng Shui* principles and guidelines, it is difficult for architects to apply the knowledge of *Feng Shui* in further enhancing their design. (Mak and Ng, 2005)	Literature	• Verification of *Feng Shui* principles by scientific approaches. • Establish a more structured code of practice for *Feng Shui* application.	• Architects/ design team - provide a benchmark in design works. • Researchers - create a platform for future research.
Feng Shui restrictions for a sleep environment shall have their own scientific origin which is not purely superstitious: a) Sleeping in alignment with door is a dead coffin position in *Feng Shui* (Shi, 2010; So & Lu, 2001). b) A window behind the bed signals upcoming health problems (Ho, 2012; Too, 2010) c) Sleeping with mirror facing to bed may invite unwanted third party into the couple's relationship (Shi, 2010; Too, 2010).	*Feng Shui* Theory and Literature	• Verification of *Feng Shui* principles by scientific approaches. • Cart away the superstitious part of bedroom *Feng Shui*.	• Researchers - create a platform for future research.
The remedy of changing bed location for better sleep quality has been practised among general bed users and insomniac without further research. A universal way of bed arrangement is essential for better human comfort, health and well-being however a well-structured design protocol for bedroom interior has not been formulated.	Personal and Practical experience	• A published design protocol for bedroom interior	• Architects/ design team - provide a benchmark in design works. • General users or insomniac - Alternatives to improve sleep quality.

1.4 Research Aims and Objectives

This research aims to contribute an alternative approach for bedroom interior arrangement through a set of scientifically proven design protocol in order to support better sleep efficiency and general well-being, specifically for young female adults in Malaysia. The stated design protocol will be developed based on bedroom *Feng Shui* conception (after completed multiple-dimensional verifications), with clear and logical flow of stages in seeking an ideal bed arrangement in different bedroom scenarios. The final recommended design protocol for bedroom interior is expected to complete with the aid of diagram, serves as an important reference for the design team, researchers, the public and even the sleep deprived category, specifically for young female adults in Malaysia.

The four (4) **research objectives** in this research are:

i. To identify whether the human most preferable arrangement in a sleep environment is corresponding to the bedroom *Feng Shui* conception and concurrently evaluates the sleep quality and psychological impacts attributed to their choices of arrangements in subjective manner.

ii. To examine the modern architects' perceptions in design procedures for a bedroom interior and assess whether the bedroom layouts produced by these architects are corresponding to the bedroom *Feng Shui* conception.

iii. To evaluate whether an ideal *Feng Shui* bed arrangement is supportive to better sleep quality using sleep experiments by wrist actigraphs and Pittsburgh Sleep Quality Index (PSQI).

iv. To develop a set of design protocol for bedroom interior based on the verified *Feng Shui* conception in objectives i, ii and iii.

1.5 Research Questions and Hypotheses

Based on the research objectives as stated in section 1.4, this study seeks to arise and explore several research questions and hypotheses. The linkages between the research objectives, research questions and research hypotheses are outlined in Table 1.2.

Table 1.2: The research questions and hypotheses addressed by each research objective.

Objectives	Research Questions	Research Hypotheses
I	Is the *Feng Shui* concept applied for bed arrangement a pragmatic approach that is broadly accepted by majority bed users?	It is hypothesized that the human most desired paradigm in a sleep environment is corresponding to the bedroom *Feng Shui* conception.
II	Is the recommended *Feng Shui* rules applied for bed arrangement parallel with the architectural design criteria for a bedroom interior?	It is hypothesized that the design criteria for a bedroom interior from the majority architects' design practice are corresponding to the recommended bedroom *Feng Shui* rules.
III	Is the *Feng Shui* concept applied for bed arrangement able to enhance human sleep quality?	It is hypothesized that an ideal *Feng Shui* bed arrangement is supportive to better sleep quality.

1.6 Significance of Study

The expected results of this study shall bring bedroom *Feng Shui* beyond the shadow of superstition in the built environment with scientific consent, so that this ancient Chinese wisdom is well recognised by the nation and universal level. Besides, the research aims to create a more harmonious and healthier sleep environment based on the validated *Feng Shui* components shall be achieved. The contribution of this research will be a design protocol of bedroom interior with clear and logical flow of stages for the purpose of seeking an ideal bed arrangement in different bedroom scenarios. The completed design protocol is anticipated to serve as an important reference for the design team, researchers and the users specifically for young female adults in Malaysia.

1.7 Scope and Delimitation of Study

The overall study predominantly covers *Feng Shui* knowledge in bed arrangement based on the Form School concept and theory of *Yin* and *Yang.* The exploration on *Feng Shui* eight cardinal directions and placement of *Feng Shui* objects or tools in a sleep environment are excluded.

On overall, respondents for the questionnaire survey, interviews, sleep experiments and even the expert validation will not be informed that the research is regarding bedroom *Feng Shui*. A more scientific terms and statements will be used while conveying the message to the invited research participants.

The respondents for questionnaire survey are limited to local people with multi-cultural background. The author targets 250 respondents and expected to take not more than 2 months to complete the survey. The survey data will be analysed using SPSS.

For the interview to modern architects, interviewees are limited to local practicing architects or interior designers from different cultural background. The author targets 15 interviewees and expected to take not more than 4 months to complete the interviews.

The case study to young female adults by sleep experiment is only conducted in Klang valley area, examining on 5 participants' sleep quality with different bed arrangements based on 5 predetermined *Feng Shui* rules. The participants are limited to young female adults aged around 18 to 25. They must agree on the terms and conditions while using wrist actigraphs during the experiment period, and complete the survey of Pittsburgh Sleep Quality Index (PSQI) to quantify sleep for research analysis. It is expected to take approximately 4 months to complete the experiments.

1.8 Research Process

The research process is drafted in a flow chart as shown in Figure 1.2. The research activities commenced with the formulation of research proposal, followed by literature review studies and selection of research methods and strategies. The process then proceeds to execution phase i.e. to carry out actual surveys and experiments, collect necessary data, running analysis and discussion of research findings. To end the process, a new output is developed prior to draw the research conclusions.

1.8.1 Formulation of Research Proposal

Before launching into a research proposal, the research began with a review of precedent works about *Feng Shui* application the built environment in order to confirm a specific research area of study. The researcher needs to consider whether the topic is researchable by identifying the gaps and research problems. After the research problems are confirmed for a more specific research topic i.e. the bedroom *Feng Shui*, the researcher then moves into the process of formulating research aims and objectives followed by drafting research methods, process and strategies.

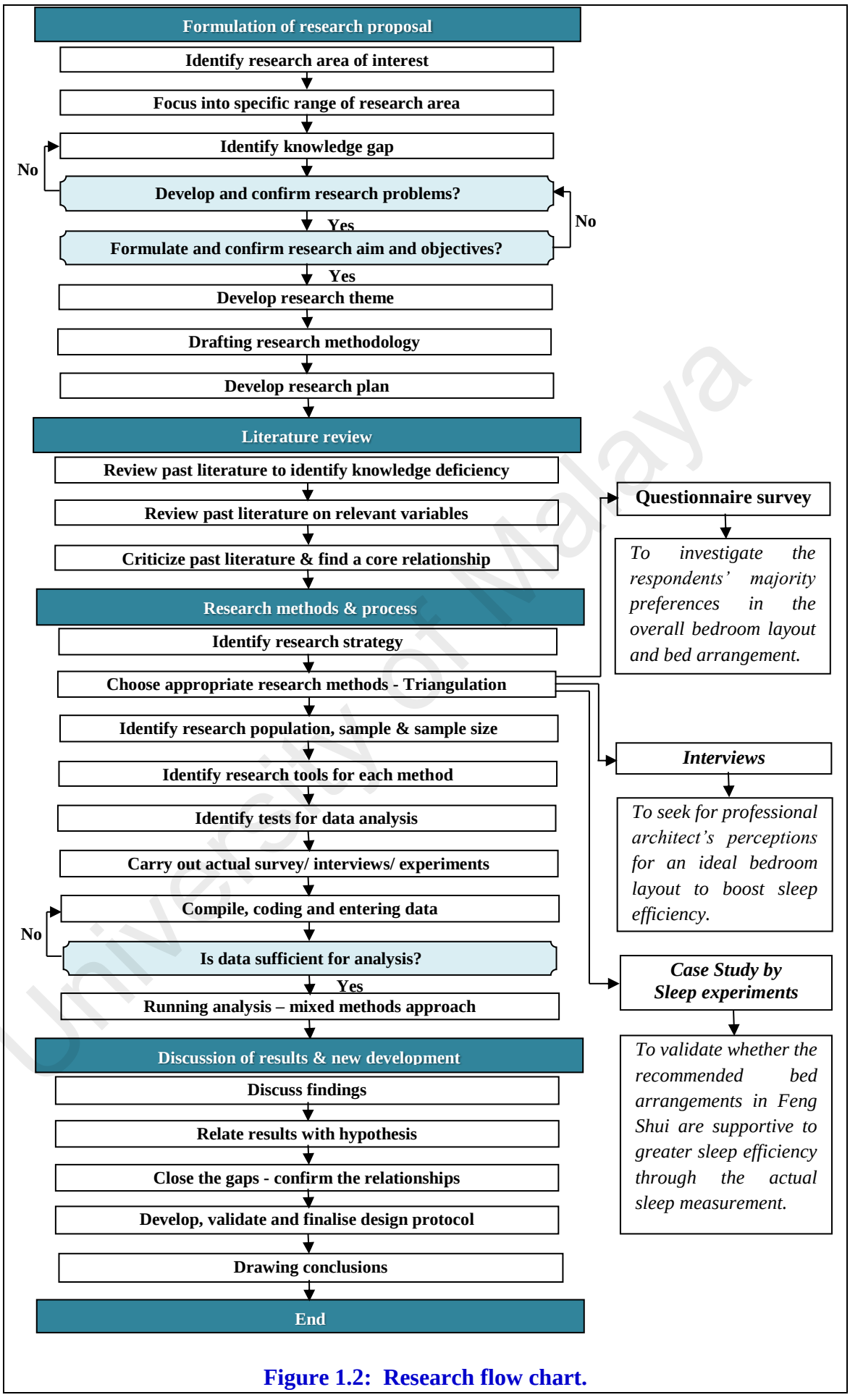


Figure 1.2: Research flow chart.

1.8.2 Literature Review

A review of the past literatures about *Feng Shui* knowledge applied to a sleep environment and its relationships with scientific viewpoints are required after the research proposal stage. It is necessary to explore on research relevant variables, to identify knowledge deficiency and to find a core relationship between theoretical and practical issues. Critical review and essential inductive analysis of the literature may help to provide a framework for establishing the significance of the research as well as becomes a benchmark for comparing the results with other findings. The related literatures were mainly from electronic and non-electronic journal articles, reference books, conference proceedings, dissertation, research blogs etc. The literature hunting usually incorporated web-based technologies such as Google Scholar, ProQuest, and UM interaktif (digital resources of University Malaya Library).

1.8.3 Research Methods and Process

The research strategies will be identified at this stage. It involves seeking primary sources data from an open questionnaire survey, interviews to architects and sleep experiments to accomplish the first three objectives. Figure 1.3 represents the sequence of the research methodology and the objectives anticipated to achieve in each data collection technique. Justifications on the selection of each research method and the research design were further explained in Chapter 3. A design protocol for bedroom interior was then developed based on the findings of the three (3) stated methods. Apparently, triangulation method was used to test the research variables, combining both qualitative and quantitative approaches to serve the research purposes. Figure 1.4 demonstrates the triangulation research method arranged for this research. The researcher then required to identify the research population, sample & sample size, research instruments for each method and the tests for data analysis. After these components are

established, the actual survey, interviews and experiments will be carried out. The researcher runs analysis using mixed-method approach only when the data are fully collected.

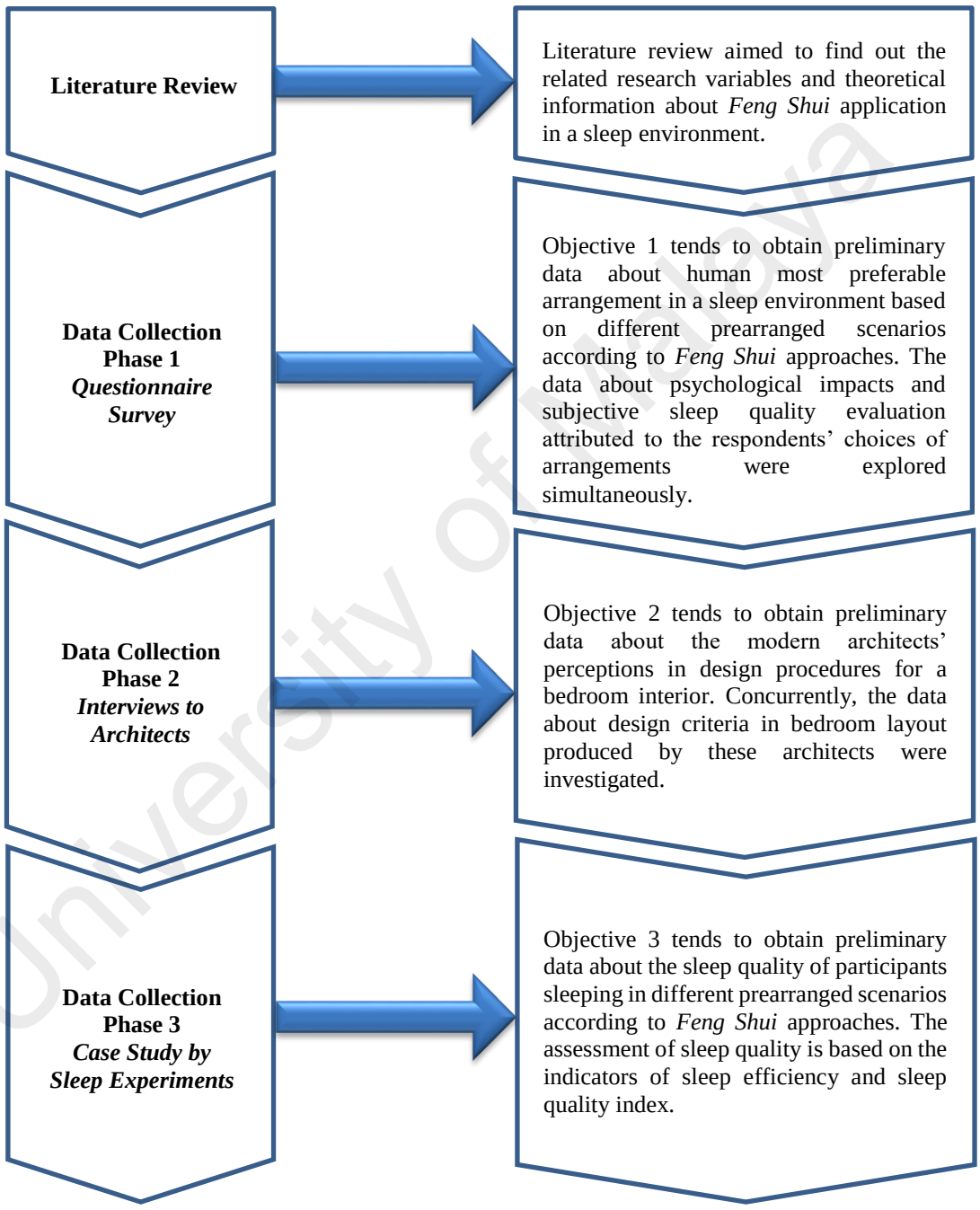


Figure 1.3: The sequence of research methodology and the anticipated objectives to be achieved.

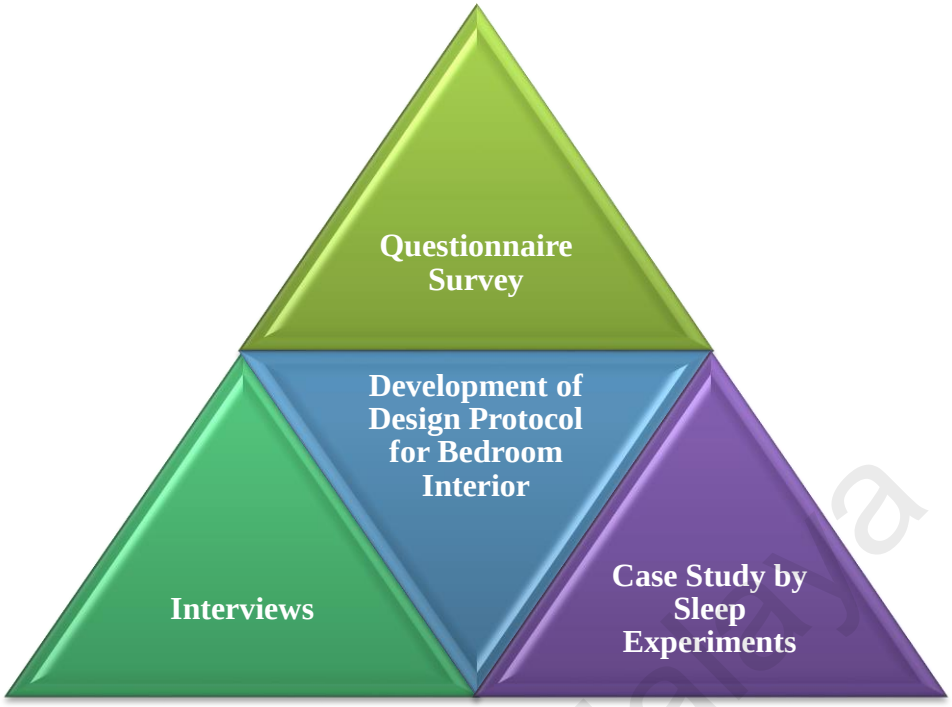


Figure 1.4: The framework of triangulation research method arranged for this research.

1.8.4 Discussion of Results & New Development

In this stage, the results of each method were analysed with interpretative discussion and linked back to the hypotheses made for each research objective. The discussions were required to close the research gaps and to confirm the expected relationships. All research findings are to be compared and subsequently to develop a design protocol for bedroom interior. Subsequently, the developed protocol will be validated by a pool of experts for its practicality and comprehensiveness. The validated model is then finalised and recommended as an alternative approach for bedroom interior arrangement for better sleep. Conclusions were drawn after the developed protocol is finalised.

1.9 Outline of Thesis Structure

The thesis was divided into eight (8) major chapters as shown in Figure 1.5.

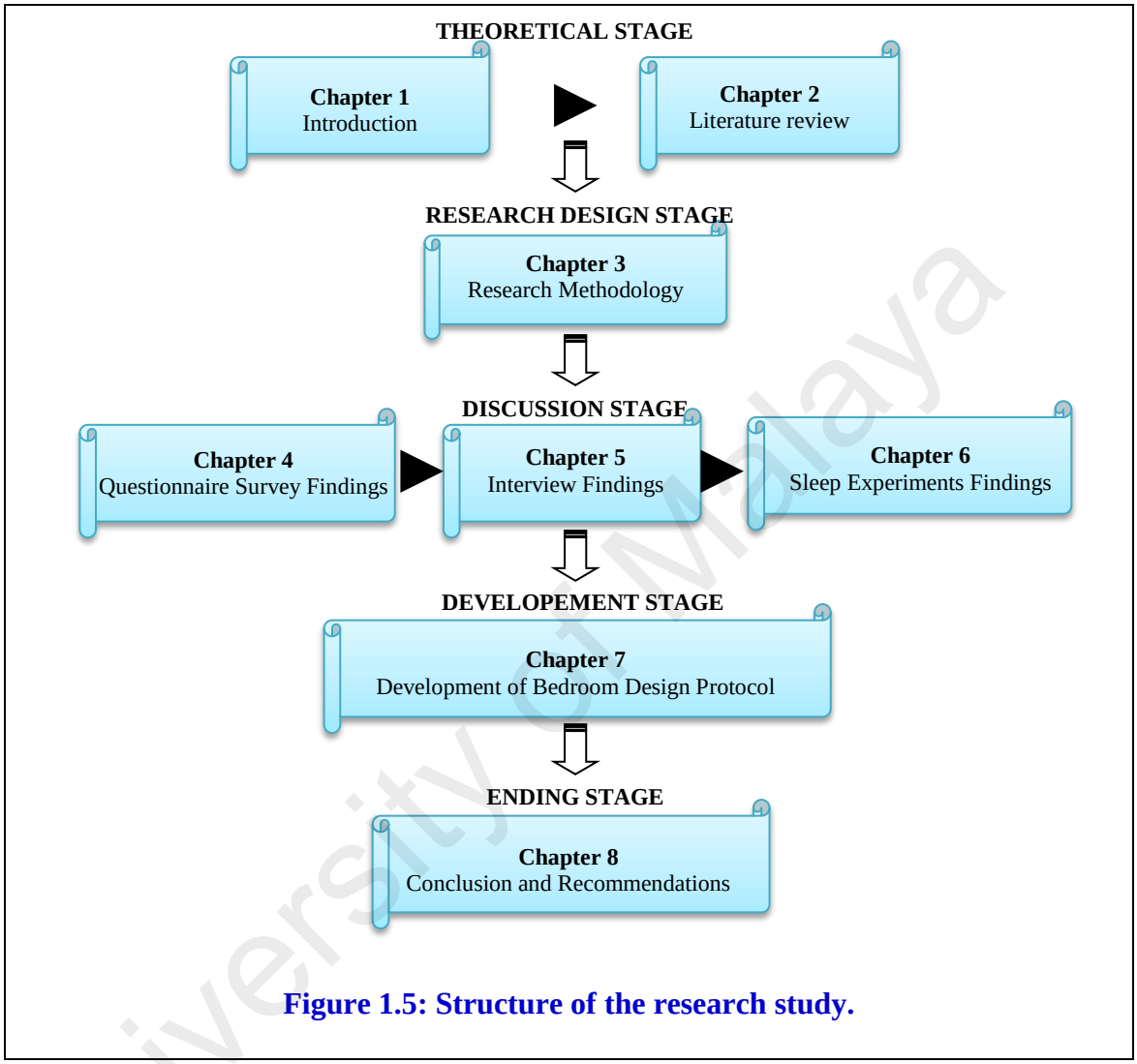


Figure 1.5: Structure of the research study.

Chapter 1: Introduction

Chapter one explains the background of this research, stated the main aim and objectives to be carried out, together with problem statements, research questions and hypothesis, significance of the study, scope of study and a synopsis on the approaches to data collection.

Chapter 2 – Literature Review

This chapter is divided into a few sub-sections. The literature firstly discussed about an overview of ancient Chinese *Feng Shui* its application into macro and micro environment. The chapter then focused into the literatures about Bedroom *Feng Shui* from the psychological, human well-being and architectural design perspectives. Subsequently, the architectural design theories such as design context and design process were discussed. The review of contemporary bedroom interior arrangement in residential was carried out in addition. The chapter then reviewed on the key design considerations for a bedroom interior. Lastly the chapter ended with discussions of sleep quality and its assessment methods which will be adopted in the current research.

Chapter 3 - Research Methodology

This chapter describes a comprehensive research methodology used in data collection, and the procedures involved to achieve the expected result. The mixed-method design in triangulation approach was explained thoroughly. A detailed discussion in each adopted research method about its design and procedures, sampling method and data analysis was presented in a systematic manner. The methodological limitation and problems encountered by the author have been outlined in addition.

Chapter 4 - Results and Discussions: Questionnaire Survey

This chapter presents and discusses the results of questionnaire survey about human preferences in bed arrangement in different prearranged scenarios based on *Feng Shui* approaches. The discussions were generally drawing relationships between an ideal bedroom *Feng Shui* arrangement and the human most preferable choice of bed arrangement, with supportive psychological impacts and subjective sleep quality evaluation attributed to their choices of bed arrangements.

Chapter 5 - Results and Discussions: Interviews

This chapter presents and discusses the results of interviews about the modern architects' perceptions in design procedures and design criteria of a bedroom interior. The discussions were mainly drawing relationships between an ideal bedroom *Feng Shui* arrangement and the architect's practice which is more scientific in nature.

Chapter 6 – Results and Discussions: Sleep Experiments

This chapter presents and discusses the results of sleep quality evaluation for the five volunteered participants based on wrist actigraphy and Pittsburgh Sleep Quality Index (PSQI). The sleep experiment indicators such as sleep efficiency and sleep quality index were used to determine whether the bedroom *Feng Shui* conception is supportive to better sleep quality. An additional sleep experiment for validation is presented at the end to reinforce the group experiment outcomes.

Chapter 7 – Development of Bedroom Design Protocol

This chapter explains how the design protocol for bedroom interior was developed using concept hierarchy approach with the aid of diagrams. The development of such design protocol was based on the embedded scientific elements in *Feng Shui* research, which have been presented in the discussion of findings in Chapter 4, 5 and 6. Model validation by experts is reported at the last section of the chapter.

Chapter 8 – Conclusion and Recommendations

This chapter summarises the overall research findings and reports the limitation of the research study. The chapter also recommends some better approaches for future research.

1.10 Summary of Chapter

This chapter firstly demonstrates good research background about bedroom *Feng Shui* conception and its corresponding relationships with the Western science of architecture, in order to support the importance of this research subject matter contributing to the built environment. The chapter also emphasizes the problem statements relating to the myths in bedroom *Feng Shui* as well as the deficiency of design regulations in interior arrangement, which have motivated the initiation of this research. At the same time the research aims and objectives were formulated based on the research questions. The linkages between the research objectives, research questions and research hypotheses were also outlined. Significance of research to the design team, researchers and the general bed users was discussed. The scopes of study were determined by then to show limitations in conducting the research. A synopsis on the approaches to data collection was delivered to describe how the study is progressed using multiple strategies in order to add values to *Feng Shui* knowledge applied for a bedroom interior. The chapter lastly outlined the thesis structure with the aid of diagram.

CHAPTER 2- LITERATURE REVIEW

2.1 Introduction

Chapter 2 presents extensive background information of the research phenomena on past studies and current knowledge pertaining to the area of research and the identified research variables. Significant and relevant literature from diverse subject area are reviewed and presented in six (6) major sections from section 2.2 to section 2.7. The outline of this chapter's sections is demonstrated in Figure 2.1.

Figure 2.1: The framework of Chapter 2.

2.2 An Overview of Ancient Chinese *Feng Shui*

The term '*Feng Shui'* (风水), pronounced as '*fung shway'* is literally translated to mean "wind-water" in English. *Feng Shui* is the term used in ancient China for the study of architecture while it was called 'Geomancy' in the west. The practice of *Feng Shui* is also found in other Asia countries, for instance the Indian practises '*Vaastushaastra'*, Vietnamese practises '*Phong Thuy'* and Japanese practises *'Fusui'*. Although such practices have some discrepancies in concept with the Ancient Chinese *Feng Shui*, but

these *Feng Shui* conception are identical in creating a harmonious blend of living space for every individual.

Chinese *Feng Shui* has been practiced for more than 3000 years. The Chinese culture as a whole is based on the principles of cosmology and philosophy, derived from an ancient book of wisdoms called "*I-Ching*" or "The Book of Changes" since more than 5,000 years ago. *Feng Shui* is actually a minor subset of the knowledge of *I-Ching*. It commences from the systematic observation of Fu Xi (伏羲) gained insight into the laws of nature and the influence of cosmic forces on the environment and the myriad. He then established *Feng Shui* to sanctify the lives of human by attuned them to the rhythms of nature, provided them with security and a sense of continuity (Chen, 2007).

From the scientific perspectives, *Feng Shui* is perceived a series of knowledge and practices that evolved from the Chinese philosophy that concurrent with traditional science of ontology. Modern sciences focus shifted from solid entities toward fields of flow or energy where the interrelationship took precedence. According to Heim (2000), there is a need to shift *Feng Shui* from the ontological prototype to correlativity study to measure the degree and direction of the relationship between two or more related variables. The concept of ancient *Feng Shui* is to achieve a harmonisation amongst heaven, earth and man (Choy, 2006). In scientific perspective, heaven refers to astronomy and astrological studies. Earth refers to the nature landforms, geography and building architecture while man refers to human who interact with the nature.

Feng Shui is the art of arrangement by considering the space in terms of its spatial configuration in such a way to enhance the flow of energies. In fact, ancient *Feng Shui* originated from the accentuation on the capture of *Qi* using the nature forms arrangement but not with any device or tool. The nature elements on the earth are believed to follow the celestial bodies' layout in the sky as per the Chinese astronomy and astrological study. As our planets orbit around the sun, the magnetic influence on each planet has different

elemental values and hence the mountains with different nature forms, layout, soil and soil quality are formed by these magnetic influential (Yap, 2006a). As a result, in most *Feng Shui* scenarios, the 'form' concept always takes priority rather than individual favourable direction.

However, *Feng Shui* is treated as superstition even until the present day, perhaps this ancient knowledge was generalised and lack of systematic documentation in the past. It is difficult to convince people with *Feng Shui* theories since the *Feng Shui* masters' insights are rather subjective, and the exaggerated effects of not complying the *Feng Shui* rules are somehow unreasonable. Most of the Chinese do not admit that they practise *Feng Shui* is based on superstition but in fact humankind just need a way to sustain healthily. According to Xu (as cited in Han, 2001, pg.76), treating anything that is partly understood as superstition is not a scientific manner of finding truth. *Feng Shui* may have supportive values for physical and mental well-being in a practical way rather than strictly superstition.

In order to make *Feng Shui* more accessible to the Western society, the spiritual leader *Grand Master Lin Yun* developed a Western form of *Feng Shui* and introduced it to the United States in the 1970s, by discarding the intricate formulas of traditional *Feng Shui* and the strict adherence to Chinese cultural elements (Secret Energy, n.d.). At present, most British and Americans understand the implications of *Feng Shui* and even the British Royal family, Citicorp and Donald Trump's companies are rumored to practice *Feng Shui* techniques into their home and business practices (The Guardian, 2016).

The focus of Chinese *Feng Shui* always link to the integration of human comfort being, spatial contentment, aesthetic and place making. It is probably a design instrument that is more integrated than those currently employed by the Western science of architecture (Lynch, 2003). The study of Ho (2012) supported the hypothesis that *Feng Shui* practices can comfort human anxiety and fear. Beside, Poole's (2005) research has proven the

students' learning distraction was settled after he rearranged the classroom environment based on *Feng Shui* approach. These research findings supported that *Feng Shui* is likely a common-sense and practical approach to our daily circumstances on architecture, interior layout and overall design.

2.2.1 The Invisible Forces of *Qi* Energy

The core principle of *Feng Shui* is to harmonise the factors of the universe (human, heaven and earth) by creating balance *Qi* (气) that is positive. *Qi* or *Chi* is pronounced as '*Chee*', refers to the universal life energy forces that present within every living thing which forms the basis of Feng Shui. The traditional concept of *Feng Shui* is originated from the accentuation or capture of *Qi* energy in both nature forms and built environment without any device or instrument. It is therefore a doubt on how a lifeless instrument, colours or paintings as suggested by the post-modern *Feng Shui* practitioners will stimulate the dwelling *Qi*.

The author of *The Book of Burial, Guo Pu* 郭璞 (276–324), stated that *Qi* and *Forms* go together. *Qi* present from the father sky to fertilise the mother earth. The mountain ridges forms barricades to protect the land from wind that may scatter *Qi* while captures and circulates the *Qi* and channel it to the water which ultimately collect and store the *Qi* (Field, 1998). The *Qi* accumulated within the embraced mountain ring are powerful and enduring. Hence, an ideal *Feng Shui* spot is where the living *Qi* meanders from mountain ridges, enfolded by side hills and finally accumulated at the flat land where watercourses meet (Hwangbo, 1999). *Qi* can also be described in terms of its movement by *Yin* and *Yang* and the five elements as stated in *Feng Shui* (Brown, 2006; Heim, 2000; Xu, 1998).

To be frank, *Qi* is the core backbone of *Feng Shui* but an obscure matter assumed by the Greeks and inherited by Western science (Hwangbo, 1999). The idea of *Qi* in particular cannot be absent from scientific clarification. From the scientific research

perspectives, Lin (2008) and Waechter (2002) referred '*Qi*' as the invisible forces or subtle flow of electromagnetic energy which flowing through every living and non-living objects. They claimed that everything in creation is made up of electromagnetic energy vibrating at different frequencies that correspond to sound, light, heat, colour etc. From a quantum physicist perspective, Michio (2017) in response to Science Channel Viewers in BigThink website acknowledged the existence of *Qi* energy by giving example on radio waves vibrating at different frequencies. Similarly, each universe vibrates at different quantum frequencies.

Besides, So & Lu (2001) demonstrated that the natural ventilation in a bathroom design is similar to the *Qi* flow pattern, through the computational fluid dynamics technique. Chou, Hung & Chiang (2007) claimed that the indoor airflow pattern is similar to the *Qi* flow pattern. They discovered through simulation method, that the scenarios of bed placement with *Feng Shui* limitations were showing poorer indoor airflow patterns compared to the recommended Feng-Shui scenarios. Hence, good *air* flow in a sleep environment implied good *Qi* flow in *Feng Shui* for the benefit of occupants' health and well-being.

From a *Feng Shui* practitioner perspective, Yap (2006a) stated that the landforms on the earth are believed to follow the celestial bodies' layout in the sky as per the Chinese astronomy and astrological study. For this reason, we foresee *Qi* energy present from the pull and push forces between the sky and the formation on the earth. Hence, good *Qi* can only be directed and accumulated through the landform arrangement or its imitation in the built environment.

Although the aforesaid studies about *Qi* movement have no physical results and always perceived as hypothetical assumptions in academic insights, but the review of *Qi* energy can be more comprehensive when it comes to the classification of '*Sheng Qi*' and '*Sha Qi*', and its movement by *Yin & Yang* in the following sections.

2.2.1.1 *Sheng Qi* and *Sha Qi*

Qi is classified into '*Sheng Qi*' and '*Sha Qi*'. '*Sheng Qi*' refers to the living *Qi*, which is warm and meandering. Conversely, '*Sha Qi*' refers to dead *Qi*, is cold and threatening (Mak & Ng, 2005). In another word, dead *Qi* exists when the living *Qi* is too strong in movement and dispersed, and that particular condition is difficult to accumulate good *Qi*. An auspicious *Feng Shui* place usually accumulates '*Sheng Qi*' which is pleasant in flow, and can support humankind towards vibrant health, wealth, happiness, harmony living, good luck and success. Conversely, an unfavourable *Feng Shui* place embedded with '*Sha Qi*' that can affect the balance of the nature, causes infertile land, bad health and misfortunes (Xu, 1998; Hwangbo, 1999). In a sleep environment, the recommended *Feng Shui* rules will advise people to arrange the beds in a way that allow '*Sheng Qi*' to meander while avoid '*Sha Qi*' to be formed.

2.2.1.2 The *Yin* and *Yang*

The world is created with two contrary yet complementary principles or qualities which are claaed *Yin* (阴) and *Yang* (阳). *Yin* and *Yang* theory is the foundation that formed the basic philosophy of ancient Chinese. Generally, *Yin* symbolizes the passive side of nature, represents the dark, the dead, and the still. *Yang* represents the active side such as the light, the living, and the moving. *Yin* and *Yang* don't exist independently as there is nothing with 100 percent of *Yin* or 100 percent of *Yang* energy. Everything contain relative amounts of both *Yin* and *Yang* energies to balance the universe (Mak & So, 2011; Xu, 1998).

According to ancient *Feng Shui* texts, mountains are *Yin*, while water is *Yang*; the solid is *Yin* and the void is *Yang*. A favourable *Feng Shui* situation exist when the *Yin* and *Yang* energy is harmonised and balanced, where everything should not be too much or very little (Teather & Chow, 2000). In an ideal *Feng Shui* place, an open space (*Yang*) is

enfolded by surrounding mountains (*Yin*). This balance was thought to bring harmonization and prosperity to the inhabitants (Xu, 1998).

Table 2.1 shows the sample qualities of *Yin* and *Yang*. Imagine that if there is no earth, then the word sky becomes meaningless. Beside, water is referred as 'father' in *Feng Shui* while the mountains are the 'mother' in *Feng Shui*. Water is active, *Yang* component; mountains are stable, *Yin* component.

Table 2.1: The qualities of *Yin* and *Yang*.

Source: Data adapted from Bramble and Xu (2003; 1998).

Qualities of *Yang*	**Qualities of *Yin***
Sky	Earth
Water	Mountain
Sun	Moon
Time	Space
Masculine	Feminine
Active	Passive
Bright	Dark
Noisy	Quiet
Voids	Solid
Above	Below
Intensity	Persistence
Day	Night
Dry	Wet
East	West
Expand	Contract
Fast	Slow
Fly	Walk
Outside	Inside
Rapid	Gradual, lingering
Restive	Still
Ascend	Descend

In *Feng Shui* terms, a too *Yang* environment is disturbing and leading to the loss of peace and harmony. For instance, a bedroom window facing a noisy street is leading in more *Yang Qi* or energy that can affect a restful sleep. Besides, water features are not recommended either inside or outside the bedroom by most of the *Feng Shui* practitioners because water carries *Yang* energy.

On the other hand, an overly *Yin* area such as a dark and quiet bedroom can make a person overly subdued and tired (Kennedy, 2010), subsequently stimulate the person into deeper sleep. A sleep environment shall attach to more constant or *Yin* energy (Ng, 2011; Yap, 2006b). As discussed before, *Qi* is similar to different frequencies of electromagnetic vibration that is equivalent to sound, heat, light, colour etc. Once the frequencies become stronger, the *Qi* turns *Yang*; more active and forceful; hence incompatible with the sleep environment. According to Ng (2011), if the bedroom has mountains view externally, it would be the most ideal for a sleep environment as mountains are *Yin* features.

2.2.2 The *Feng Shui* School of Thoughts

According to Mak & So (2011), *Feng Shui* theory is originated from the two basic concepts of early Chinese settlement namely House Divination (*Pu Zhai*) and House Examination (*Xiang Zhai*). These concepts have recorded textual sources that indicate houses divination practice during *Shang* Dynasty (ca. 16th – 11th BC) and *Zhou* Dynasty (11th – 770 BC). Subsequently, these two concepts blend together and form the antecedent of *Feng Shui* practice. During the late of *Tang* Dynasty (618-907) and early of *Song* Dynasty (960-1279), *Feng Shui* is clearly divided into two major school of thoughts and practice i.e. the Form and Compass school.

The Form School is the oldest school of *Feng Shui*, which was originally concerned with the location and orientation of tombs or *Yin* House *Feng Shui* (阴宅风水) which was of great importance in the Chinese beliefs, intended to bring good fortunes to the descendants. The school then progressed to the consideration of human accommodation called *Yang* House *Feng Shui* (阳宅风水). The *Jin (晉: 265-420)* Dynasty's scholar *Guo Pu* (郭璞) has described its full concept in The *Book of Burial* or The *ZangShu* (葬書). Form School deals with the analysis of physical configuration of physical landform and

its surrounding environment. As its concepts can be applied to both macrocosm and microcosm, the thoughts have been well recognised and widely accepted by *Feng Shui* researchers due to its scientific basis in the analysis of built environment. For example, the research carried out by Xu (1990) indicated that Form School concept is a more powerful instrument for site analysis as compared to the Hendler model, a renowned site analysis model from the West (Mak and Ng, 2008, pg. 60).

Compass School *Feng Shui* is based on the metaphysical speculations of cosmology as originated from *The Book of Changes* or *Yi Jing* (易经). It refers to a collection of more recent techniques based on the eight cardinal directions aspects of the given site in term of the relationships amongst the Five Elements, Eight Trigrams, Heavenly Stems, Earthly Branches and Constellations. Each cardinal direction was said to have unique *Qi*. Its application requires the use of *Luopan* (罗盘) or *Feng Shui* compass, a disc marked with formulas in concentric rings around a magnetic compass and the practice is highly dependent on mysterious formulae.

2.2.2.1 Form School *Feng Shui*

The word "form" in Form School *Feng Shui* refers to the physical environmental features in the macro environment such as mountains, plateaus, buildings, river and water. On a smaller scale, forms can be referred to the interior set up of a property i.e. interior forms of the room layout, the shape, size and space. Form School analysis is based on the five geographical factors, namely *dragon*; *sand*; *cave*; *direction* and *water*; as developed by *Yang Junsong's* (楊筠松) analytical methodology in the late *Tang* Dynasty [618–907] (Mak and So; 2011).

Figure 2.2 delineates the five geographical factors of Form School *Feng Shui* model and its simplified model. The *dragon*, refers to the mountain ridges from the peak of ancestors descent to the hill of parents. The *sand*, refers to the enfolding hills or four

emblems (*Azure Dragon, White Tiger; Red Bird and Black Tortoise*) that represent the protection to the cave from strong wind. The *cave*, refers to the ideal *Feng Shui* spot. The *direction*, refers to the house facing direction and the *water* refers to the water flows in front of the flat land called bright court to store the *Qi*.

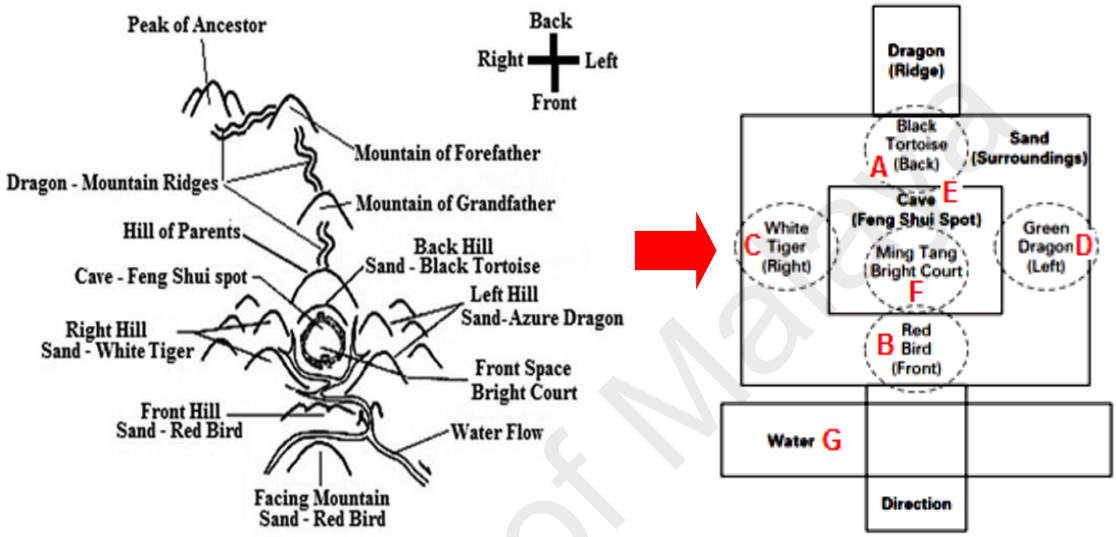


Figure 2.2: The ancient Chinese *Feng Shui* model and its simplified model.

Source: Adapted from Mak & Ng, (2008).

The *sand*, or the four emblems originate from the Chinese astronomy of 28 '*Xiu*' (Mansions). According to Skinner (as cited in Mak & Ng, 2005, p. 428), the sky is divided into 28 mansions or unevenly sized minor constellations. Each emblem contained seven mansions in groups according to their shapes and directions in the sky namely the *Azure Dragon*, *White Tiger*, *Red Bird* and *Black Tortoise*; representing east, west, south and north respectively according to their directions in the sky.

Besides, the four cardinal house facing directions of east, west, south and north are referred as left, right, front and back respectively, under the practice of Form School (Lee, cited from Mak, 2005, p.429). When cardinal directions mingled with the four emblems, dwelling faces south will have an Azure Dragon on the left, White Tiger on the right, Red

Bird at the front and Black Tortoise at the back. These four emblems are the primary features of embraced concept in both macro and micro *Feng Shui*.

Both of the internal and external *Feng Shui* assessment are basically employing the same Form School concepts as the benchmark (Mak & Ng, 2005). Rossbach (as cited in Mak, 2011, p. 92) mentioned the principles of Form School approach were applied to different situation from rural, townscape and urban design, to interior architecture and furniture arrangement.

2.2.2.2 The application of Form School embraced concept

The "Form" principles are not only applied in China dwellings but have also been broadly practiced in many other countries. An analysis revealed that 14 out of the top 20 major cities planning in the world are in line with the ideal arrangement of the *Feng Shui* model (Mak & Ng, 2005). Form school *Feng Shui* believes that by responding to an accommodating nature; the favourable *Qi* is arranged and good fortunes will come consequently. Thus, the imitation of landform *Feng Shui* in a building architecture design demonstrates a physical embodiment of an ideal dwelling.

As discussed in the previous section, the Form School embraced concept can be applied into both macro and micro environment. The most ideal *Feng Shui* spot of a tomb sitting, a house position or even a city planning is strongly bound to the major geographical factors of sand, cave and direction. Other than the accommodation, Mak (2011) and Wei (2006) indicated that the structure of the nature in Form School model is corresponding to the human's body. In all situations, the embraced armchairs concept has been adopted for physical and psychological protection to the cave. Several literatures about ideal *Feng Shui* arrangement have been reviewed on its application into the macro and micro scale, and have successfully demonstrated the significance of having embraced arrangement for an ideal *Feng Shui* spot. The Korean *Sa-sin-sa* system in *Bi-bo Feng*

Shui, the *Ho:go* (forest belt) concept in the Japanese Traditional Village, the latter Beijing courtyard house and the human embraced arrangement are the good scenarios to demonstrate the application of embracing armchairs concept in Form School *Feng Shui*. Table 2.2 shows the overall pattern, orientation and spatial arrangement in these *Feng Shui* scenarios revealed high connectivity with the landscape matrix in Form School embraced concept.

As shown in Table 2.2, on the macro scale, the *Sa-sin-sa* (四神砂) principles in Korean *Bi-bo Feng Shui* (裨補風水) are corresponding to the *sand* in Form School *Feng Shui* to protect and embrace the *Hyul* (穴) or *cave* while the ideal *Myung-dang* (明堂) concept is corresponding to the Bright Court that accumulates the most favourable *Qi* in Chinese *Feng Shui*. The enfolding *Sa-sin-sa* system is referred as the four emblems in Chinese *Feng Shui* which namely as the blue dragon, white tiger, black turtle, and red peacock. The existence of any weak outer embracing mountains (*Sa-sin-sa*) will be improved by trees planting and ponds making for spatial completeness in their watershed (Whang & Lee, 2006).

The traditional *Feng Shui* village in Ryukyu Islands, Japan also applied the similar *Feng Shui* thoughts in embracing the living energy (*Qi*) as per the Chinese *Feng Shui* model. The multiple layers of forest belt with Fukugi trees planting that enclose all houses, village(s) or the coastline is called *Ho:go* (habitat-embracing forest); meaning to embrace and protect by forest planting in order to retain the living energy (Chen, Nakama, & Kurima, 2008). When building the houses the sand was used to make fences around the residences followed by Ho:go planting in the sand (see Table 2.2). These man-made hilly fences and Ho:go tree lines that enfold the house and the village symbolizing the embracing armchairs concept in Chinese *Feng Shui*; which serve to protect the house against seasonal typhoons and cold winds (Chen, et al., 2008).

The Chinese courtyard house exhibits the fundamental characteristics of Chinese architecture based on *Feng Shui* and becoming the template for most Chinese architectural styles all over China. Table 2.2 delineates the typical Chinese courtyard model for *Kung* class families. The house arrangement with a central open courtyard enclosed by four inward-facing buildings symbolizes a standard traditional Chinese arrangement, named *Siheyuan* (四合院). The house layout of *Siheyuan* has fully adopted the Form school thought of embraced arrangement which offers the best *Qi* arrangement and protection against aggressors, dust and storms (Lu & Jones, 2000). The four inward-facing buildings i.e. the *Zheng Fang* (正房), *Zuo Xiang Fang* (左廂房), *You Xiang Fang* (右廂房) and *Dao Zuo Fang* (倒座房) are referred as the *Feng Shui* spot, Azure Dragon, White Tiger and Red Bird in Form School model respectively. The open courtyard at the centre of the building provides a great space for the *Qi* meanders as the vital *Feng Shui* 'Bright Court'.

Besides, the latter Chinese courtyard house is well kept and has become a cultural symbol of Beijing. Its design concept that contains a group of open yards (*Yang*) enfolded by surrounding buildings (*Yin*) is undeniably comparable to Chinese *Feng Shui* model. Table 2.2 illustrates the master room building (*Zheng Fang*) of the typical Beijing courtyard house protected by a rear building (*Hou Zhao Fang*), two side chambers (*Zuo Xiang Fang* and *You Xiang Fang*) and screen walls at the front as facing mountain. The yards at the centre provide a meandering sequence of access to the master room symbolizes a meandering path which serves to accumulate favourable *Qi* (Xu, 1998).

On the micro scale, the *Feng Shui* model, by nature, can also be applied to the human body and spatial interior arrangement. As shown in Table 2.2, the toddler in the mother's embrace refers to the ideal *Feng Shui* spot, fully supported by the mother's body (back hill supports), protected by embracing arms (side hills) and the grasping hands (facing mountain).

Due to the notion of children acquire the greatest sleep in a mother's loving embrace (Ball, 2002; James-Robert, 2008), an ideal *Feng Shui* model inside a bedroom shall be explained via a mother's embracing arms concept which can be explained by the Form School idea. A mother's embrace is always the most comfortable, stable and secure place to sleep in. This is undoubtedly a unique and sustainable approach for sleep quality improvement other than those pharmacological approaches. From the proposed bedroom *Feng Shui* model in Table 2.2, the bed location refers to an ideal *Feng Shui* spot, and also a comfort zone for a child to sleep. Alike the mother's body support to the toddler, the solid wall behind the bed signifies the Black Tortoise support to the *Feng Shui* spot. The wardrobe and sofa seats beside the bed signify the protection of Azure Dragon and White Tiger, which is corresponding to the protective arms of a mother. The TV rack in front of the open space refers to the Red Bird guardian, identical to a mother's grasping hands which to avoid the child falling from cuddle.

In short, the imitation of ideal landform *Feng Shui* to the interior layout of a house or a bedroom is to adopt the art of arrangement using the concept of physical protection to the *Feng Shui* spot. This concept is probable a common guideline in architectural design for both macro and micro environments.

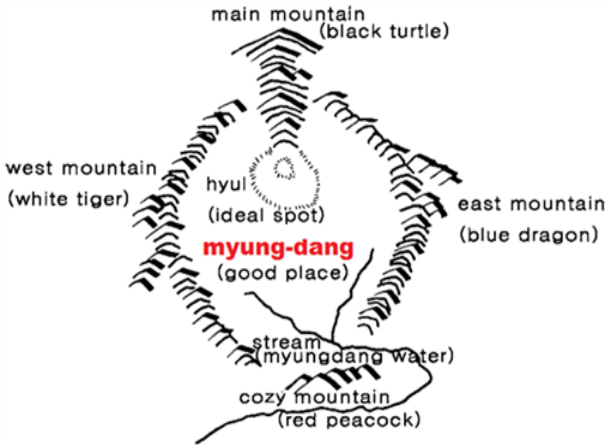
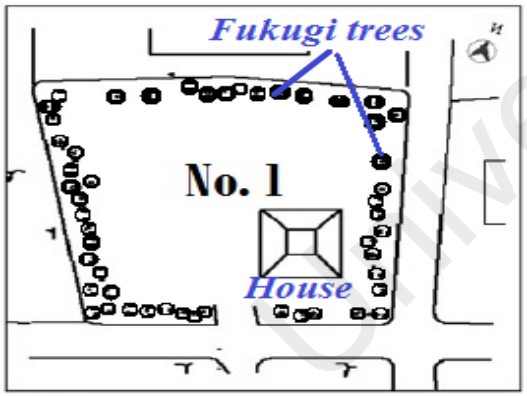
Form School Model in Different Scenarios	Sand				Feng Shui Spot	Bright Court
	Black Tortoise	Azure Dragon	White Tiger	Red Bird		
 **(a) *Sa-sin-sa* in Korean Bi-bo *Feng Shui*** *(Adapted from Whang & Lee, 2006)*	Main Mountain (Black Turtle)	East Mountain (Blue dragon),	West Mountain (White Tiger)	Cozy Mountain (Red Peacock)	Hyul	Myung-dang
 ***(b)*** **Ho:go (forest belt) in Ryukyu *Feng Shui* villages in Okinawa, Japan** *(Adapted from Chen, Nakama, 2010)*	House-embracing Fukugi trees that encircles a house, a village, several villages or the coastline.				House or Village(s)	Open Space in front of house

Table 2.2: The matrix of Form School *Feng Shui* application in macro and micro environments.

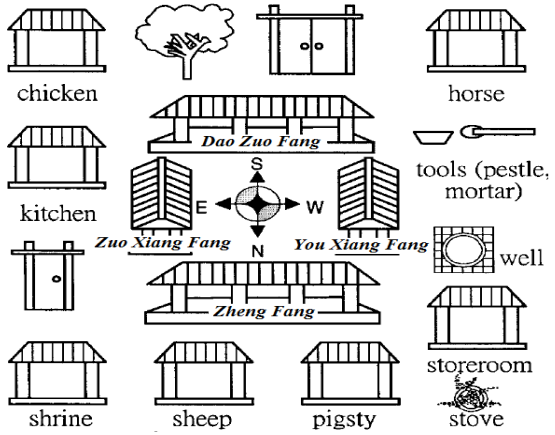
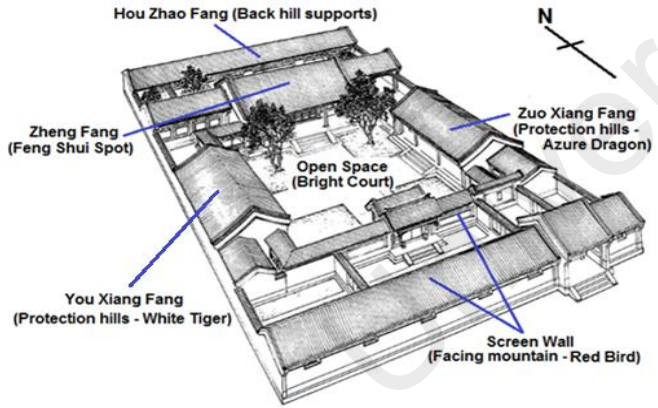
Form School Model in Different Scenarios	Sand				Feng Shui Spot	Bright Court
	Black Tortoise	Azure Dragon	White Tiger	Red Bird		
 ***(c)*** **Typical Chinese courtyard house for *Kung* class families** *(Adapted from Lu & Jones, 2000)*	Stove, Shrine, Pigsty, etc.	Zuo Xiang Fang (Left chamber)	You Xiang Fang (Right chamber)	Dao Zuo Fang (Rear chamber)	Zheng Fang (Main chamber)	Open Space in front of *Zheng Fang*
 ***(d)*** **The latter Beijing Courtyard House** (Adapted from Metz, August 2011)	Hou Zhao Fang (Rear building)	Zuo Xiang Fang	You Xiang Fang	Screen Wall	Zheng Fang (Main building)	Open Space in front of Zheng Fang

Table 2.2: The matrix of Form School *Feng Shui* application in macro and micro environments. (cont'd)

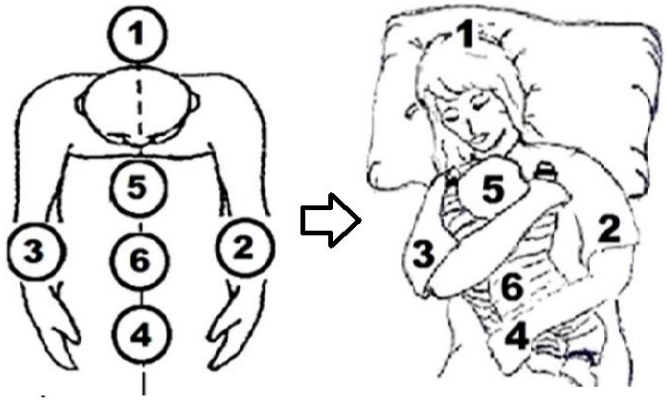
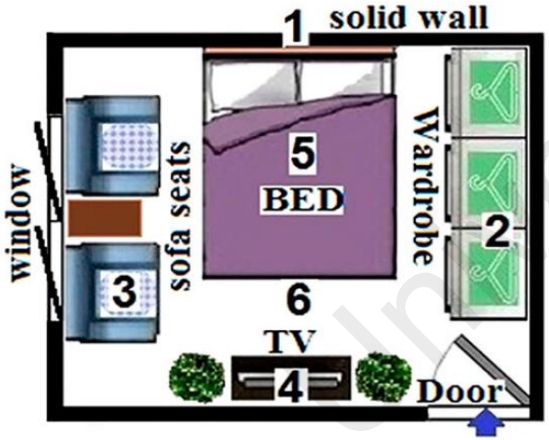
Form School Model in Different Scenarios	Sand				Feng Shui Spot	Bright Court
	Black Tortoise	Azure Dragon	White Tiger	Red Bird		
 ***(e)*** **A mother's embrace** (Drawn by author)	Head and Body	Left Arm	Right Arm	Grasping Hands	Toddler	Open Space between toddler and grasping hands
 ***(f)*** **Bedroom Interior Arrangement** *(Drawn by author)*	Solid Wall	Wardrobe	Sofa Seats	TV rack	Bed	Open Space in front of bed

Table 2.2: The matrix of Form School *Feng Shui* application in macro and micro environments. (cont'd)

2.3 *Feng Shui* in the Sleep Environment

Bedroom *Feng Shui* rules are commonly shared among the Chinese community to facilitate sleep activity, carried from the ancestors to the current generation. These practices were expected to bring good health and good luck to the bed users. It may not be a completely grandmother story as it can be found in plenty of *Feng Shui* books from all over the world. A more practical dimension of bedroom *Feng Shui* shall be the philosophical, logical, and psychological dimension rather than the employment of specific device or tools. There were many design ideas from books or websites adopted Chinese *Feng Shui* rules as bedroom design ideas but do not quote *Feng Shui* as the basis of their thoughts. The Better Sleep Council (n.d.) website, McMillan, and McMillan's (2011) book are good examples. Both authors' published their ideas for sleep environment improvement but not based on *Feng Shui* perspectives. As a result, the reliability and practicality of these *Feng Shui* rules are therefore vastly dependent on the academic research materials which employed scientific methods on its analysis.

Although there are many *Feng Shui* techniques that can be used to enhance a sleep environment such as Form School concept, Flying Star and the Five Elements theory; but the most regular *Feng Shui* rules that found in the literatures are based on the Form School *Feng Shui* concept, emphasizing the theory of *Yin* & *Yang*. As Form School emphasizes on the art of arrangement to capture *Qi*, bedroom *Feng Shui* should therefore work around the bed position without any device or tools.

The adoption of tools such as animal statues, crystals and etc. is referred as part of the New Age *Feng Shui* and believed to engage with commercialised technique. These devices may have its own value in relation to the Five Elements *Feng Shui* theory but thus far it is believed to be symbolic objects, and bring only psychological effect rather than real *Feng Shui* effects. These devices have even caused misconception amongst the public

to strongly believe that *Feng Shui* is related to such credulous devices (Hoo, n.d.; Yap, 2006b).

Some *Feng Shui* practitioners adopt 'colour' as one of the method in improving the bedroom *Feng Shui*. Nonetheless, based on ancient Chinese *Feng Shui* documentation, there is no *Feng Shui* colour for bedrooms as such. According to Yap (2006b), colours provide more psychological effect rather than activate the real *Qi* effect in a space.

Besides, the extra stimulation of electronic devices such as hand phone TV, and computer are advised to be removed from the bedroom. The logic behind this *Feng Shui* advice is because electronic devices are *Yang* features that generating unstable *Qi* and it is incompatible to the stable energy for sleep. It is believed that the unstable *Qi* are transformed to sound, electromagnetic waves and radiation that possibly stay in the room and affect our sleep.

Table 2.3: The most emphasized *Feng Shui* rules in bed arrangement.

Source: Adapted from Hong et al, 2014.

	Authors from the West						***Authors from the East***							
Feng Shui* Bed Arrangement** ****The most emphasized at the top	***Mak & So (Australia & H.K.)***	***Rodika Tchi (Canada)***	***Sally Painter (California, US)***	***Victor Cheung (US & Taiwan)***	***Wang, M. (US)***	***Coxon, T. (UK)***	***Ong, H.T. (Malaysia)***	***Yap, J. (Malaysia)***	***Too, L. (Malaysia)***	***Hoo, K. (Malaysia)***	***Chou, Hung, & Chiang (Taiwan)***	***Shi, Q.Q. (China)***	***Chen, Y.F. (China)***	***Koh & Zou (Singapore)***
Favourable Practices														
Bed supported by solid wall	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Visible to door/ door diagonally far from the bed	√	√	√	√	√	√		√		√		√		√
Window at the side/ front	√				√									
Unfavourable Practices														
Bed directly facing/ in line with door	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Window against the bed head	√		√	√	√	√	√	√	√	√	√	√	√	
Bed pointed by sharp angle		√	√		√	√	√	√	√	√				√
Mirror facing to bed			√	√	√	√	√	√	√	√				√
Legend:	√	**Emphasized by author**												

Table 2.3 shows the regular *Feng Shui* rules in bed placement which have been majorly emphasized among the 14 *Feng Shui* practitioners and academicians of different origins. It was apparent that authors from the East and the West have reciprocal understanding in bedroom Feng Shui. Most authors' emphases were apparently the same as remarked in the Table. Minority of the authors have additional comments on these bedroom *Feng Shui* principles rather than complying them all, subject to some terms and conditions. However, this section of study is limited to accumulating the authors' "most emphasized" Feng Shui rules in bed placement rather than comparing the minor contradiction of individual concepts. The potential conflicts in these *Feng Shui* rules are part of the exploration study as stated in the research objectives, from three dimensional perspectives.

Looking at the data gathered in Table 2.3, the rule listed at the top was referred as the most emphasized by all authors. The principles about the 'bed head shall be supported by solid wall but not window' and the 'bed shall not in line with the door' are the most important in practising good *Feng Shui*. These principles are well explained via the theory of *Yin & Yang*, and its analogies with human psychological perception in the following sub-sections.

2.3.1 The Wall Supports

From the bedroom *Feng Shui* perspective, it is strongly recommended to keep the bed with a solid wall as the back support (Shi, 2010; Too, 2010). This refers to a black tortoise mountain support that is significant in Form School *Feng Shui* theory. Wall is a main component in the formation of space in ancient Chinese perception (Hu, 2008). It is a *Yin* element with constant energy that is compatible with sleep activity. Besides, the bedding headboard and high partitions are debatable as an alternative of bed support. In fact, other than the wall, the bed is better to be supported by any other stable elements rather than to be backed by a window. On the psychological perspectives, this position offers positive

intuition of being supported, protected and secured. The sleepers are also provided with better acoustic quality and better visual command of the space.

However, placing the bed with back support shall also consider the sense of balance inside the bedroom i.e. the bed shall be accessible from each side. This is due to placing the bed directly against a side wall (with no space between the bed side and the wall) may create imbalance *Qi* flow, making the sleeper feels restricted and less flexible in life.

2.3.2 The Door Direction

Doors and windows are the mouth of *Qi* energy which must be well guarded against the direct intake of unfavourable *Qi* generated by external buildings and street alignments. As a result, the position of the bed relative to the bedroom door rates more significantly than the compass direction (east, west, north, or south) the bed faces. It is rather easy to position the bed according to the way it best relates to the door.

In *Feng Shui*, it is seriously an unfavourable practice to place the bed in line with the path of the doorway, especially in a relatively short distance (Shi, 2010; Ong, 2007). Such placement is referred as the "dead coffin" position in *Feng Shui* (So & Lu, 2001). Although this exaggerated saying is not a concern however the direct *Qi* flow that enters the bed in this position is possibly too rush especially in a relatively short distance. In this case, the benevolent *Qi* is almost vanished and therefore '*Sha Qi*' exists, contributing stress and health problems to the sleepers.

An ideal bed location in *Feng Shui* is a position that is not in line with the bedroom door where the door is diagonally farther from the bed, and allows a clear sight of the bedroom door (McMillan, K. K., & McMillan, P. H., 2011; Yap, 2006b). While sleeping at the *Feng Shui* recommended bed location, good *Qi* meanders through the open space before reaching to the bed. The bed is far enough from the doorway that is exposed by excessive *Qi*. In order to retain the good *Qi* flow in bedroom, it is strongly advised to

close the bedroom door during bedtime. In addition, the farther the bed sits from the door, the more control the sleeper can feel over the space and life. Besides, clear sight of the bedroom door allows the sleeper to have better visual command of the space and improve the sleeper's *Qi* and his or her life vision. The space in front of the bed (*Bright Court*) shall be larger for the sleeper's better life expansion and health improvement.

From the justification of *Yin & Yang* theory, the bed (*Yin*) and the door (*Yang)* are two incompatible energies. The overall situation is not harmonised when the bed is closely attach to the door because the rushing *Qi* enters from the door is not compatible with the stable energy for sleep.

From the psychological perspective, placing the bed in line with door in a restricted distance may easily cause the sleepers to have psychological distress; possibly due to the direct impact of intruders. This situation may also direct potential lighting and noises from the external, making the users feeling anxiety and unsecured especially in a door-opened scenario. According to the *Feng Shui* masters' advice, the bedroom door and bathroom doors are not advised to leave opened while sleeping (So & Lu, 2001) because the good *Qi* or good luck will be easily flushed away.

2.3.3 The Window Direction

A window behind the bed signals upcoming health problems (Ho, 2012; Too, 2010). The position of bed head against the window was told as unfavourable in *Feng Shui* practice as the sleeper at this position has no black tortoise mountain (*Yin*) support. From the interior designers' perspectives, McMillan, K. K., & McMillan, P. H. (2011) also advise not to locate the bed against a window, especially when the window will be opened regularly, giving chance to create uncomfortable drafts.

Windows are made of glass, fragile and transparent. It is a *Yang* element that doesn't compatible to the bed (*Yin*). The ancient records showed that windows of the ancient

China buildings are made of bamboo paper. Its soundproofing is worse compared to the modern glass window. Therefore, the impact of sleeping under a window is totally insecure in the past. It tends to create imbalance *Qi* flow due to the wind; noise and reflection of light from the window. In modern houses, a glass window that is closed and fully covered by thick blinds during sleep could help to solve the problem (Too, 2010; Yap, 2006b).

Psychologically, sleeping against the window may cause unpredicted and insecure feelings as a result of latent traffic noises and vibrations; temperature variation; reflection of light from the external. This scenario is contradict to the stability sense in a sleep environment and consequently affects human indoor comfort; acoustic quality and visual command.

The overall review discovered that most of the *Feng Shui* practitioners and scholars do not emphasize the exact position of window for best *Feng Shui* practice. Some prefer on the right (Ng, 2011, Wang, n.d.) and some in favour of the front (Mak & So, 2011). It is considered ideal as long as the window is viewable from the bed position. Window at the side or in front of the bed signify a new day and new hope begin in the morning where the sleeper is provided with readiness to face the reality.

2.3.4 The Poison Arrows

Bed pointed by room corner or sharp angles (also known as poison arrow) is considered as unfavourable in *Feng Shui* (Yap, 2006b; Too, 2010). *Qi* flow is perceived as balance in square or rectangular room from the *Feng Shui* perspectives but not balanced in the uneven or L-shaped room. This is due to the in-built '*Sha' Qi* (harmful energy) created from the bumping room comers or protruded furnishings. '*Sha*' literary means killing in Chinese but it refers to unfavourable energy in *Feng Shui*. According to Yap (2006b), '*Sha*' is not shooting *Qi* that kills but at the sharp angles, *Qi* has been scattered

by wind. Hence, when the bed is facing sharp angles such as wall corner or internal column, the sleeper may experiences an angle that cannot collect *Qi* because *Qi* has been scattered by wind. Nevertheless, this viewpoint needs to be further investigated by scientific approach.

Psychologically, if the sharp angle and the bed is in a very close distance, sleeper at this bed position may sense the pointing threats, possibly have the feeling of pierced, disturbed and unpleasant visual experience. These days, many modern room design and furniture cannot avoid sharp angles particularly in non-spacious rooms. The possibility of having impact of misfortunes in this situation is never definite. Consequently, this *Feng Shui* limitation shall be re-evaluated on its significance in bedroom, perhaps the height of the angles and the distance from the pointing threats to the bed are the concerns. Pointing threats at lower height such as reading tables and drawer cabinets are expected to provide less adverse psychological impact and less *Qi* disproportion issue.

2.3.5 The Mirror Threats

Placing a mirror facing to bed is a major threat in *Feng Shui* (Shi, 2010; Too, 2010). According to modern *Feng Shui*, the principle of having mirror faces bed is seen as a major threat to our health. The ancient Chinese believed that our spirit leaves our body when we are asleep. Mirror faces the bed will either cause the spirit not finding its ways back or may invite third party in a relationship. These beliefs are unreasonable, over exaggerated and never been proven scientifically.

According to Ng (2011) and Yap (2006b), bed faces a mirror will catch and reflect light that may affect our vision and mood before we get into sleep. This in in compliance with concept of *Yin* and *Yang* theory because mirror's reflection is identical to water reflection, a '*Yang*' element that may counter to sleep (*Yin*) activity. Thus, bed faces a

mirror does not cause any *Feng Shui* problem such as the spirit that leaving the body will be frightened or the attraction of third party into a relationship.

Psychologically, the main threats of mirror faces bed shall be the fearsome image of our own reflection in the mirror in the dark. This would be an uncomfortable visual and mind experience to degrade our sleep, but it is still largely depending on the mirror dimension that applied. Nowadays, many modern hotels arrange the rooms with mirror faces the bed in order to provide a false perception of bigger space. If the guest does not stay in the room for a long term basis, the psychological well-being and sleep quality may not be a serious issue.

2.3.6 The Beams and Low Ceiling

The bedrooms designed with uncovered beams and low ceiling are no longer practical these days with the exception of some old or wooden dwellings. Even in some old concrete houses, beams are mostly been covered up by ceiling boards in most bedrooms.

Sleeping directly under a beam is strictly not advisable in *Feng Shui* (Mak, 2011; Too, 2010; Yap, 2006b). This is due to the protruded beams may suppress *Qi* that entering the room, gushing *Qi* downwards and become imbalance. In *Feng Shui* perspectives, such practice is possibly creating health problems by affecting individual sleep quality and decreasing daily performance of the sleepers. The condition of sleeping under the low ceiling or inclined ceiling is similarly explained. It is believed to affect individual sleep quality and well-being due to the disproportion *Qi* flow in the room.

Based on the above explanation, the condition of double decker bed sleeper is arguable. This issue may require further investigation for verification. On the psychological perspectives, sense of threats to the bed users and impact of falling objects could exist. They may also experience pressured and narrow breath in such situation.

2.4 Design Theories and Context in Architecture

Architecture has been inevitably intertwined with contextual thinking. Context is found in the design of different components that it gives direction to design and can be found from city silhouettes to small details in interior settings (Sotoudeh, 2012). It involves three main essential fields such as; architectural discourse, theory and architectural practice. Contextual data are sometimes the essentials of design solution; while other times they can be seen as complications that can be easily ignored (Çizgen, 2012).

Context and its placement within architecture is defined by Architects Design Partnership (as cited in Çizgen, 2012, p.12) as: "The circumstances that form the setting for an event, statement or idea, and in terms of which it can be fully understood" (Oxford Dictionary of English). In the case of architectural design, 'circumstances' that surround building design range from social, political, cultural and economic environment which it is built, as well as the more obvious physical setting.

Besides, according to Mohd Sahabuddin (2011), context includes both physical and non-physical external components that influence a design. Infrastructures, buildings, and landforms are examples for physical elements while climate condition, local culture, as well as political and financial constraints are non-physical elements.

Capon (1999) separates contextual data into three categories and emphasizes it is imperative for building design:-

- **Visual Contextual Factors** - These are the factors seen as one of the values engaged the most in the attainment of contextual fitting. In addition to functional and construction details, context plays a part in the selection of form and size, mass, use of colour and materials to support visual balance with the built and the natural environment (generally existing architectural setting).

- **Formal Contextual Factors -** These are the scientific environmental data, climate data, regional, topographical characteristics of the context, within the scientific perspective. They are the significant values that should be taken into account in architectural design. Designers require to design buildings that meet the criteria of local climate such as building orientation, materials, and also size and openings (Mohd Sahabuddin, 2011).
- **Human Contextual Factors -** These are the contextual factors that added meaning within human life and have consequently gained a place within architecture. They are mainly identity, cultural and historical factors which making architectural design more meaningful for both the user and the community as a whole.

Responsive design from townships to small courtyards and subsequently to building interiors, can help to create varied and interesting spaces that individuals enjoy because they have a distinctiveness and character with which they can readily identify (Breckland Council, 2018). As buildings are to be designed in harmony with environmental factors, this leads to different design concepts according to different geographical contexts. At this point, it should be seen as dissimilar to an artistic and conscious claim. Such concept of harmonization with the natural environment is very similar to the concept of *Feng Shui* application in the macro and micro built environment, which is investigated in the current research.

2.4.1 Design Protocol and its application in the Sleep Environment

Design process in the building industry, whether in macro or micro has great influence on the quality of the final product and subsequently the end-users' satisfaction. Despite its significance in the design routine, relatively little attention has been given to the

management of design process (Formoso, Tzotzopoulos, Jobim, & Liedtke, 1998). The fact that design process has been neglected in the past is due to the complexity of building design and the concern of flexibility in design under a highly undefined built environment. There were large number of decisions have been made in building design over a period of time, with plentiful interdependencies. Apparently, the design process for a building interior is far more simple and unsophisticated, such as the design process for a bedroom interior.

From the architectural perspectives, building design is referred as art, always subjective and mainly based on intuitive practices, experiences and creativity of designers (Mak & Ng, 2008 and Çizgen, 2012). To some extent, it has no fixed regulations but just to promise a functional supportive design. It is therefore difficult to understand the meaning and the process of design is. Sometimes we just need to justify what is good design, and what is acceptable design.

Markus and Arch (1970) recognised two patterns in design process i.e. (1) individual decision making process that concerned with the creation of alternative solutions, and (2) management process, which develop from the general and abstract to the detailed and concrete phase. An ideal design process undeniably requires the consideration of both patterns, blending the both ideas of "Design as a Creative Process" and "Design as a Management Process".

According to Formoso, et.al (1998), a design protocol consists of a general plan of the design process with the following elements: - (1) the content of the main activities, (2) their precedence relationships, (3) the main inputs and outputs for each activity, (4) tools (if any) that can be used for supporting the execution of such activities, (5) the role and responsibilities of the actor(s), and (6) a model of the information flow.

The current research tends to develop a design protocol for bedroom interior with clear and logical flow of stages for the purpose of seeking an ideal bed arrangement in

different bedroom scenarios. The contents in the design process will be predominantly based on the verified bedroom *Feng Shui* principles and its relationships with the potential bedroom scenarios. Each activity flow in the model will deliver an output in diagram format, in every given bedroom scenario. The developed design protocol is targeted to be implemented by the design teams and bed-users.

Such model with logical information flow in design process can potentially bring a number of benefits. It can provide easy identification of the information flow for necessary improvements, such as reduction of the number of steps, etc. In addition, it is also possible to increase the effectiveness of the information flow, and consequently improve both the quality of design and creates the chances of reducing the duration of the design. With the aids of diagram, it becomes easier to devise, implement, control and feedback to the design process performance.

2.4.2 A Review of Contemporary Bedroom Interior Arrangement

Table 2.4: Analysis of bedroom interior arrangement in a residential house using bedroom *Feng Shui* rules.

Source: Baja Real Estate Group, n.d.

Assumptions in analysis:
* All components' direction from the bed was judged from the bed head facing position.
* All mirror's location were assumed at wardrobe area.
* All elements with sharp angle that pointing to bed were not considered for its height and its distance from the bed.

Layout R1	Bed head supports	Window direction from the bed	Door direction from the bed	Sharp angle pointing to bed	Mirror threats facing to bed
Master Bedroom	*solid wall*	*side*	*diagonal*	*reading desk*	*wardrobe*
Bedroom 2	*solid wall*	*diagonal*	*diagonal*	*reading desk*	*wardrobe*
Bedroom 3	*solid wall*	*side*	*diagonal*	*reading desk*	*wardrobe*

Interior arrangement is related to the allocation of spatial resources. The work is challenging because it involves not only functional but visual criteria. The author has reviewed and analysed contemporary bedroom interior arrangement from 15 residential layouts in landed houses, based on the aforesaid *Feng Shui* rules in bed placement. These residential cases were selected randomly from different home design webpages and real estate websites but without emphasizing the house and bedroom facing direction. This is because the author expects the analysis to be done without external constraints but only looking into the bed arrangement in relation to wall, door, window, sharp angle and mirror. Besides, the bedroom external conditions such as sun orientation, street view, types of adjacent building and potential noise disruptions were not available from the data collection. The review of bedroom interior arrangement in these bedrooms was mainly seeking the corresponding relationships of interior instances no matter in what is happening externally. Appendix I displays the 15 residential bedroom layouts for review and the relevant analysis based on bedroom *Feng Shui* rules were demonstrated respectively for each layout.

By considering the bedroom examples in Layout R1 for a residential house, it is apparent that the interior architect's design ideas in the master bedroom, bedroom 2 and bedroom 3 are majorly in compliance with the bedroom *Feng Shui* rules. As shown in Table 2.4, all beds in the three bedrooms are located with solid wall as back supports in Layout R1. Concurrently, the doors of these bedrooms are diagonally far from the beds and the directions of windows are visible from the bed (either at the side or in front). Insignificant sharp angle threat from the reading desk was found pointing to the bed in all bedrooms but its distance from the bed location is relatively far. As the layout does not indicate the placement of vanity inside all bedrooms, the author then considered the mirror is attached to the wardrobe area and hence all beds are facing with mirror threats in Layout R1. The analysis results for Layout R2 to Layout R15 are somehow consistent,

where majority of the beds are complying the bedroom *Feng Shui* rules dealing with solid wall, door and window. Sharp angle threats and mirror threats in all bedrooms seem to be unavoidable in most circumstances.

2.5 Bedroom *Feng Shui* Rules in Scientific Perspectives

The doubts of whether *Feng Shui* is science or superstition have been a hotly debated subject. There are always doubts about the scientific evidence for positive effects of using bedroom *Feng Shui* rules to improve a sleep environment. However, due to the research of scientists and academics such as Zeisel (2006) and Mak & Ng (2005), there is a great deal of scientific evidence to support the positive mental, spiritual, spatial and consequently human well-being associated with the application of this ancient wisdom of *Feng Shui*. The following sub-sections discuss about the related research from different scientific perspectives.

2.5.1 From Psychological Perspectives

Teather & Chow (2000) highlighted that *Feng Shui* is connected to human well-being by its visual–psychological implications. It induces environmental planning in accordance with human subjective feelings about, especially essential in a sleep environment. Yu (as cited in Wei, 2006, p.5) also stated that *Feng Shui* possessed great psychological values in determining human lives in harmony with nature and hence people activities should be designed with nature in mind. Many common rules in bedroom *Feng Shui* are found to be logical in terms of psychological analysis.

From the modern architecture perspective, when designing interior environments, the typical considerations are such as daylight, acoustics, accessibility and the interior organisation or arrangement of the inner space. In fact, interior environments could aim to stimulate experiences that provide pleasure and meaning to its occupants (Petermans

and Pohlmeyer, 2014). An ideal bed location shall involve good visual and psychological attributes with the intention of calming the sleeper's emotion. The threatening aspects such as noise, flickering light, heat and visual implications (*Yang* energies) are simply perceptible from an unfavourable *Feng Shui* bed positions, and hence leading to unhealthy sleep. In contrast, the recommended *Feng Shui* bed positions provide more secure and peaceful mind to the sleepers and thus supportive to better quality sleep.

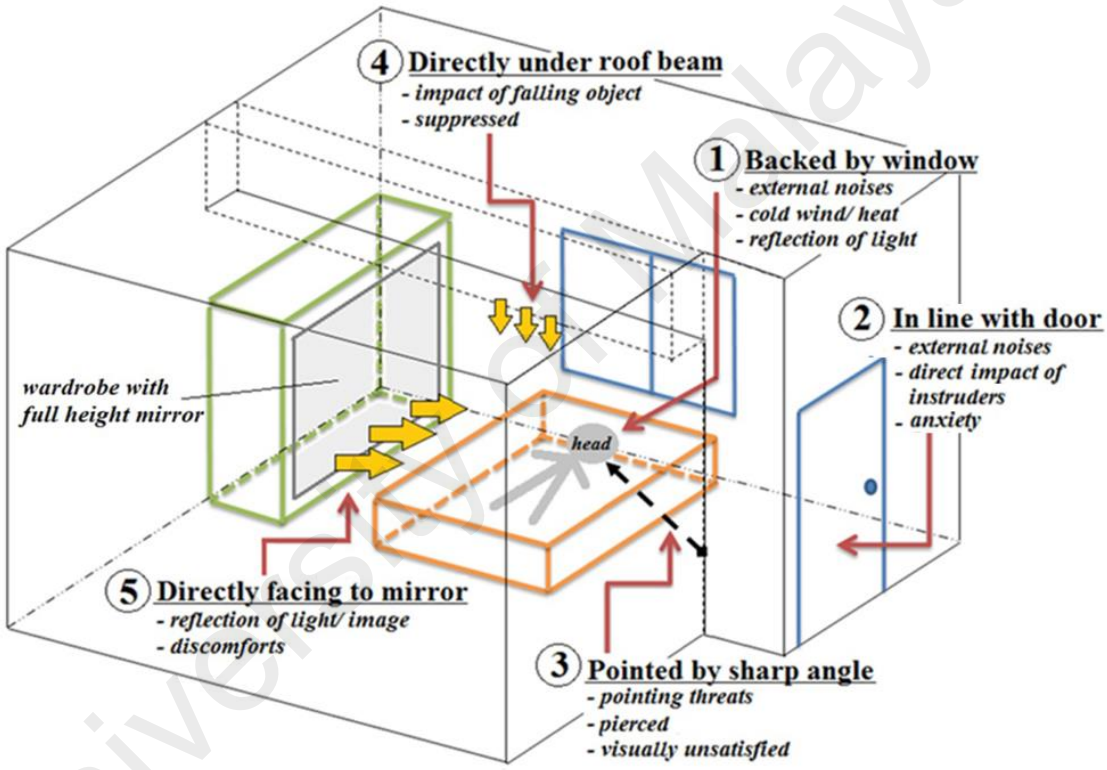


Figure 2.3: An unfavourable bed arrangement according to Chinese *Feng Shui* and its potential psychological impacts to the users.

Source: Adapted from Hong, Abdul-Rahman & Wang, 2014

The study of Hong, Abdul-Rahman & Wang (2014) verified that the bed arrangements that tied with favourable *Feng Shui* conditions were highly preferred among the respondents of multicultural background while the one that tied with unfavourable *Feng*

Shui setting was mostly declined. The psychological perceptions claimed by the respondents on individual bed choices were somehow consistent with supporting values to bedroom *Feng Shui* rules. Figure 2.3 demonstrates an unfavourable bed arrangement according to Chinese *Feng Shui*, together with its potential threats arisen from such arrangement. The potential threats such as external noise, illuminance level, electromagnetic field, temperatures and other visual stimulation may lead to intense psychological impact to the sleepers inside a bedroom. The potential psychological impacts in such unfavourable *Feng Shui* setting including anxiety, temperature variation, fear of storms, light reflection and impact of intruders.

From the evolutionary psychology perspective, Spörrle & Stich (2010) verified that human have corresponding preferences on the selection of sleeping site that is secured from aggressors and night time predation. Concurrently, the study also evidenced that the respondent preferences were in line with some of the bedroom *Feng Shui* rules where (1) the door shall be in farther position from the bed and (2) the bed head shall be ideally supported by solid wall rather than a window. Thus, it was apparent from Spörrle & Stich studies that the basis of these *Feng Shui* rules has significant psychological effects to the bed users. Human tends to use senses to create the best environment for sleep. Other than the protection against aggressors, the preferable bed arrangement in relation to the door also implied that the respondents are preventing noise, lighting, threats and pressures from the external. As a result, these *Feng Shui* rules in bedroom are subconsciously practised with the intention to ensure a more comfortable environment with better visual command before falling into sleep. Spörrle & Stich's research findings are not fully explained by ergonomic-functionality because people should not prefer to walk for longer distance from the bed to the entrance at night. These findings are countering convenience, contradict to human considerations and functionality.

On the other hand, window direction from the bed is also a significant point in bedroom *Feng Shui*. As sleep is particularly sensitive to noise, the environmental noise disruptions are usually amplified when the bed is placed against the window. The potential environmental sound sources are vehicles, gardening machinery; ventilation; TV/radio; sound of steps; sound of pets/birds, children playing and people talking. These annoying noise sources may increase negative psychological impacts to the sleeper but do not produce serious mental illness in short term. Besides, Aries, Veitch, & Newsham (2010) studied the window views quality in the office in supporting to the users nocturnal sleep quality. It was found that the position with good window views successfully reduced users' daytime discomfort and hence promotes better sleep quality at night. However, being closer to window might cause thermal and glare problems. Although the study is focusing on the office environment, this study may also denote that window views in a good distance from the bed may be beneficial to sleep. According to Beute and de Kort (2014), visual access to outdoor via window is the principal key to healthful urban design as viewing nature may calm our mind by reducing psychological distress, making people feelings pleasure and contented. In conclusion, the studies about indoor visual-psychological implications disclosed an ideal location of window where it is best for the users to have a window view in a good distance in all situations. This is coherent with the bedroom *Feng Shui* rule as discussed in the previous section about what is a good window position from the bed.

The concept of an ideal interior architectural layout is always parallel with an ideal *Feng Shui* bedroom arrangement. An ideal *Feng Shui* bedroom layout is mainly psychologically accepted as the bed is arranged in a way that avoids *Yang* energy disruptions. Such arrangement is likely to enhance human mental comfort at bed time and assist patient towards speedy recovery.

2.5.2 From Architectural Design Perspectives

Architectural design and interior planning jobs have no specific rule of thumb. The architects usually make his decision based on intuition and past design experiences. In fact, architectural design jobs falls between art and science (Mak & Ng, 2008). An ideal bedroom interior arrangement undeniably requires combination knowledge of both art and science, just like the application of *Feng Shui* approaches. However, over the years, *Feng Shui* approaches applied for bedroom has never been documented as a set of knowledge or benchmark used for bedroom interior arrangement.

Although the architect's design involves more scientific basis in general, we foresee *Feng Shui* conception in bed arrangement is likely the design orientation of all architects for an ideal bedroom interior arrangement. Instead of the architect perceptions, it is also important to examine whether the *Feng Shui* resembling arrangements in a sleep environment are predominantly preferred and providing significant wellness effects to humankind.

On the architectural design perspectives, the indoor parameters considered for a sleep environment design such as indoor air quality; thermal comfort and acoustic quality are always the concern. The variation of these parameters in a sleep environment is probably manipulated by how we organise our bed and other furniture in relation to the room openings, and hence it is strongly related to the bedroom *Feng Shui* practices. A poor indoor planning in bedroom appears to impede individual satisfaction and comfort, evoke distress and uneasiness during bedtime and subsequently affect our sleep, health and well-being. When the sleep environment is situated in an unfavourable *Feng Shui* condition as shown in Figure 2.3 in the above section, the related indoor parameters are possibly coexist at the most discomfort level especially when the threats of noise, smell; cold wind and flickering light from outdoor are directly channelled to the bed. It is strongly believed

that the architects or interior designers will never locate the bed in such a manner to arouse human emotion at bedtime.

In Rossbach's book of *Interior Design with Feng Shui*, she used a number of interior design diagram to illustrate the inner form in terms of contemporary design criteria, including furniture placement of a living room (as cited in Mak, 2011, p. 92). Most of the best arrangements in her design are fulfilling the embraced arrangement concept in Form School (four emblems protection), mostly with supported back, protected sides and visible door farther from the seats.

Besides, the study of Mak & Ng (2005) discovered that the modern architects' thoughts (from both Sydney and Hong Kong) are generally corresponding to the Form School *Feng Shui* concept on the selection of surrounding environment for a building and a lounge room interior layout. The results implied the professional architects' have subconsciously acknowledged *Feng Shui* thoughts as the design instrument in managing human comforts and needs in both macro and micro environment. In view of the fact that Form School *Feng Shui* thoughts are concurrent with the contemporary practices of Eastern and Western architects on building environment studies, this *Feng Shui* concept shall be a part of science rather than merely superstitious. Figure 2.4 shows the illustration of a lounge room layout designed by one of the architect participants from Sydney. In comparison with the Form school simplified model, the illustration shows the person is sitting at the *Feng Shui* spot i.e. the sofa (E). The wall painting (A) behind the sofa seats denotes the back hill supports. The fire stove (B) in front of the open space (F) - the Bright Court, refers to the front guarded hill (Red Bird) while the pair of armchairs (C) and (D) denote the right and left protective hills, the White Tiger and Azure Dragon respectively. Windows (G) give sunlight and hope in daytime while linking the roads or traffic flow outside the windows. Sunlight and noises are *Yang* energies and therefore corresponding to water flow which is mobile.

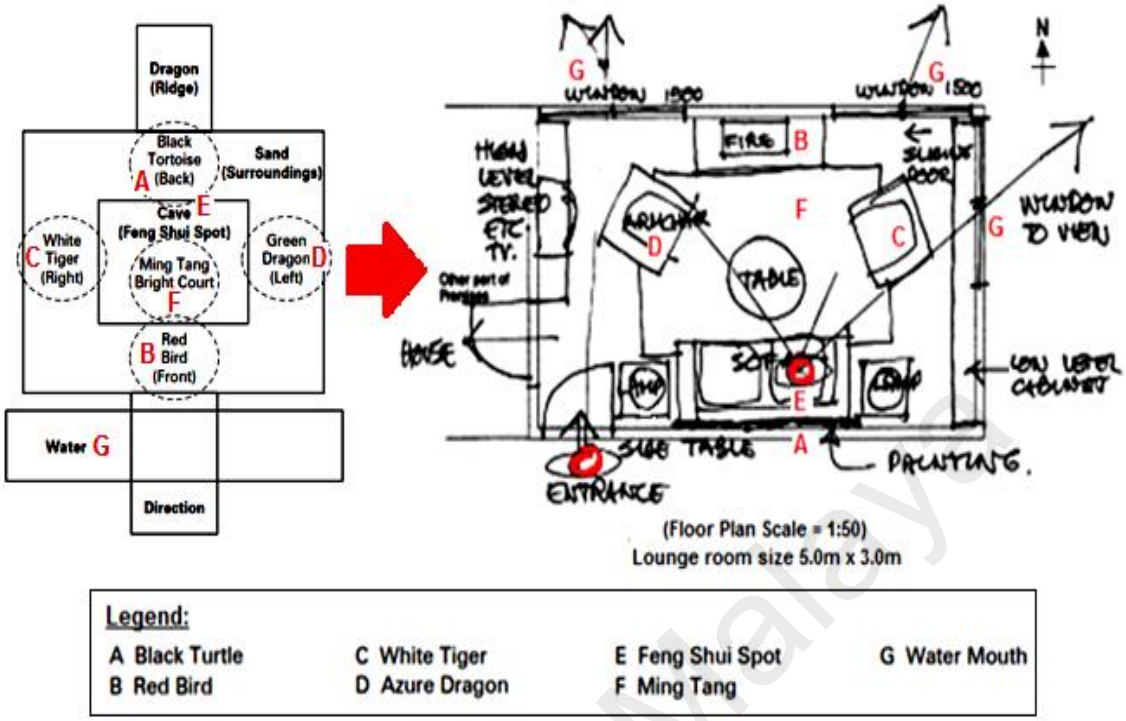


Figure 2.4: The lounge room layout designed by one of the architect participants from Sydney is corresponding to the simplified model of Form School *Feng Shui*.

Source: Adapted from Mak & Ng, (2005)

2.5.3 From Human Well-being Perspectives

It was realised that most of the studies about building indoor quality are associated with thermal comfort, air dampness and ventilation. These environmental qualities are often linked to passive building design and advanced technology rather than emphasising on 'interior positioning'.

In fact, interior planning and design has significant effects in determining human comfort and well-being inside of buildings (De Giuli, Da Pos & De Carli, 2012). It can possibly act as the complementary to therapeutic effect (Lee, Dilani, Morelli & Byun, 2007) especially the healing design for mental and physical well-being in hospital environment (Gesler et.al, 2004). Alike the hospital, a sleep environment also involves space for rest that requires full comfort and satisfaction to secure human well-being.

In a sleep environment, human satisfaction involves the sense of comfort and secured in place, as both are the key principles on which human being base their needs for indoor environment (Hughes, 2013). As discussed in the previous section, sense of comfort and secured in bedroom are possibly delivered when the bed is ideally positioned based on *Feng Shui* rules. The airflow or *Qi* flow (specifically in *Feng Shui*) in such arrangement is always favourable to sustain a healthier human being. However, sense of comfort can be very subjective for different gender and age groups of people. The common ways to quantify sense of comfort is by satisfaction rating survey, predicted mean vote (PMV) method (Calis and Kuru, 2017) and data loggers (Feriadi & Wong, 2004 and Lam, Loughnan & Tapper, 2018), to measure air temperature, relative humidity, wind speed, etc. When a survey or experiment is conducted for the purpose, the sample and results should be categorised and analysed separately based on different gender, age groups and other criteria. Kalmár (2017) and Kim, et al. (2013) studies for indoor environment evaluation by gender and age discovered that young women are significantly more sensitive in thermal and comfort sensation in comparison with the other groups.

So and Lu (2001) verified an important *Feng Shui* rule by Computational Fluid Dynamics (CFD) simulation where the bed should not be located next to the bathroom door due to the bad airflow directed from the bathroom. Good airflow is always favourable from *Feng Shui* viewpoint for the benefit of the occupants' well-being because the characteristics of *Qi* closely resemble airflow. The *Feng Shui* rule about the bathroom door must be closed whenever possible is similar to the *Feng Shui* rule for the bedroom door shall be closed during bedtime. This is in compliance with the concept of *Yin* and *Yang* as the bathroom foul air, heat and moist are more *Yang* energy which may frequently enter the bedrooms. Bathroom foul air and moist can threaten human health and well-being in long-term basis.

Alike the study of *So and Lu*, Chou, Hung & Chiang (2007) claimed that the indoor airflow pattern is similar to the *Qi* flow pattern in *Feng Shui*. They validated that the bedroom scenarios associated with unfavourable *Feng Shui* were showing poor indoor airflow patterns via CFD simulation method. However, the indoor airflow patterns in the recommended *Feng Shui* scenarios were much better. The air flow patterns were evidently unfavourable especially in the door-open scenarios. The overall study reveals that healthier ventilation exists when the bed is in compliance with all favourable *Feng Shui* rules. Consequently, healthier ventilation may have impacts on thermal comfort and air quality, subsequently the human emotions and well-being.

2.6 Design Considerations in Bedroom Interior Arrangement

Interior planning and design are mainly intuitive practices based on designers‟ experiences and inventive thoughts. It has no regulations of its own but a functional supportive design is truly demanded. Armaghan & Servatju (2014) referred interior design as a vital component of architecture and assumed that it is not a skill as anyone is able to arrange their own place to a sense of comfiness based on their cultural, social and economic conditions.

There are some contemporary architects proposed informal procedures on how to arrange furniture of a space, mostly in home magazines, designers' blog or websites. Some of them may have different perceptions in furniture arrangement which have never been united. Thus far, none of these recommended procedures are validated in research because people always think it is a job to do with art that shouldn't be restricted. From the review of design ideas in bedroom, it was realised that the contemporary architects have unintentionally apply *Feng Shui* rules in most of their written procedures but did not quote *Feng Shui* knowledge as the basis of their thoughts. The Better Sleep Council (n.d.) website and McMillan and McMillan's (2011) book are good examples. These reading

materials are not published based on *Feng Shui* perspectives but mainly for enhancement of sleep environment. Thus, in the author's perception, design procedures for sleep environment can be united based on a well-documented *Feng Shui* rules.

Bed arrangement is part of furniture arrangement. Furniture arrangement is a sub-field of interior design which is associated with allocation of spatial resources. Smith (2015) highlighted that "arranging furniture is not restricted to an art. It involves a trace of thought but plenty of experimentation. One of the most difficult rooms to design tends to be the bedroom, especially if it's small". It is quite a challenging job and requires reciprocal optimisation of both functional and visual criteria. The functional criteria examine how well the spatial layout can supports human activities such as circulation and conversation that occur in a room, while the visual criteria concern about the perception of the layout as a visual composition (Merrell et al., 2011). Nonetheless, function and visual composition can be conflicts frequently.

The following sub-sections discuss the design considerations for furniture arrangement in architectural perspectives. These sections will serve as the basis for the bedroom interior arrangement. The similarities between Western design perceptions and Chinese *Feng Shui* conception are highlighted in the discussion. Figure 2.5 demonstrates some of the key considerations for furniture arrangement.

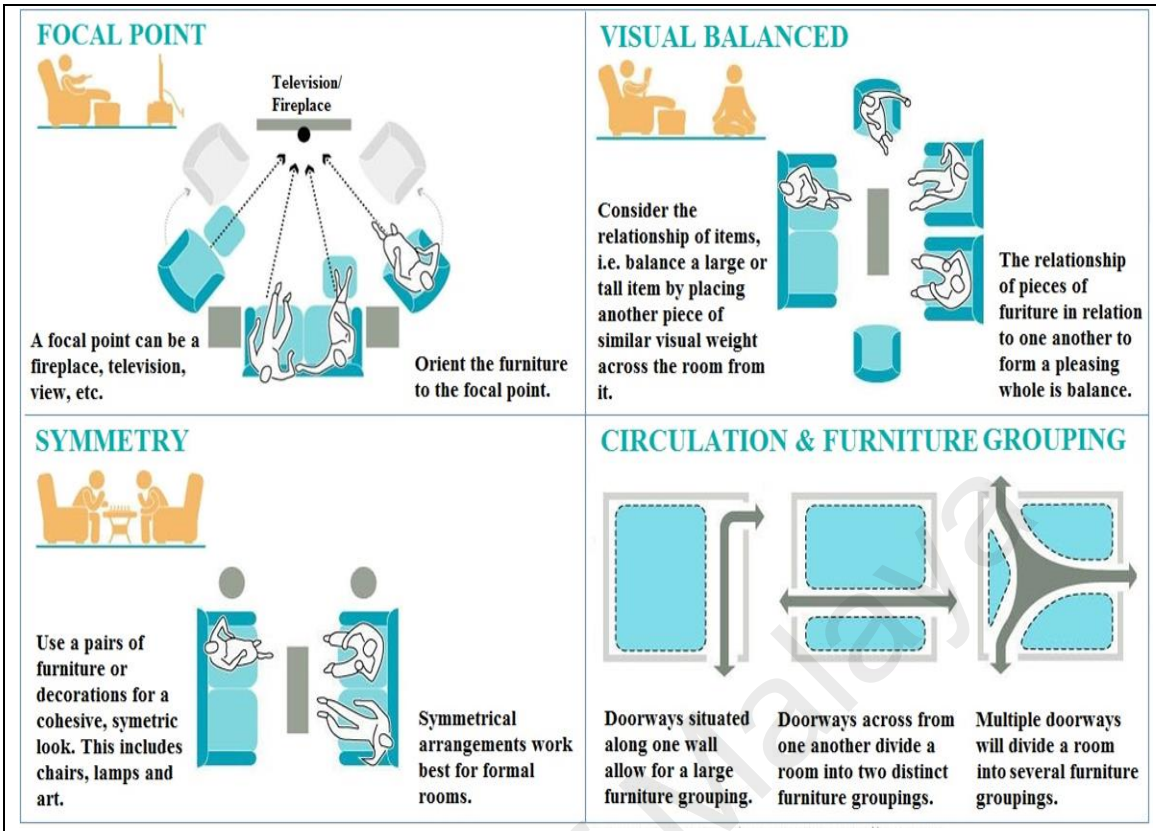


Figure 2.5: The key considerations for furniture arrangement.

Source: adapted from Homesthetics (n.d.).

2.6.1 Function of the Space

According to Albert (2014), furniture arrangement must firstly consider the room functions and the number of room users as this will dictate the furnishings category of required. However, the room size, form and shape factors are the additional concerns in furniture arrangement which cannot be neglected. In a small room, it is encouraged to put in only necessary furniture (Smith, 2015). Concurrently, bedroom *Feng Shui* also advises people to clear out unnecessary item inside the bedroom to allow better *Qi* flow. To be safe, dimensions of the bedroom and the biggest furniture such as bed and dresser shall be measured before allocating the furniture into the bedroom. This step allows the bedroom furniture placement with different options as experiments.

2.6.2 Priority

After the identification of the room function, furniture arrangement shall begin with the placement of the largest piece of furniture (Albert (2014). The bed usually occupies the largest floor area inside the bedroom while the sofa seats are the biggest in the living room. Subsequently, the decision of where to place the largest piece of furniture is significant. In most cases, the largest piece of furniture is often the obliged item to meet the function in that particular room; or it is the room focal point. For example, the bed is the basic and fundamental item and it occupies the largest area of the bedroom. So, to begin with the bed, traditionally, it should be placed against the wall opposite to the door or along the longest wall without windows (McMillan, K. K. & McMillan, P. H., 2011). However, in a small bedroom, we may have to break these rules, though. After the spot of bed is determined, with a proper plan of pathways for circulation, the dresser shall be arranged next, followed by bedside tables, vanity shelves, chairs, etc.

2.6.3 Focal Point

A focal point is referred as a point of interest in a space. Stefano (2013) stated that it should be the 'first thing' you see when entering into a room, or it could be the largest item in a room. Furniture First (n.d.) also emphasised that the flow of a room begins at the focal point and travels around, considering the scale, balance, patterns, and proportions of all the other items in the room. The flow is affected not only by what is placed in the room but by where the item is placed.

Commonly, the norm of furniture planning inside a room is to arrange the furniture around a focal point. For instance, when a fireplace is the focal point, orient the furniture around the fireplace (Albert, 2014). Inside a bedroom, the bed is the key piece of furniture and it naturally becomes the focal point. The bed is often the focal point which should

dominate the design without sacrificing the good balance and harmony of the whole (White, 2011). In this case, other furniture shall be arranged around the bed.

2.6.4 Visual Balance or Symmetry

Other than the focal point, the major visual rules of thumb in furniture arrangement include visual balance and alignment. Visual balance or visual symmetry is the equal distribution of visual weight. When furniture items are not arranged in symmetrical form, it is disturbing and uncomfortable. Albert (2014) and Potthoff, et al. (1990) emphasised that symmetrical arrangement is important in interior design and it work best in all formal rooms by creating a more proper and traditional look.

However, asymmetrical arrangements make a room feel more casual or some said artistic. Asymmetrical placement is contemporary and informal with arrangement of furnishings of different sizes and shapes together to create a balance environment. The commonly seen symmetrical arrangements are such as bedside tables and a pair of single sofa seats. Simultaneously, symmetrical arrangement has been practiced in Chinese *Feng Shui* model in both macrocosm or microcosm layouts, where the features around the *Feng Shui* spot are balanced and harmonised. The protective hills on the left and right of the *Feng Shui* cave and the left and right chambers of the typical Chinese Courtyard house are the good examples. Figure 2.6 shows a number of arrangement options in a small living room. All proposed arrangements are majorly symmetrical, visually balanced and harmonised, just resembling the Form School *Feng Shui* thoughts.

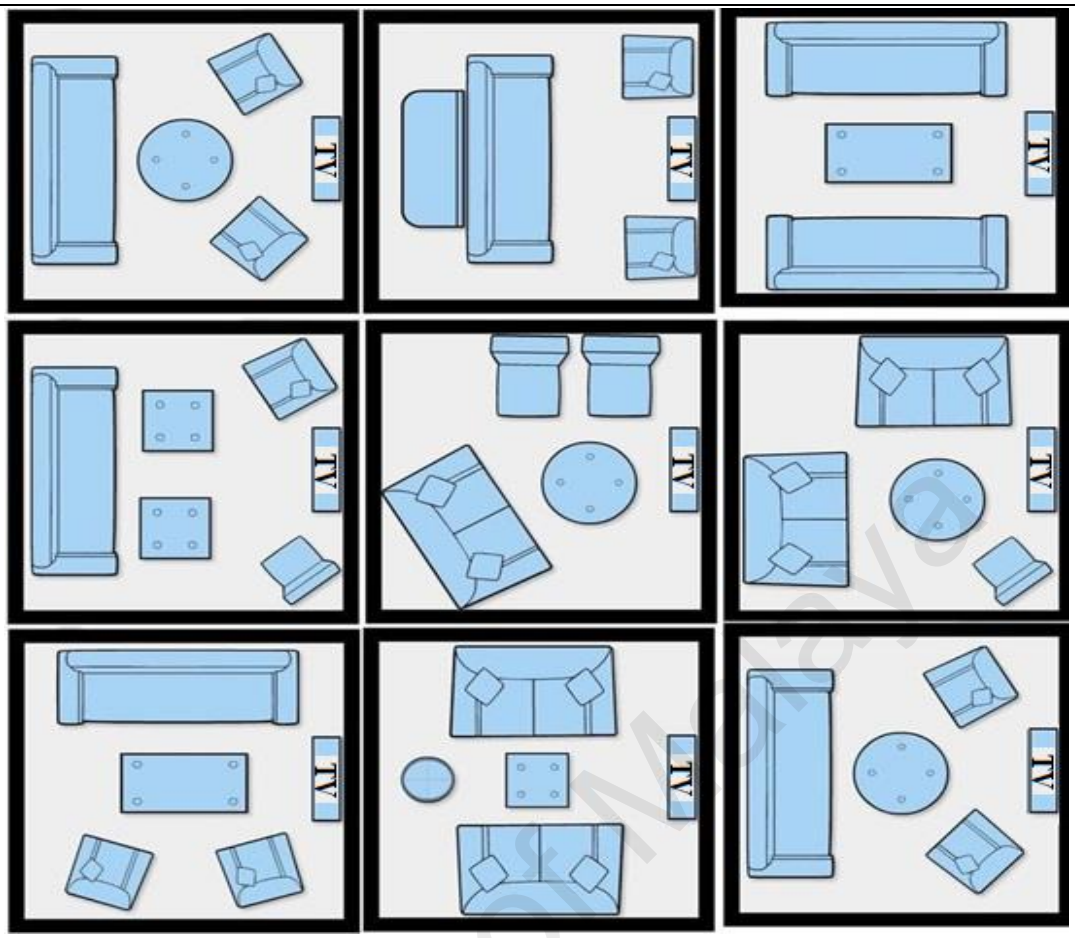


Figure 2.6: The furniture arrangements options in a small living room.

Source: Adapted from Homesthetics, n.d.

2.6.5 Alignment

Alignment refers to the orientation of furniture items in relation to each other and to the walls of the room. Furniture items shall be aligned or perpendicular with nearby walls. In furniture arrangement, the dominant point of emphasis is used to find out the relative importance of each element in a composition. It is created by orienting the furniture items towards the same point and symmetrically around the central point (Merrell et al., 2011). This concept is applicable to a bedroom as well. For example, when the bed is the focal point inside a bedroom, dresser and bookshelves can be located facing towards the bed, aligned to the left and right wall from the bed position.

2.6.6 Circulation

Circulation is about how people move through the space. It demands adequate space to walk around in the room, without blocking the pathways to all operative furniture as well as between doorways with any other furniture.

In a sleep environment, an effective furniture arrangement shall support circulation throughout the space. McMillan, K. K., & McMillan, P. H. (2011) emphasised not to locate the bed where it obstructs a walkway through the room or a doorway into the room. Access to windows and other furniture shall also be always clear. However there is an exceptional where a low back sofa can be located in front of the window provided it supports enough clearance to open the window. Typically several pathways will be reserved to facilitate movement while the remainder area is planned for furnishing. Therefore, designers tend to locate most furniture against the wall in order to make good pathways for circulation. This concept is similar to the Form School *Feng Shui* concept where pathways (open space) are designed for *Qi* circulation and the *Yang* (open space) is enfolded by *Yin* (furniture).

2.7 Sleep Assessment

Human spend one-third of their lives asleep. As discussed in the earlier section, a more harmony and comfort paradigm in a sleep environment can probably be achieved via *Feng Shui* bed arrangement. Zhang, Cao and Zhu (2018) specified that “Indoor environment (including interior arrangement that could impact on human physical and psychological comfort), in addition to many other factors, such as emotion and body condition, can disturb an individual's sleep.” An ideal bed arrangement is very likely to assure good sleep quality for long-term, provided that other influencing factors such as external environment and individual stress or biological factors are constantly unchanged. When a survey or experiment is conducted for sleep quality assessment, the bed

arrangement or bedroom layout options shall be the research variables while other individual and environmental factors shall be under controlled.

2.7.1 Sleep Quality and its Terminologies

Good sleep quality is fundamental for good physiological and psychological health. The term 'sleep quality' is often referred as a complicated phenomenon that is difficult to define and measure. It involves a set of measurements which comprising sleep efficiency, sleep duration, sleep onset latency, and number of awakenings (Barclay, Eley, Buysse, Rijsdijk, & Gregory, 2010).

Sleep duration refers or total time in bed (TIB) refers to the recorded time of getting into bed to the time of getting out of bed in the morning. Sleep onset latency refers to amount of time it takes to fall asleep or the time between sleep onset and the onset of the first episode of REM sleep. Sleep efficiency (SE) refers to the most commonly used measure of objective sleep quality. It calculates the percentage of time in bed that is spent sleeping i.e. sleep-ratio of total sleep time (TST) to time in bed (TIB). According to Van Cauter, (1997), if a man plan to have an 8-hour sleep period, the sleep onset latency takes 30 minutes; and wakes up 30 minutes earlier the scheduled end of the sleep period and experienced sleep interruptions for a total of 60 minutes, the sleep efficiency is 6 hours/ 8 hours = 75%. Number of awakenings refers to an act of waking from sleep or reasonably alert state of awareness of the environment.

2.7.2 Methods of Assessment

There are two methods to assess human sleep quality, i.e. through objective measures and subjective measures. The most common sleep assessment of a healthy person is through subjective measures. Subjective sleep quality refers to one's perception on whether they (a) are satisfied with their overall sleep, (b) can fall asleep easily, (c) get

sufficient duration of sleep, (d) experience frequent awakenings, and (e) experience excessive daytime sleepiness (Buysse, 2014; Krystal & Edinger, 2008). Typically, the assessment of subjective sleep quality is defined as either 'good' or 'poor' sleepers by subjective ratings given to the examinees. The renowned tool to assess subjective sleep quality are sleep logs and Pittsburgh Sleep Quality Index (PSQI) developed by Buysse, Reynolds, Monk, Berman, & Kupfer (1989) of Sleep Medicine Institute in University of Pittsburgh. A sample copy of PSQI survey is presented in Appendix V and its scoring method based on PSQI is presented in Appendix VI.

In scientific research, the use of objectives measures are highly encouraged as sleep quality is quantifiable using polysomnography (PSG) and sleep actigraphy. Polysomnography (PSG) is a multi-parametric test used as a diagnostic tool in sleep research. It is widely used among the different types of patients. It allows the evaluation of the sleep stages (wake, REM, non-REM) and records comprehensive bio-physiological changes such as brain activity (EEG - electroencephalogram), muscle activity or skeletal muscle activation (EMG – Electromyogram); eye movements (EOG - electro-oculogram) and heart rhythm (ECG - electrocardiogram) that occur during sleep, which jointly define sleep and wakefulness. On the contrary, sleep actigraphy is a one-dimensional and non-invasive approach which has been limited to the monitoring of human sleep-wake activities. It measures sleep efficiency (SE) by detecting the ratio of sleep-wake activities. The watch-like unit (actiwatch) with an actimetry sensor is worn by the examinee on wrist to measure gross motor activity (Pigot, et al., 2003). There are also actigraphs to be worn around waist, hip or thigh with longer strips but it is more disturbing during sleep.

2.7.3 The Sleep Environment versus Sleep Quality related Research

The research done by Spörrle & Stich (2010) and Chou, Hung & Chiang (2007) as stated in section 2.5.1 and section 2.5.3 respectively in some way showing the affirmative results to support the rationality of bedroom *Feng Shui* conception as anticipated in the current research hypotheses. However both studies did not complete with human sleep quality assessment but only involved discussions on evolutionary psychology perspective and indoor airflow patterns via CFD simulation method. As agreeing to the above perceptions by Zhang, Cao and Zhu (2018), these studies on indoor environment with suggestions of ideal bed arrangement are promoting healthier state of mind at bedtime as well as healthier ventilation in bedroom which are directly associated with individual sleep quality.

It was truly a fact that there has been no previous study looking for a relationship between bedroom interior arrangement (or *Feng Shui* bed arrangement) and sleep quality. However, several studies have revealed relationships between sleep quality, gender behaviours and indoor environmental satisfaction which including air temperature, noise, illumination etc. majorly from female adults' perspectives. These studies are discussed and referred by the author in the following paragraphs.

Rubens, Miller and Zeringue (2017) examined factors associated to the sleep environment (i.e., ambient sleep disruptions, sleeping in a bed, and sleeping in one's own home) in relation to externalising behaviours (engagement in delinquency, substance use, arrest history) in adolescents or young adults (mean age = 18.02). As a results, understanding disruptions within the sleep environment, such as being bothered by room temperature, noise in the house and caring for a family member while trying to sleep, is so important when assessing sleep problems, including among youth exhibiting externalizing behaviours. Such disruptions are seemingly and significantly associated with bedroom interior arrangement.

From the research by Strøm-Tejsen, Zukowska, Wargocki, & Wyon (2016), the results indicated bedroom air quality was improved when clean outdoor air supply rate in bedrooms are increased by an opened window. When the bedroom air quality was improved, the examinees reported that the bedroom air was fresher, sleep quality was improved, less sleepy and logical thinking improved in the next day. However, this research did not mention the bed locations during the experiments were conducted. Therefore the results may or may not contradict to the research hypothesis about bedroom *Feng Shui* restrictions versus sleep quality.

There were some sleep quality researches conducted in group(s), with more than one person in a room, using objective and subjective measures. In the research to study the sleep status of college students, Liu et. al (2017) assessed the sleep quality of 12 college students by the waistband sleep monitor system. The result showed that the examinees bed times are majorly late and onset latencies are long, as other parameters are regular. Besides, there are the following studies by Laverge & Janssens (2011) and Bano, et.al (2014) implied the effect of ventilation and bed position or light exposure had certain level of implications to sleep quality.

Laverge & Janssens (2011) studied the influence of ventilation rate on the sleep pattern. The examinees was asked to sleep in their normal sleeping environment i.e. student dorms with more than one examinee in a room, in order to cause as little disruption in the normal pattern as possible. Actigraphy was used to measure sleep patterns as it is the least disturbing measurement techniques available. Questionnaires were also used to determine their general attitude towards sleep and their subjective appreciation of the sleep quality. The results showed a very small effect of the ventilation rate on the examinees' sleep pattern.

Bano, et.al (2014) assessed assess sleep quality in a group of medical inpatients, in relation to environmental factors, and the switch to daylight-saving time. Assessment by

standard questionnaires were conducted to patients sleeping in double or quadruple rooms, facing South or South-East, and were qualified as sleeping near or far from the window. Illuminance and noise were measured at the same time. As a conclusion from the research, medical wards appear to be noisy environments, in which limited attention is paid to light or dark hygiene. A relationship was observed between sleep quality and bed position or light exposure, which is worthy of further study.

On the other hand, the study of Zhang, Cao and Zhu (2018) employed online survey and conducted field study in university dormitories to figure out the relationship between indoor environments and sleep quality. The online survey results revealed individuals have differing perceptions of the effects of environment on sleep quality while the field study results showed an excellent linear relationship between sleeping environment satisfaction and sleeping quality satisfaction. It was found that the most satisfactory operative temperature was found to be 24.2 °C, and subjects have a lower neutral temperature and a broader accepted temperature range during sleep. A multivariate analysis showed that several environmental factors believed to disturb sleep are interrelated. This research apparently using subjective measure - PSQI to assess sleep quality in the field study but the author proposes a more accurate way to quantify sleep quality by wrist actigraphy.

Another study by Lindberg et. al (1997) similarly employed subjective measure to identify the prevalent sleep disturbances and the association between these complaints and psychological status. Despite a longer total sleep time (TST), females reported insufficient sleep, difficulties maintaining sleep (DMS), excessive daytime sleepiness (EDS) and the absence of feeling refreshed in the morning more frequently than males. According to the Hospital Anxiety and Depression scale, females also suffered from anxiety more frequently than males.

Kim, Chun and Han (2010) conducted a study of bedroom environment and sleep quality to investigate 24 women who lived in apartments in Seoul and its environs. Two groups of measurements were carried out with the first group to consider sleep environmental elements such as mean radiant temperature, illumination, equivalent noise level, etc., and the second group to assess sleep quality elements such as the apnea–hypopnea index, and inspiratory flow limitation by polysomnography. The results discovered significant positive correlations between sleep environmental factors such as mean radiant temperatures and sleep quality in winter and spring. Besides, the effect of the sleep environment on sleep quality was varying by age. Sleep quality was found to be better in a warmer environment.

The above results by Lindberg et. al (1997) and Kim, Chun & Han (2010) denote a right path to investigate the sleep quality of young female adults in the current research as women are the sensitive category that could respond more accurately to a sleep environment.

2.8 Summary of Chapter

This chapter has thoroughly reviewed literatures and provided interpretative discussions about bedroom *Feng Shui* conception and its relationships with multiple dimensions of scientific perspectives such as the architectural design and sleep psychology. The design procedures and considerations in for a bedroom interior were also linked with bedroom *Feng Shui* conception. Lastly, literatures about sleep quality assessment were delineated.

Several researchable implications have been drawn out from the literatures to support the research area, research objectives and research problems. Although bed arrangement is considered arts and perceptual works in architectural perspectives, it has parallelism with bedroom *Feng Shui* conception and show strong relationships with sleep quality.

Both architectural design and *Feng Shui* shall never be ignored regardless of which knowledge is a subset of another.

CHAPTER 3 – RESEARCH METHODOLOGY

3.1 Introduction

This chapter shows a comprehensive research methodology used in data collection and the procedures involved to achieve the expected result. The chapter begins with an outline of the research design and process followed by the rationale of the choice of research methods. The chapter also covers the area of investigation, sample of selection, instruments used for data collection, procedures involved for each method used and data analysis. The problems and limitations experienced by the researcher have also been outlined. The structure of this chapter is illustrated in Figure 3.1.

Figure 3.1: The framework of Chapter 3.

3.2 Research Design and Process

A research design and process is important as each major step is having its own value of the research. Selecting an appropriate strategy in research design is the key to ensuring research questions are addressed in a more valued way and in compatible with the overall research topic, aim and objectives of the research. It is also intended to minimise the expenditure of efforts, time and money for the collection of relevant data.

The current study involves a blend of confirmatory and exploratory research. According to Sekaran (2000), exploratory research is the stage of the research process that aims to gain insight into a given situation and phenomenon. Confirmatory research or hypothesis testing is where researchers have a theory or several theories (as stated in the research objectives) to be investigated if the theories are supported by the facts. Confirmatory and exploratory research are two complementary components of the same direction, i.e. to discover related findings in the most efficient, reliable, replicable and applicable manner. Researchers would normally do some exploratory studies and gather potentially interesting findings. Subsequently, the researchers would decide precisely on how to confirm the findings on the basis of these interesting results with appropriate research design and strategies.

This research explored the preferences of survey respondents and interviewees in bedroom interior arrangement, as well as the human sleep quality in the given scenarios. These exploratory findings were then served as the basis to confirm the pragmatism of *Feng Shui* theories applied to a sleep environment.

3.2.1 Scientific Investigation for *Feng Shui* Research

As *Feng Shui* knowledge has a deep influence to human life and well-being, the urge of conducting scientific research in its application to the built environment is essential. Scientific approach in research is denoted as the process for examination or experimentation, aiming to discover and interpret evidences, review and postulate theories that can explain natural or social phenomena, or in other words, build scientific knowledge. In academic point of view, both theories and observations are the main constituents of scientific research. Scientific knowledge is delivered based on the process of logic in theories and evidence from observations. It concerned with testing of the theoretical concepts and relationships to see whether they reflect our observations of

reality, with the goal of ultimately building better theories. A theory can be more and more refined until the science gains maturity (Mak and So, 2011). It is important to understand that it is not always possible to conduct investigations that are 100% scientific, due to the data are collected in the subjective areas of perceptions and attitudes.

This research adopted one of the primary methods of scientific investigation that is the hypothetico-deductive method. It is the process by which we arrive at a reasoned conclusion by logical broad view of a known fact (Sekaran, & Bougie, 2016). Figure 3.2 depicts the building blocks of scientific investigation which include the processes of observing phenomena, identifying the problems, developing hypotheses based on existing theories, determining elements of the research design, collecting and analysing the data, and lastly interpreting the results. The building blocks are referred as the outset for the hypothetico-deductive method of scientific research.

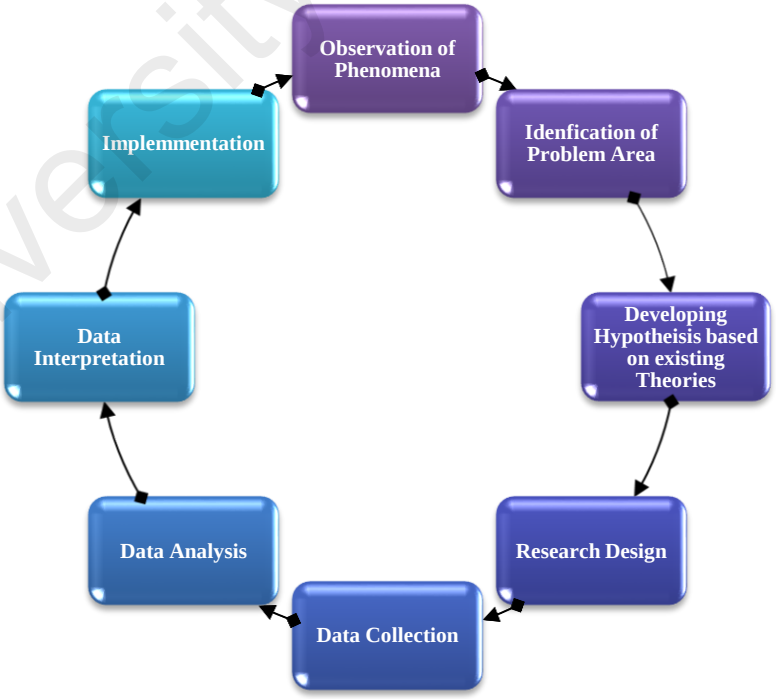


Figure 3.2: The building blocks of scientific investigation.

Source: adapted from Sekaran, & Bougie (2016).

In this research, a few things were observed at first i.e. the adoption of *Feng Shui* theories in the micro built environment and the design criteria for a building interior. Subsequently, a few problems were identified from the observation. As discussed in section 1.3, the identified problems are: deficiency of published design procedures in the sleep environment and lack of well-documented *Feng Shui* theories for the architects to apply in the sleep environment. It was also found that there are potential relationships between bedroom *Feng Shui* conception and the architects' design criteria, as well as the human preferable arrangement for a bedroom interior.

Hence, with the integration of all information gathered, a number of hypotheses have been generated. The hypotheses expect: (1) majority of the respondents prefer a sleep environment that is corresponding to the bedroom *Feng Shui* conception, (2) the modern architects' perceptions in design procedures and design criteria for a bedroom interior are corresponding to the bedroom *Feng Shui* conception and (3) an ideal *Feng Shui* bed arrangement is supportive to better sleep quality. The hypotheses are then tested to determine if the data support them. Next, a research design is set up to decide on how to collect, analyse and interpret data, and lastly, to provide solutions to the problems. The research design and process are presented in the following sections. The whole process of seeking from logical analysis from multiple perspectives in order to make conclusion to the relationship between bedroom *Feng Shui* conception and the abovementioned point of view is called deduction.

3.2.2 The Research Design

This section covers on how the current research was carried out to achieve the research aims and objectives. The step-by-step research processes from the establishment of research proposal to the production of final research report is drafted in a flow chart as shown in Figure 3.3.

To begin, the research was planned at the outset according to a specified period in stage 1 with three (3) sub-stages. The first sub-stage of the research planning was to identify research problems. The second sub-stage was related to the formulation of research objectives and scopes of study based on the theoretical and empirical materials from precedent studies. The third sub-stage involved drafting research methodology and research processes.

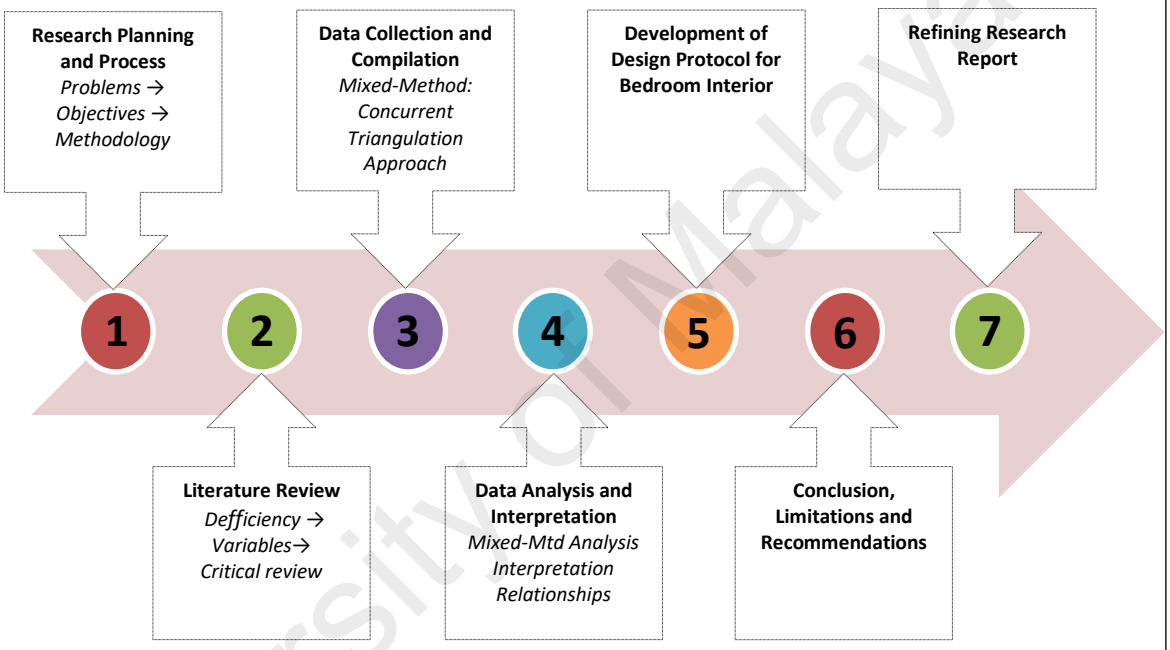


Figure 3.3: Research design and processes.

Literature survey was conducted with another three (3) sub-stages in stage 2. These secondary data sources were largely from a few channels i.e. journal articles, conference papers, thesis, online database and etc. The first sub-stage of the literature survey was to identify knowledge deficiency within the investigation capacity. The second sub-stage progressed to examine past literature on relevant variables selected for empirical research. These variables were linking back to the research objectives as formulated in stage 1. Subsequently the survey moved on to do critical review on those literatures and find core relationships between theories and practices.

In stage 3, a mixture of quantitative and qualitative research approaches were adopted to collect and compile the primary data, facts and information. Concurrent triangulation strategy was employed by combining three research methods i.e. interviews, questionnaire survey and experiments. The research samples, tools and test for data analysis were identified after the confirmation of research strategies.

Next, the research processes were progressed to stage 4 for data analysis and interpretation. Multiple analysis methods were used to analyse both quantitative and qualitative results. The combined results were then discussed, interpreted and confirmed with the hypothetical relationships in bedroom *Feng Shui* conception.

In stage 5 of the research processes, a design protocol for bedroom interior was developed based on the tested *Feng Shui* variables using triangulation method. Expert's validation was performed to ensure the comprehensiveness and practicality of the design protocol. Subsequently, the conclusion, research limitations and future recommendations were presented in stage 6. The final stage of research processes ended with refining the research report.

3.3 Selection of Research Methodology

Research design and process involves decision from a broader assumption to detailed method of data collection and analysis (Creswell, 2013). The philosophical worldview, procedures of inquiry and methods of data collection, analysis and interpretation contribute to a research design that tends to be quantitative, qualitative, or mixed. As this research employed mixed-methods design, the research will definitely take extra time because of the need to collect and analyse both quantitative and qualitative data. The well-organised structure of quantitative research and the flexibility of qualitative inquiry suggest more reliable results to solve the research problems. Figure 3.4 demonstrates the

interconnection of worldviews, strategies of inquiry and research methods used in the current research design.

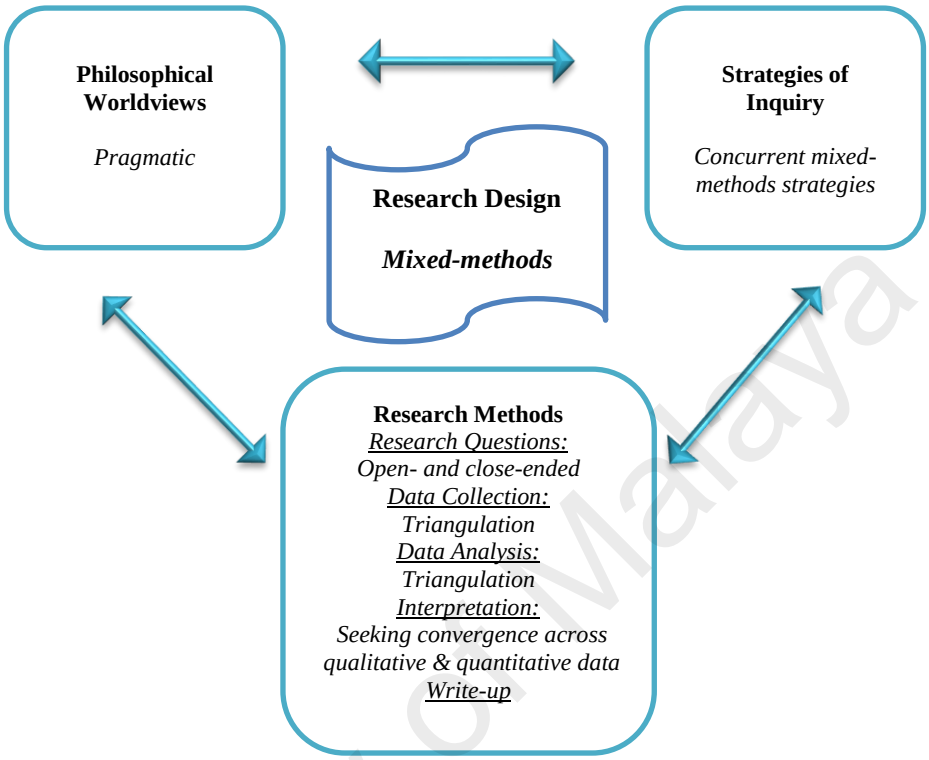


Figure 3.4: The interconnection of worldviews, strategies of inquiry and research methods in the current research design.

3.3.1 Pragmatic Worldview

The researcher holds pragmatic worldview as commencing in this research. The pragmatic worldview is concerned with applications and what works to the solution of a problem. In lieu of focusing on methods, researchers use all approaches available to address and emphasise the research problems. This applies to mixed-methods research as researchers are free to select the methods, techniques, and processes in collecting and analysing data, which best meet their research aims and objectives. It requires a rationale for the motives why quantitative and qualitative data need to be mixed in the first place (Creswell, 2013).

3.3.2 Strategies of Inquiry

For the strategies of inquiry, this research adopted mixed-methods approach to provide specific direction for the procedures in research design. As mixed methods strategies employed multi-method matrix to examine multiple approaches to data collection, it can neutralize the biases inherent in any single method applied. Figure 3.5 illustrates the mixed methods design adopted in this research, showing how the data would be collected and analysed to address to research questions. In this research, interviews (qualitative data) were combined with conventional questionnaire survey and experiments (quantitative data). Then the results of both types of data were used side by side to strengthen each other, i.e. qualitative quotes support statistical results and vice versa (Creswell & Clark, 2007). The strategies employed in this study are called concurrent mixed methods, where quantitative and qualitative data can be collected at the same time (refer to Figure 3.7 in later section).

Figure 3.5: The design of mixed methods approach.

The study commenced with a questionnaire survey in order to generalize the results to a population. Concurrently, it focuses on qualitative data where detailed viewpoints from architects were collected by open-ended interviews. The results were then strengthened again by sleep experiments with quantitative data. Lastly, all data were integrated for the interpretation of the overall results.

3.3.3 Research Methods

As discussed in Chapter 1 and the previous sections, there are three (3) types of research methods adopted for data collection, namely questionnaire survey, interviews and experiments. A matrix of research methods used for each research objective (i) to (iii) has been delineated in Chapter 1 in Figure 1.3. The mixed-methods approach formed a triangulation strategy to test a set of variables in concurrent manner, using both open and close ended questions. It is apparent that the use of only one method to measure a given phenomenon will produce limited and biased results. The core idea in triangulation approach is that all methods have inherent strengths and limitations/biases. When more than two methods that can offset biases are used to assess a given phenomenon, and the results of these methods congregate or substantiate one another, so that the validity of inquiry findings is improved. The methods used in triangulation approach must to be conceptualised, designed, and implemented simultaneously to preserve their counteracting biases, and also be implemented independently within the same conceptual phenomenon or paradigmatic framework.

The triangulating data in this research, including statistical and descriptive data were then collected, analysed, and interpreted. Once the hypothetical relationships were confirmed, they shaped the basis for the development of design protocol for bedroom interior in Objective (iv).

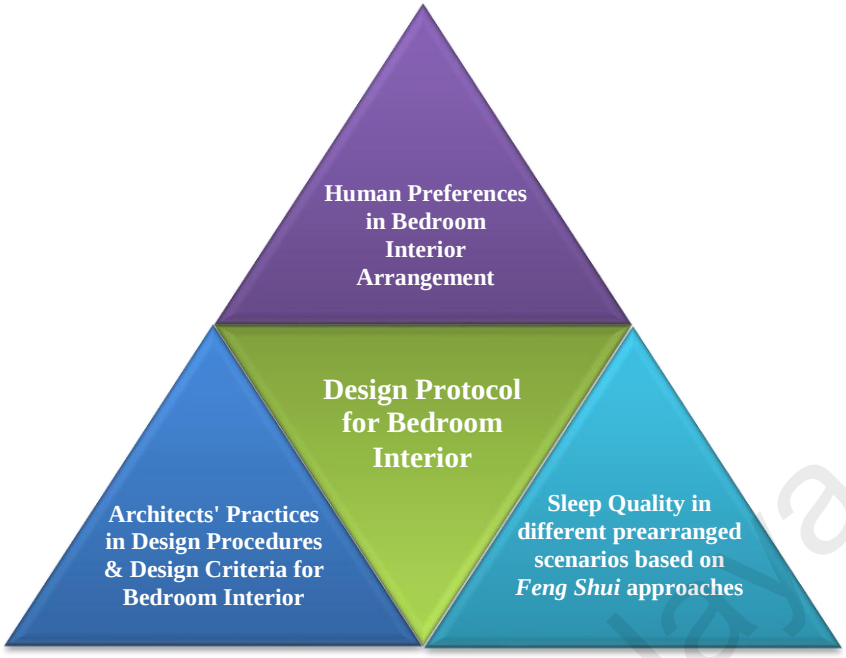


Figure 3.6: The development of design protocol for bedroom interior was supported by concurrent triangulation method i.e. verification from architectural perspectives, verification from human preferences and sleep quality assessment.

Figure 3.6 shows the triangulation research method used for the development of design protocol for bedroom interior. The three (3) methods that were carried out concurrently involved the verification from human preferences by questionnaire survey, verification from architectural perspectives and measurement of sleep quality; which will be discussed in section 3.4, section 3.5 and section 3.6 respectively. Such triangulation approach was to seeking convergence across qualitative and quantitative methods and the combined results of these methods will establish robust relationships to develop a design protocol based on bedroom Feng Shui conception.

For the data analysis section, the research employed a combination of qualitative and quantitative analysis. Qualitative analysis involved the discussions of similar patterns that emerge from descriptive data while the quantitative analysis involved the discussions of statistical data such as SPSS relationship tests, scoring, sleep index etc. These results were then combined to relate with the hypothesis and to confirm their relationships prior to the

development of design protocol. Figure 3.7 demonstrates the details of mixed-methods design in triangulation approach applied to this research. The methods and procedures to conduct questionnaire survey, interviews and sleep assessments are detailed in section 3.4, 3.5 and 3.6 respectively. The development of design protocol for bedroom interior is discussed in the whole Chapter 7.

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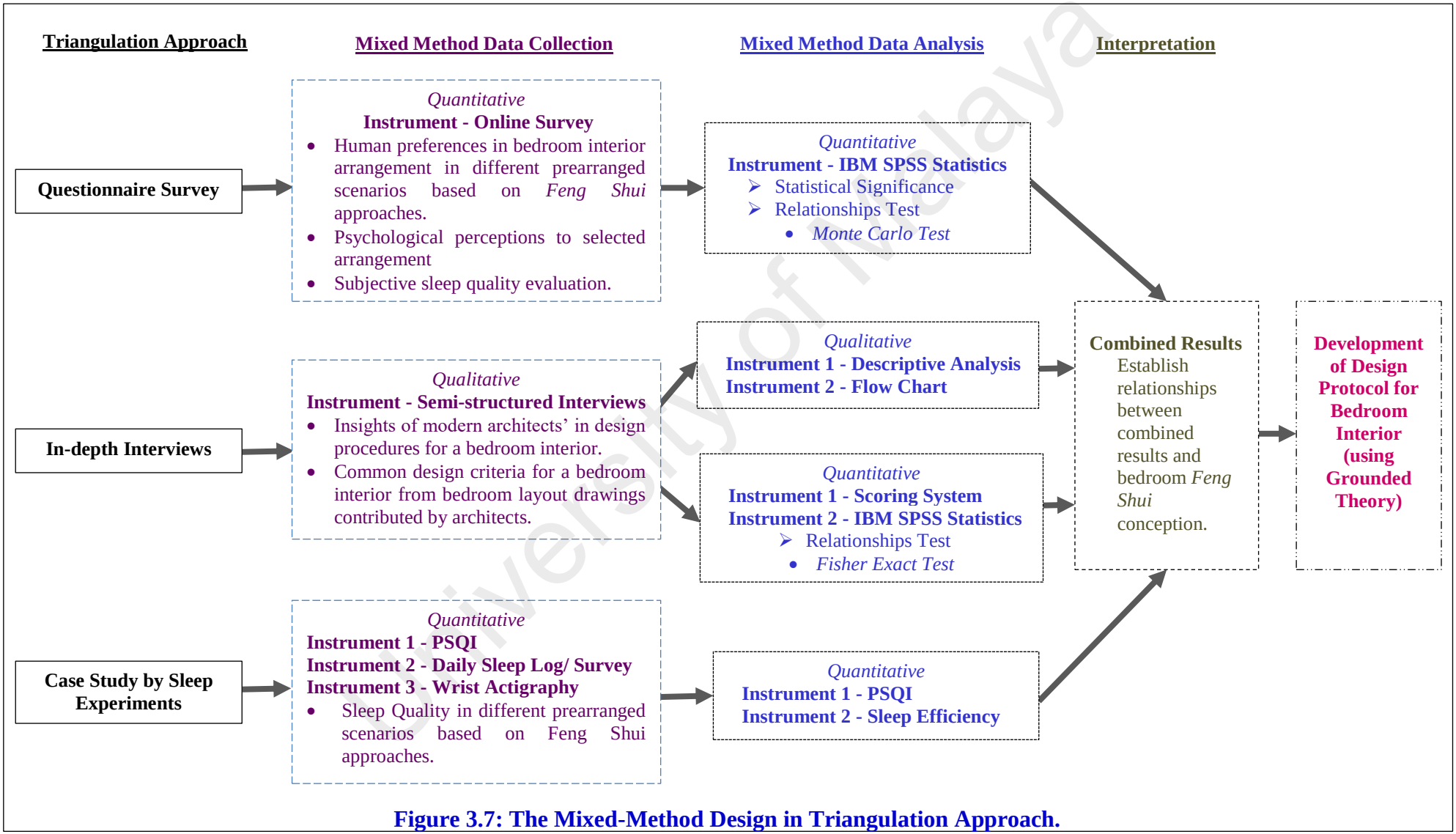


Figure 3.7: The Mixed-Method Design in Triangulation Approach.

3.4 Questionnaire Survey

A questionnaire survey was developed to investigate whether the respondents' most preferable bedroom layout are corresponding to the ideal *Feng Shui* model (integrating Form School concept and common bedroom *Feng Shui* rules) applied to a sleep environment. Concurrently, supplementary questions about subjective sleep quality evaluation and psychological impacts attributed to their choices of arrangements were explored. The relationships between the respondents' choice of bedroom arrangement and their demographic variables were subsequently explored. The survey expected a findings that confirm the corresponding relationships between the respondents' majority preferences and the ideal bedroom *Feng Shui* model.

The questionnaire instrument was divided into six (6) stages, i.e. (1) design and procedures, (2) question types and scales, (3) survey sample and distribution, (4) draft review and amendment, (5) limitation of survey and (6) data analysis.

3.4.1 Design and Procedures

First and foremost, a draft questionnaire of thirty (30) questions was designed and divided into four (4) sections. The structure diagram of the survey questions is outlined in Figure 3.8. The options given in each draft question and the way in which they were structured were derived from careful considerations of the research team members and opinions of some experienced academicians of different origins. In order to pledge the survey is conducted in an unprejudiced manner, *Feng Shui* terminologies or jargons were not applied in the survey questions.

Section I of the draft questionnaire was designed with six (6) questions to find out the respondents' demographic data, which comprise of 'race', 'religion', 'gender', 'occupation', 'age', and 'number of current roommates or bed partners.

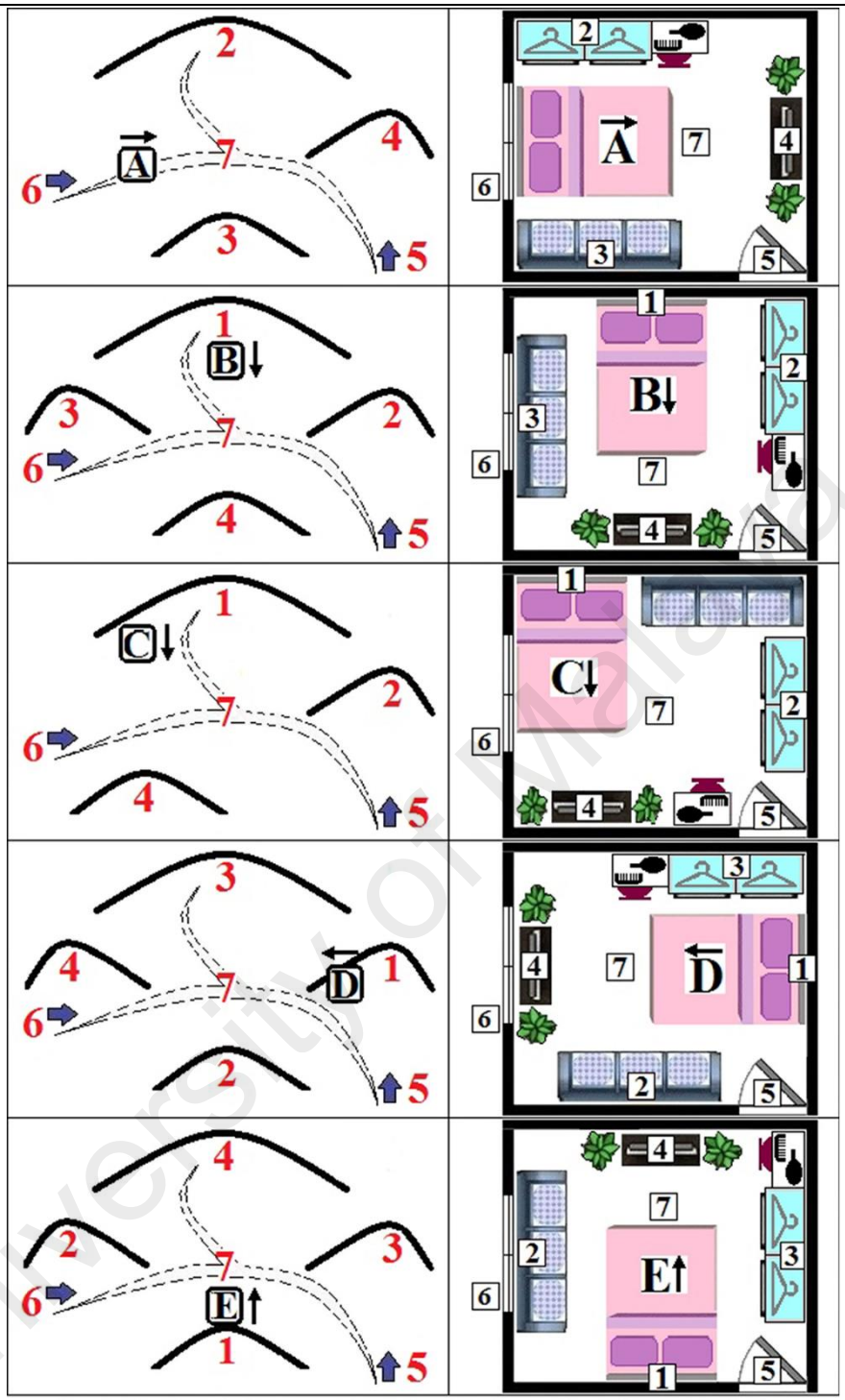
Figure 3.8: The questionnaire survey structure diagram.

Section II was designed with two (2) questions with the aid of diagrams. The first question required the respondents to opt for their 'most preferable arrangement' among five different bedroom layouts with similar conditions. Since the type of bedroom layout that obtains the lowest response does not imply the respondent's least preferable choice, the second question to opt for the 'least preferable bedroom layout' was subsequently added. In both layout selection questions, there were statements asking the respondents to assume all five layout choices are sharing the same external environmental conditions, which including bedroom facing direction, daylight orientation, breeze direction, window view and distance from noise sources.

Among the five diagram options, all bedrooms were square in form (approximately 12 feet length × 12 feet wide on plan), and enclosed with solid brick wall that comes with a door and a double pane window. All bedrooms were equally furnished with a queen sized bed, a closet, a vanity, 2-seats sofa and a TV rack. The five layout options and their corresponding relationships with the landform arrangement based on Form School *Feng Shui* concept are delineated in Figure 3.9.

In option A, the bed was arranged to be backed by a window, devoid of the Black Tortoise support that is considered as the most important in an ideal *Feng Shui* model. Option B was exactly an imitation of the *Form School Feng Shui* model. Bed B was fully protected by the enfolding components, and the distance between the bed and the Qi mouth (door and window) is reasonably far. Option C was an imbalanced arrangement with the absent of White tiger protection (right *sand* guard), making the Qi flows rushed towards the bed without barrier. Bed D was located in line with the door in a nearer distance, where the accumulated Qi is possibly dispersed at such bed location. Bed E was located near the door but in a way that prohibited one from seeing the door. The breeze from the door behind the bed head line in option E may somehow disrupt the Qi flow around bed E.

Five (5) questions related to subjective sleep quality evaluation were drafted in Section III. In this section, respondents were required to define whether their actual bedroom layout are resembling their most preferable choice of bedroom layout in Section II. The question specified that the respondents were required to assess the resemblance of both their ‘actual’ and ‘most preferable’ layouts based on the bed location, by considering the bed direction from wall, door and window; followed by the location of other furniture.



Condition (a): Square and furnished room (size 12' x 12')

LEGEND	FENG SHUI MODEL	BEDROOM MODEL
1	Black tortoise	Brickwall
2	Green dragon	Wardrobe / sofa
3	White tiger	Wardrobe / sofa
4	Red bird	TV set
5	Qi mouth	Door
6	Qi mouth	Window
7	Bright court	Open space
A↑	Cave / facing direction	Bed / facing direction

Figure 3.9. The relationships between the bedroom layout choices and Form School *Feng Shui* model.

In addition, the respondents need to assume that the external environmental conditions of both their actual and selected layout were the same. Three-point scales were appointed for this question, namely: (a) yes, almost the same, (b) no, totally different, and (c) I'm not sure; so that the results will not be affected by the indeterminate respondents. Following this, the respondents were asked to rate their sleep quality by subjective measures in relation to their actual bedroom arrangement in the past month. The evaluations were based on some components in the Pittsburgh Sleep Quality Index instrument, namely, (1) subjective sleep quality, (2) sleep latency, (3) use of sleeping medication, and (4) use of other sleeping aids (Buysse et al., 1989). The PSQI instrument has high test-retest reliability and a good validity for patients (Backhaus, 2002 and Popević, 2018). These questions have stated that the respondents were required to assess their sleep quality based on their actual bedroom layout however shall eliminate the potential outdoor disturbances which may possibly affect their sleep quality in the past month. In order to distinguish between 'good' and 'poor' sleepers, the options given for the question 'subjective sleep quality' were 'very good', 'fairly good', 'fairly poor', and 'very poor'. Besides, the intervals given for the question 'estimated time to fall asleep' were '15 minutes or less', '16–30 minutes', '31–60 minutes', and 'more than 60 minutes'. For the questions to determine frequency of using sleeping medication and other sleeping aids, the given intervals were 'not during the past month', 'once or twice in a month', 'once or twice in a week', and 'three or more times in a week'.

Section IV was designed with seventeen (17) questions. This section firstly asked the respondents to rank the criteria to be considered in bed arrangement for a sleep environment. The most significant criterion shall be ranked as '1' while the least significant one shall be ranked as '4'.

The subsequent questions in section IV were designed based on diagrams (see Table 3.1) with four (4) different bedroom scenarios (a) to (d). All bedrooms were designed

with floor plans approximately 12 feet length x 12 feet wide, unfilled and equipped with a door and a double-pane window. The predetermined bedroom scenarios were: (a) closed door and closed window with blinds; (b) opened door and opened window; (c) room corner and 20" x 60" full body mirror; and (d) uncovered beams and low ceiling. There were five choices of bed arrangement in each bedroom scenario, as illustrated in Table 3.1. A blend of recommended and restricted *Feng Shui* concepts was incorporated into the questions development for the choices of bed arrangement in each bedroom scenario. In all scenarios, bed B was designed as the most ideal bed arrangement which is free of bedroom *Feng Shui* restrictions. Scenario (a) and (b) were designed to find out the respondents' choice of bed location in relation to wall, door and window. The five choices of bed arrangements (A to E) were exactly the same in scenario (a) and (b). Scenario (c) was designed to find out the respondents' preferences against sharp angle and mirror threats whereas scenario (d) was designed to find out the respondents' feedbacks concerning threats from the top. The analysis of all choices of bed arrangements in relation to the recommended bedroom *Feng Shui* rules are shown in Table 3.1.

Respondents were required to opt for their most preferable and least preferable bed location to sleep in scenario (a), (b), (c) and (d). After the selection of the bed locations, respondents were enquired to discourse the potential emotions or psychological perceptions when sleeping in the selected bed arrangement in the four (4) bedroom scenarios. In the psychological perception questions, respondents were allowed to pick more than one answer and fill in one answer in "others" in the last choice. The choices for positive emotions were predetermined as: protected, supported; stable; secured; balanced; comfortable; embraced; convenient and visually satisfied. Conversely, the choices for adverse emotions were: anxiety, disturbed; suppressed; unsecured; fearful; piercing; imbalance; uncomfortable and visually unsatisfied.

Lastly, to assist the respondents in answering the questions, all respondents were notified about the rationales of each survey question in the final section of questionnaire, without any *Feng Shui* jargons. Appendix II displays the distributed questionnaire survey sample together with intended rationales for each question.

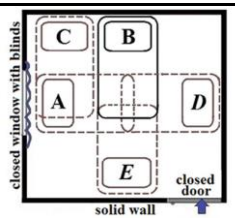
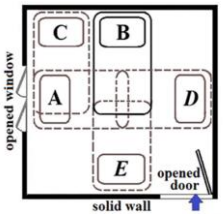
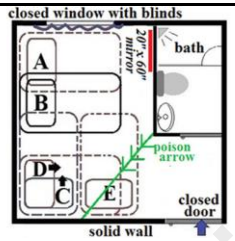
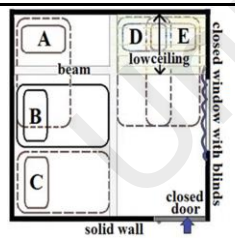
Bedroom Scenarios		Options	Recommended *Feng Shui* practices for bed arrangement						
			Supported by solid wall	Not in line with door	Window at the side/ front	Away from sharp angles threats	Away from mirror threats	Not directly under roof beam	Not directly under low ceiling
a) closed door and closed window with blinds		A	✗	✔	✗	n.a	n.a	n.a	n.a
		B	✔	✔	✔				
		C	✔	✔	✔				
		D	✔	✘	✔				
		E	✔	✔	✔				
b) opened door and opened window		A	✗	✔	✗	n.a	n.a	n.a	n.a
		B	✔	✔	✔				
		C	✔	✔	✔				
		D	✔	✘	✔				
		E	✔	✔	✔				
c) room corner and 20” x 60” full body mirror		A	n.a	n.a	n.a	✔	✗	n.a	n.a
		B				✔	✔		
		C				✔	✔		
		D				✗	✔		
		E				✗	✔		
d) uncovered beams and low ceiling		A	n.a	n.a	n.a	n.a	n.a	✗	✔
		B						✔	✔
		C						✔	✔
		D						✔	✗
		E						✔	✗

Table 3.1: The analysis of bed arrangement choices in relation to the recommended bedroom *Feng Shui* rules for scenario (a), (b), (c) and (d).

3.4.2 Question Types and Scale

Closed-ended and multiple choice questions were majorly adopted in this survey. For the questions related to the selection of preferable arrangement, nominal scale was used in instead of Likert scale. This is due to the author expects a distinct answer from each respondent rather than seeing the respondents selecting 'neutral scale' in their preferences. Table 3.2 shows the question types and scales designed for each survey question.

Table 3.2: The question types and scales designed for each survey question.

Questions	*Types*			*Scale*		
	Closed -ended	Multiple choice (one response)	Multiple choice (multiple responses)	Nominal scale	Interval scale	Ordinal scale
Section I - Question 1 to 6: Demographic background	√	√		√		
Section II - Question 7: The most preferable bedroom layout	√	√		√		
Section II - Question 8: The least preferable bedroom layout	√	√		√		
Section III - Question 9: Resemblance of actual bedroom layout and the preferable layout	√	√		√		
Section III - Question 10: Subjective sleep quality	√	√			√	
Section III - Question 11: Sleep latency	√	√			√	
Section III - Question 12: Use of sleeping medication	√	√			√	
Section III - Question 13: Use of non-drug sleeping aids	√	√			√	
Section IV - Question 14: Significant criteria in considering bed placement	√					√
Section IV - Question 15, 19, 23 & 27: The most preferable bed location (Scenario I, II III & IV)	√	√		√		
Section IV - Question 16, 20, 24 & 28: The least preferable bed location (Scenario I, II III & IV)	√	√		√		
Section IV - Question 17, 21, 25 & 29: Psychological perceptions for the "most preferable" choice	√		√	√		
Section IV - Question 18, 22, 26 & 30: Psychological perceptions for the "least preferable" choice	√		√	√		

3.4.3 Survey Sample and Distribution

This survey was invented and written for adults across the multi-racial country, Malaysia. The targeted respondents were a blend of student adults and working adults who have high level of maturity. The authors believed that these groups of people are capable of interpreting a two-dimensional drawing plan and capable of solving questions written in English.

The survey adopted a simple random sampling method. Invitations to participate in the survey were emailed to approximate 1500 of potential respondents in a blend of working adults and student adults. Concurrently, a link to direct the respondents to the online survey and an introductory letter stating the official research project description (without *Feng Shui* terminologies) were attached in the invitation email. The email addresses were obtained and filtered from multiple sources including staff contacts from a variety of consulting firms, university staff and student directories, personal email contacts and friends' list from social media application. For a fully responded questionnaire, respondents received a modest compensation.

3.4.4 Draft Review and Amendment

Upon the completion of the draft questionnaire, five reviewers including two architects and three academicians went through the draft for reliability and content validity. Next, the draft questionnaire was evaluated in a pilot study to analyse the clarity of item, comprehensibility and components related to the psychometric properties of the instrument. The participants (N = 30) in the pilot study were in a blend of postgraduate students and working adults, including a number of architects and lecturers. They were asked to state the deficiencies of the questionnaire contents, significance of each item and other potential approaches for a better survey design.

As a result, the questionnaire was adjusted to a final edition, with improved content validity according to the feedbacks and criticisms from draft reviews and pilot studies. It was found that nominal questions were more appropriate and conventional for multiple-levels of adult respondents, as the respondents may have difficulties in considering the scale of their preferences in selecting a bed arrangement. Since the main objective of this questionnaire is to find out the most preferable and least preferable arrangement via statistical significance, the questions were best addressed in nominal design. The final edition of questions was then created using an online survey tool, called 'Survey Gizmo'.

3.4.5 Limitations

A methodological limitation in the current survey is that respondents were required to make their choices based on imagination from the diagrams. They were not able to experience the actual room arrangement. Such restriction was due to time and funding constraint, difficulties in finding bedrooms with predetermined scenarios plus the challenges of inviting hundreds of participants to the experimental bedrooms. Nonetheless, the current survey approach was referring to Mak & Ng's (2005) survey concept in their *Feng Shui* research for the selection of ideal surrounding environment and lounge room design.

3.4.6 Data Analysis

The questionnaire survey findings were analysed using Statistical Package of Social Science (IBM SPSS) version 21.0 for Windows. Descriptive analysis and statistical results such as means, frequencies and percentages were used as necessary for demographic variables and the main questionnaire items.

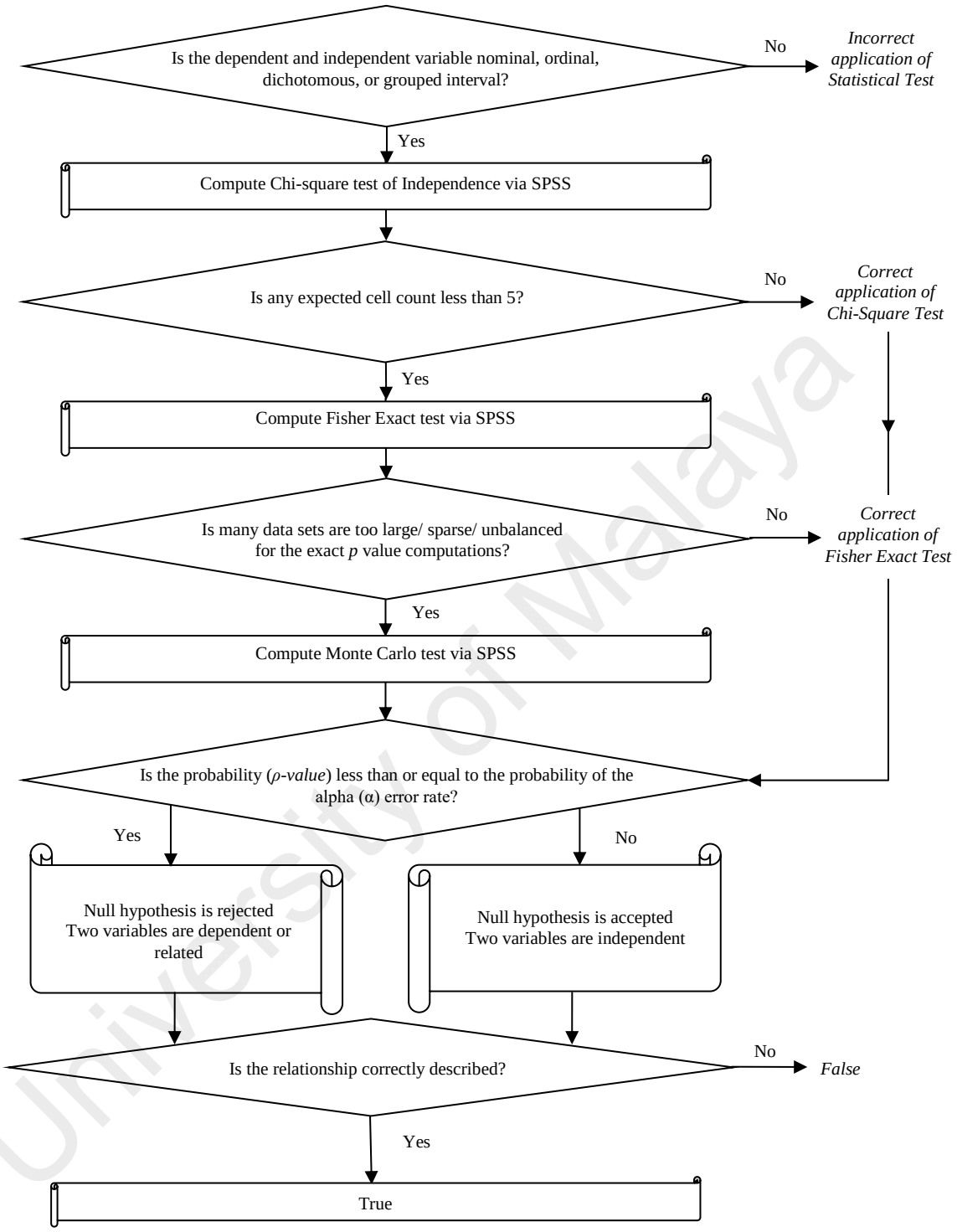


Figure 3.10: The process of running an inferential test for a relationship confirmation applied in this survey.

Source: Adapted from Mehta & Patel (1989, 2011) and SPSS, IBM. (2012).

Chi-square test of Independence (χ^2) was adopted to test the inferential relationships in the beginning, for the verification of perceptual difference between the participants' demographic variables. However, the Chi-square asymptotic p value computations were not accepted due to the data sets were too large and some cells had an observed count less than 5. Figure 3.10 demonstrates the process of running an inferential test to confirm a relationship in this survey. Consequently, Monte Carlo approach was adopted for the relationship tests. This method produces an unbiased estimate that is reliable up to 99% of confidence interval. The "choices of bed arrangement in different scenarios" were predetermined as the dependent variables while the demographic backgrounds such as race, religion, age, occupation etc. were predetermined as the independent variables in the inferential tests. All tests were 2-tailed, and the results were considered statistically significant when $p < 0.05$.

3.5 Interviews

Interview is optimal for collecting data on individual perception and experience sharing. This research adopted in-depth exploratory interview to investigate whether the current practicing architects' perceptions in bedroom interior arrangement are corresponding to the ideal *Feng Shui* model (integrating Form School concept and common bedroom *Feng Shui* rules) applied to a sleep environment.

The interviews firstly investigated on the perceptions of multicultural-background architects on the design procedures for a bedroom interior. Concurrently, the design characteristics for an ideal bedroom layout were explored based on the architect's design submission. The relationships between the design characteristics for an ideal bedroom layout and the architects' demographic variables were subsequently explored. The survey expected findings that confirm the corresponding relationships between the more scientific piece of design work and the ideal bedroom *Feng Shui* model.

The interview instrument was divided into four (4) stages which including (1) design and procedures, (2) types of interview, (3) sampling method and invitation to participate and (4) data analysis.

3.5.1 Design and Procedures

All interview sessions were anonymised and tape-recorded for a period from 45 to 60 minutes. Interviewees had full freedom to establish the conversation within the research theme. Most of the interviews were conducted face-to-face at the participants' working place with consent except a number of interviewees who preferred phone interview due to their working location and busy schedule.

Firstly, the interview initiated with enquiries on demographic data which comprising of race; religion; gender; nature of profession and years of working experience. The interviewees' background were documented and studied for their professional reliability.

Subsequently, the interview dialogue opened with the key question, seeking the respondents' experience in regular design procedure for a bedroom interior. This interview question expected to get a concept on how the sleep environment is organised based on the architects' expertise in the present and past construction projects. The additional questions including: how do the (1) room size, shape and form; (2) direction of room openings and (3) other construction works such as mechanical and electrical works affect the decision in bed placement. This interview approach permitted arguments and information that were not directly hunted to enter the conversation, so that the extra information that they considered was important and relevant would enhance the study.

Finally, based on the architects' design proficiency, all interviewees were asked to contribute floor plan drawing of a sleep environment, with some stated requirements. The drawing must be completed with ideal furniture arrangement to ensure the greatest comfort and functionality for sleep activity. The drawing could be generated from

AutoCAD or a free-hand sketch drawing. Some basic components in their master piece were necessary, which includes a bed; a door, a window; a wardrobe and a vanity. The drawing has no limitation on the design of bedroom form and measurement. However, it was enforced to connect the bedroom with an attached bathroom. The architects also had freedom in determining the bathroom size and the direction of bathroom door and windows. There was no restriction for additional piece of fittings. Most importantly, the architects were allowed to contribute more than one drawing provided that the additional drawings were perceived as important for this study. All the drawing contributions were assessed with the common design criteria and these criteria were then compared with the bedroom *Feng Shui* rules. Appendix III displays the sample of interview questions presented to the interviewees.

For the interviews conducted through phone calls, the submission of ideal bedroom layout drawings were sent by email within one month from the date of interview. On the whole, there were a number of follow-up interviews with the architects intended for minor clarifications about the symbol given in the drawings. For each completed interview, interviewee was remunerated with a token of appreciation.

3.5.2 Types of Interview

In order to encourage more architects to participate in the interviews, face-to-face and telephone interview were conducted. The combination of these approaches allowed participants in the farther region to take part. The overall interview was planned to be semi-structured and open-ended so that the interviewees are free to discourse any perspectives about the study issues.

3.5.3 Sampling Method and Invitation to Participate

For the interviews to design experts, architects and interior designers of multiple cultural backgrounds who had minimum two years of working experience were selected.

3.5.3.1 Stratified sampling

Due to the population size of the targeted interviewees (architects and interior designers) was too large; a more feasible approach was used by selecting a smaller group from the population i.e. the stratified random sampling method.

Thus far, there were 2092 architects and 592 interior designers registered with the Board of Architects Malaysia. The entire population were then divided based on gender, race, years of working experience and career background. A random sample from each of the categorised stratum was taken in a number proportional to the stratum's size when compared to the whole population. These subsets of the strata were then pooled to form a simple random sample of 500.

Subsequently, invitations to take part in the interviews were sent to 500 potential respondents from the directories of Board of Architects Malaysia by email. Among the 500 invitations, 7 of the email contacts were invalid and not delivered. Among the 493 sent invitations, 141 of them are interior designers.

In order to pledge the survey is conducted in an unbiased manner, *Feng Shui* terminologies were not referred in the invitation letter and even throughout the interview questions. The invitation required the potential interviewees to feedback on their availability for interview within two months period from the date of invitation.

3.5.3.2 Snowball sampling

The response was exceptionally low after a month of waiting period. As a result, the author followed up the invitations by random phone calls, but the response remained insufficient. Consequently, snowball or respondent-driven sampling became an alternative strategy. The snowball strategy is a form of purposeful sampling in interview that naturally proceeds after a research study begins. It occurred in just a few steps: (1) Approach related stakeholders and ask for contacts, (2) Gain contacts and ask the potential interviewees to participate, (3) Continue the snowballing with contacts to gain more potential interviewees if necessary, and (4) Ensure a variety of contacts by broadening the profile of persons involved in the snowballing exercise.

Hence, while establishing credibility and rapport with the contacted interviewees, they were requested to assist the author in finding potential interviewees who were willing to take part and contribute to the study. On top of that, other construction stakeholders who had high potential to recommend the qualified interviewees were approached in order to gain more contacts for the interview.

3.5.4 Data Analysis

All collected data and drawing submissions from the interviews were reviewed and analysed to support the empirical basis of bedroom *Feng Shui* theories. The qualitative data from interviews were recorded verbatim and analysed using thematic analysis approach to report common patterns across a data set. Figure 3.11 presents the steps of thematic data analysis by Creswell (2013). When the steps are adapted for the current interview, firstly, the raw data from voice recorded interviews were played back and sorted. Secondly, the general ideas of the interviewees were listened carefully and their thoughts were recorded. Subsequently, coding or creation of categories in relation to the collected data were performed. The data of interviewees were categorised and themes for

major findings were generated. The generated themes were based on phases i.e. (i) consideration phase and (ii) implementation phase, in seeking the respondents' perceptions in design procedure for a bedroom interior. Then, the themes were interconnected with additional layers to convey the findings of analysis. Diagrams and tables were used to aid the discussions. Lastly, significant meanings were derived by comparing the interviewees' perceptions with information reviewed from the literature review i.e. *Feng Shui* theories.

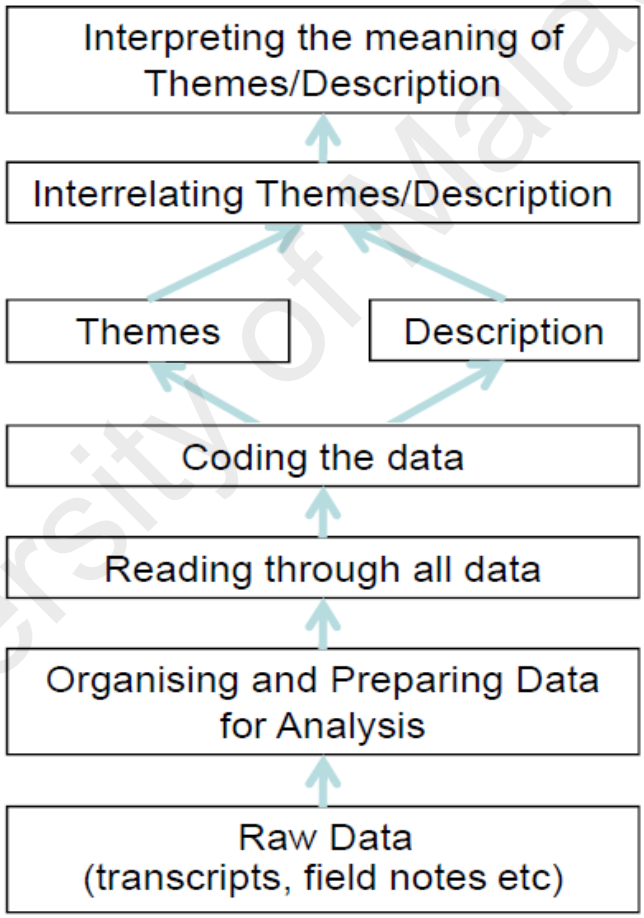


Figure 3.11: Data Analysis in Qualitative Research - Interview.

Source: Adapted from Creswell 2013.

Besides, drawings submitted by the architects were analysed quantitatively based on a scoring system, which was established based on the five most common *Feng Shui* criteria (research variables) in bed arrangement. Each submitted bedroom layout would be assessed based on the scoring system as demonstrated in Table 3.3. The five predetermined *Feng Shui* criteria for drawing assessment include: (1) bed head supports, (2) window direction from the bed, (3) door direction from the bed, (4) sharp angle threats and (5) mirror threats. For the fulfilment of each recommended *Feng Shui* criteria in bedroom, the drawing will score "1" or otherwise score "0". A full score of "5" implied that the architect's design for a bedroom interior is perfectly corresponding to the bedroom *Feng Shui* conception. The adopted scoring system is identical to the scoring concept used by Mak & Ng (2005) for the assessment of a lounge room interior arrangement based on ideal Form School model.

Table 3.3: The scoring system designed for analysis of architects' design outputs based on five main *Feng Shui* criteria for a sleep environment.

BEDROOM LAYOUT	Bed head supports	Window direction from the bed	Door direction from the bed	Sharp angle pointing to the bed	Mirror in line with bed
SCORING SYSTEM (Maximum score / layout = 5.0)					
Score: 1	*Solid wall*	*Sides/ front*	*Diagonal*	*No*	*No*
Score: 0	*Window*	*Back*	*In line with bed*	*Yes*	*Yes*

In order to test the inferential relationships between the architects' background and the design criteria in bed arrangement, Chi-square test of Independence (χ^2) was carried out at the outset via IBM SPSS, version 21.0. Nevertheless, the asymptotic p value computations were not accepted due to the data sets had an observed count less than 5. Consequently, Fisher's Exact test was adopted following the procedures of running an

inferential relationship test as in Figure 3.10. The results were considered statistically significant when $p < 0.05$, implying that there are inference between the architects' background and their bedroom design characteristics. The "design criteria of bed arrangement" were referred as the dependent variables while the architects' backgrounds such as race, religion and gender were referred as the independent variables in the relationship tests.

3.6 Case Study by Sleep Experiments

On top of the results from human insights in questionnaire survey and interviews, actual sleep measurements were conducted using Pittsburgh Sleep Quality Index (PSQI) and sleep actigraphy to verify whether the relationships are robust and supportive to greater sleep efficiency. The use of PSQI and sleep actigraphs was intended to quantify 'sleep' which is subjective in nature, in different bedroom scenarios designed based on the five *Feng Shui* variables in bed arrangement.

The experiments expected findings that can reveal the level of significance of each *Feng Shui* rule in bed arrangement in improving individual nocturnal sleep quality. The experiment instrument was divided into five (5) stages which including (i) sampling method, (ii) location of experiment, (iii) experimental tools, (iv) design and procedures and (v) data analysis.

3.6.1 Sampling Method

Before the sleep experiment begin, the author explored on qualified participants who may fit into the experiment requirements. It was discovered from the earlier questionnaire that majority of the survey respondents were young adults aged between 18 to 34 years. Minear, & Park (2004) and Pepper, Kirshner & Ryglewicz, (1981) stated that a person in the age range of 18 to 35 is categorised as young adults. Besides, this age category was

observed as a category which is at increased risk of suffering from poor sleep, especially the young female adults (Kalak, Brand, Beck, Holsboer-Trachsler, & Wollmer, 2015). According to Tworoger, et al. (2005), there are multiple factors related to sleep quality especially the perceived stress, employment; menstrual problems; age and BMI in young female adults. It is expected in young adulthood people are having comparable life pressures such as tension in tertiary education, unstable career and love relationships. They are mostly having busier social life compared to older adults or adolescents and hence it is a habitually sleep deprived category, but not chronic patients in sleep disorder.

The reason of not finding hospital patients as the experimental participants due to these people may have different inbuilt health conditions which are not easy to be controlled and may possibly affect the experimental results. If the experiments can benefit a young healthy adult by a little implication, it is believed that it works well for a patient too.

As a result, the sleep experiments require at least five (5) young female adults to participate in the experiments. Besides, each participant must be able to sleep for 7 consecutive nights with an assigned wrist actigraph, for each of the stated bed arrangement designed with different *Feng Shui* rules. Participants are required to complete their sleep log after a night of data record about their daily activity, physical and mental condition during the data recording period. They are also required to fill in a weekly survey, precisely to measure their sleep quality index for each type of sleep arrangement. All participants must be responsible in taking care of the given device and honest in carrying out the whole experiment for 35 nights. For the participants who are interested, an introductory session will be arranged to provide volunteers with all of the necessary information and for any questions to be answered. It was expected to spend at least two (2) months to find the qualified participants for experiments.

3.6.2 Location of Experiment

As sleeping is an important part of human daily routine, any processes and requirements that might result in any long-term impairment or perceived impairment of the research participants' sleep shall be fully avoided. Based on research ethical viewpoint, a reasoned balance should be struck between protecting research participants and recognising their agency and capacity in adapting to an unfamiliar sleep environment in the study. The researcher has to consider from the research participant's perspective, and any other individuals, groups or communities who may be potentially affected by the research, with the aim of avoiding potential risks to psychological well-being, mental health, personal values, the invasion of privacy or dignity (Oates, Kwiatkowski, & Coulthard, 2014 and Marczyk, DeMatteo, & Festinger, 2005). Hence, running the sleep experiments in a new and unfamiliar sleeping place will be tough for the participants, where the unavoidable tensions, risks or harms may arise and it could be an additional to those to which they have exposed in their normal lifestyles. As a result, the experiment location was planned to be the participants' existing accommodation with controlled environment.

The original setting of the participant's existing bedroom will be remained except the only variable - bed arrangement. Each of the participants will be required to sleep at different conditioned bed arrangement every week along the five (5) weeks of research period. The research sleep environment will be controlled with constant air-conditioning temperature along the experiment period and the existing roommate will be unchanged. Besides, all participants are expected to sleep in the same house to avoid additional assessment of external *Feng Shui* condition. The external *Feng Shui* of the house shall be at least an acceptable condition without major harmful energies such as electrical pylons and poison arrows.

3.6.3 Experiment Tools

Sleep quality assessment can be divided into subjective and objective methods. A most common and well validated instrument for the measurement of subjective sleep quality is the Pittsburgh Sleep Quality Index (PSQI) questionnaire. It provides a global score of sleep quality on a scale and has been used and verified for more than 25 years. Conversely, the most commonly used measure of objective sleep quality is "sleep efficiency," defined as the percentage of time in bed spent asleep (Van Cauter, 1997). These years, the sleep efficiency among the healthy and unhealthy societies has given rise to several instruments for its measurement. The most regular used instruments to evaluate sleep efficiency including polysomnography and actigraphy devices.

Polysomnography (PSG) is a multi-parametric test used as a diagnostic tool in sleep research. Polysomnogram is referred as the test results. It is widely used among the different types of patients. However, polysomnography is not a portable instrument as it requires the participants to put on multiple sticky patches and belts with electrodes sensor to their face, chest, limbs, fingers and belly (Kawamoto, Kuriyama, & Tajima, 2013). This may physically and psychologically burden the participants before and during sleep (Meyer, Eveloff, Kline and Millman, 1993), causing a different experimental result. In addition, its limitations including high expenditures, complicated execution and required skilful person for monitoring and measurement. These limitations constricted its practice to short term measurements and to selected patients only (Kawamoto, Kuriyama, & Tajima, 2013).

On the contrary, actigraphy is a one-dimensional and non-invasive approach which has been limited to the monitoring of human sleep/ wake activities. The watch-like unit (actiwatch or wrist actigraphy) with an actimetry sensor is worn by the examinee on wrist to measure gross motor activity (Pigot, et al., 2003). There are also actigraphs to be worn around waist, hip or thigh with longer strips but it is more disturbing during sleep.

3.6.3.1 Wrist Actigraphy

This research adopted wrist actigraphs (GT3X+) as the main instrument. The GT3X+ based activity monitor has been widely used in the past sleep research and clinical applications. GT3X+ records all movements of the examinee's wrist undergo during sleep using the micro-electro-mechanical system (MEMS) based accelerometer inside it (ActigraphCorp, n.d.). It classifies activity types and interprets activity levels of the examinees endured. Its accelerometer feature can indicates whether a subject is sitting, standing or lying when the device is worn as well as indicating that a device is removed from the subject. It determines the angles or orientation of device due to gravity and subsequently determines a subject's posture where the 3 axes: *x, y,* and *z* represents the acceleration along each axis. Appendix X displayed a set of device manual for Wrist Actigraph (GT3X+) which has been complied by the author along the preparation and execution of sleep experiments.

The recorded data is then transferred to the computer. The data also can be transmitted and analysed in real time. The algorithms for recorded data will automatically distinguish sleep and wake epochs without further analysis (Kawamoto, Kuriyama, & Tajima, 2013). Although there was no exploration on analysing the sleep stages successfully using actigraphy system, the automatic scoring of wrist activity can accurately distinguish sleep and wakefulness which is corresponding with the parameters scored in polysomnography (Cole, Kripke, Gruen, Mullaney, & Gilin, 1992).

According to Martin and Hakim (2011), actigraphy has been well validated for the assessment of night time sleep parameters across all age groups but has low validity on the estimation of sleep onset latency (SOT) and daytime sleeping. Until the present time, there are growing numbers of sleep research adopted actigraphy as an alternative to quantify sleep because it carries the least pressure to patients; economical in cost; easily manageable; and appropriate for long-term usage. Furthermore, this activity-based

monitoring also provides reliable results with an above 90% of accuracy close to polysomnography. It's technique is more extensively used in academic research (Jean-Louis et al., 1997). Figure 3.12 illustrates the differences between two instruments, showing wrist actigraph is more appropriate for healthy examinees.

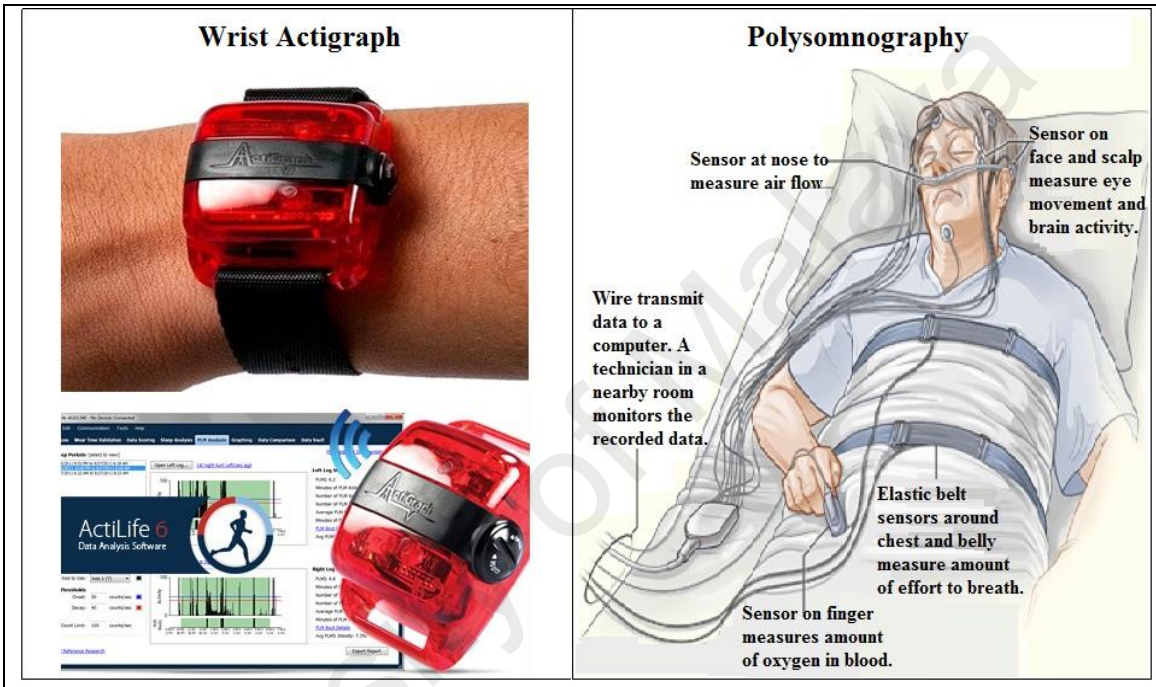


Figure 3.12: Wrist actigraph is portable and lightweight while polysomnography involves wiring connecting multiple sticky patches with electrodes sensor to the examinee's face, chest, limbs, fingers and belly.

Source: Adapted from ActigraphCorp (n.d.) and Colon (2012).

3.6.3.2 Daily Sleep Log and Weekly PSQI Survey

For an effective sleep quality measurement, it is recommended to use complementary assessment methods (objective and subjective) whenever possible. Apart from wrist actigraphy, daily sleep log and weekly self-reported survey to measure sleep quality index were used as complement.

As a standard sleep assessment tool, the daily sleep log was designed following the recommendations made by Buysse, Ancoli-Israel, Edinger, Lichstein & Morin (2006). In the sleep diary, participants compulsorily detailed on the time they went to bed to sleep, how long it took them to get to sleep; whether they woke up in the middle of the night and what time they woke up in the morning. The participants also advised to record their daily activities that occur before sunset and before on bed, probably the activities may affect individual nocturnal sleep efficiency. A sample copy of experiment sleep diary is shown in Appendix VII. Any history information of participants the patient has had that might influence the study results was not recorded, except for the physiological parameters actually recorded in the daily sleep log during each monitoring session.

Simultaneously, a weekly PSQI survey to measure sleep quality index was used to complete the experiments. The weekly PSQI survey questions and scoring method were developed based on the PSQI monthly survey established by Buysse, et al. (1989) of Sleep Medicine Institute in University of Pittsburgh. PSQI is a self-rated questionnaire comes with a scoring program in Microsoft Access to evaluate sleep quality and sleep disturbances over a one-month time interval. Before the sleep experiments begin, the author has attained permission to use the PSQI survey questions and got the consent to convert and modify the monthly survey into weekly survey from Dr. Buysse via email (see Appendix VIII). A sample copy of weekly PSQI survey is presented in Appendix V and its scoring method based on PSQI is presented in Appendix VI. The weekly PSQI survey questions are as shown in Table 3.4. Participants are required to answer all survey

questions upon a week of sleep assessment is completed for a particular type of bed arrangement.

Table 3.4: Survey questions for weekly PSQI.

Question No.	
1	Time to get into bed.
2	Time to get up in the morning
3	Time to fall asleep (in minutes)
4	Actual hours of sleep
5	Troubles of sleeping
6	Rating of overall sleep quality
7	Medical assistance for sleep
8	Trouble staying awake in daily activities
9	Trouble to keep up enough enthusiasm to get things done
10	Trouble with bed partner or roommate

3.6.4 Design and Procedures

To test the five (5) Feng Shui rules in bed arrangement, five (5) participants is required in a group. A rotation chart of sleep arrangement for the five (5) participants is shown in Table 3.5. Each *Feng Shui* rule (as designed in Bed A to bed E) will be tested for one week (7 consecutive nights) by one participant and the participant was then required to sleep in another bed location in the following week, until he/ she completed for all bed locations. The arrangement of Bed A to bed E inside the bedroom of both groups of participants will be arranged based on the five *Feng Shui* rules and decided by the research author throughout the experimental period. As a result, the method will end up with 35 nights of actigraphy data per participant.

Table 3.5: Rotation chart for participants' sleep arrangement.

PARTICIPANTS	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5
C1	BED A	BED B	BED C	BED D	BED E
C2	BED B	BED C	BED D	BED E	BED A
C3	BED C	BED D	BED E	BED A	BED B
C4	BED D	BED E	BED A	BED B	BED C
C5	BED E	BED A	BED B	BED C	BED D

According to Tworoger, Davis, Vitiello, Lentz, & McTiernan (2005), a single night of actigraphy data is unreliable to determine a person's sleep onset, time in bed and total sleep time, but it is adequate for measuring sleep efficiency as what is presented in this research. Usually a minimum of 3 nights of actigraphy data is taken in research (Lauderdale, et al., 2006). To obtain reliable actigraph measures of sleep, five or more nights of practical recordings are required (Acebo, et al., 1999). To be common, seven days of data record for wrist actigraphy is sufficient to estimate average sleep duration (weekday, weekend and combined) and sleep efficiency (Arora, & Taheri, 2015; Evans, et al., 2011 and Tworoger, et al., 2005). Consequently, this research carried out 7 continuous days of actigraphy data record to test each variable, which is considered as the optimum period for sleep measurement.

To start with the experiment, each group of volunteer participants were asked to put on a sleep actigraph (GT3X+) firmly at their non-dominant hand when go to bed and remove it when go out from bed (awakening) for 5 weeks to test all variables. Participants were not advised to skip for sleep measurement during the experimental period except for unavoidable personal reasons. The vacant sleep records on the specific day(s) will be ignored and an average reading will be taken on the remainder days of recorded data.

The experiments shall commence from the week 1 for the first bed arrangement and resume on the next bed arrangement on the following week. The procedure repeated until the last bed arrangement is completed. Along the experimental period, participants were required to put on a wrist actigraphy on “non-dominant” hand when going to bed and remove the device after wake-up in the morning. The device shall not be removed along the sleeping hours including occasional or regular wake up in the midnight.

Wrist actigraphs have not been a trouble to the participants as it is lightweight, unobtrusive and no harm to human body. A briefing on the device was carried out before the commencement of the experiment to each group of participants. Each device is allocated with a unique serial number and the participants will be assigned with one fixed serial number device throughout the 5 experimental weeks. No one can exchange the device in between the experimental period. All participants were responsible in taking care of the given device along the sleep experiment. Any damage or destruction of the device may require them to compensate. In addition, participants were advised to be honest in carrying out the experiment. They were not allowed to modify the bed arrangement set by the research author during the experimental period and must be frank in reporting their daily activity, physical and mental condition that may affect individual sleep quality.

After a week of data recording or completion of one test variable, participants shall return the wrist actigraphs to the author for data download and analysis. Within an hour or two of download process, the wrist actigraphs were reset and distributed again to participants according to their predetermined serial number. The experiment then began for the following bed arrangement in the coming week and such procedure repeated until the last bed arrangement is completed. The analysis of data was using the manufacturer-supplied software - ActiLife version 6.0.

At the same time, the participants were required to fill up the daily sleep log (see Appendix VII), recording the timing of sleep and wakefulness. When the device encountered malfunction, the sleep log may provide as backup data that could be added to the data file, to record bedtime and wake time. The sleep log was modified partway through data collection to solicit on other not recorded information. To avoid bias, participants completed the sleep diary first thing in the morning, notifying the previous night's sleep. Sleep diaries were considered valid if participants provided information from at least 5 days (O'Connell, Griffiths & Clemes, 2014).

Upon the completion of one week experiment, participants were asked to fill up a weekly PSQI survey to measure sleep efficiency and other sleep quality index. The weekly survey questions have been discussed section 3.6.3.2.

3.6.5 Data Analysis.

Upon the completion of each week of sleep experiments, sleep actigraphs (GT3X+) were connected to software program (ActiLife 6.0) sequentially to transfer sleep data into the computer. Each sleep study is scored epoch by epoch, from lights off (trying to go to bed) to lights on (awake time) during the nights in which the wrist actigraph was worn. The program initially transferred 10-second epoch data into the 'data scoring' tool and subsequently automatically reintegrated to 60-second epochs (Hjorth, et al., 2013) for sleep analysis. Although epoch length used in actigraphy data collection may affects physical activity and sedentary behaviour outcomes according to Tryon, 2004 and Colley, Harvey, Grattan, & Adamo, 2014; nonetheless the final decision still depending on the device recommended paper speeds in mm per second (KU Medical Center, n.d.).

Once the dataset is loaded into the 'sleep analysis' tool, the 'AutoScore' feature will automatically detect sleep or wake for each epoch using Cole-Kripke sleep algorithm. The raw data that determined a sleep or wake epoch including (a) X, Y and Z axis counts,

(b) gravity projected counts using all three axes, (c) steps of movement (d) down vector - normalized gravity vector for inclination information and (e) lux. These data together with detailed sleep-wake epochs were exported as a PDF or CSV file for further analysis.

To determined sleep duration, self-reported bedtimes and waking times were used as the complement to wrist actigraphs' data. In any circumstances where the self-reported bedtimes and waking time differ from the device recorded sleep data, the time(s) was then visually determined from the individual Actograms – the activity records.

The research does not consider sleep onset latency as part of the sleep quality measurement because the previous studies showed lower validity on the estimation of sleep onset latency (SOT) using sleep actigraphy (Cole, et al., 1992; Martin and Hakim, 2011; Sadeh, 2011).

Total time in bed (TIB) was calculated from the time participants recorded getting into bed to the time they got out of bed in the morning. Total recording time (TRT) was referred as the duration of time from the beginning of a sleep recording to final awakening. Total Sleep Period or sleep period time (SPT) is measured from sleep onset to final awakening which including the time taken up by arousals and movement time until wake-up. Total sleep time (TST) was calculated from the time participants recorded falling asleep to the time they recorded waking up the following morning deducting the time they were awake during the night.

The experiments' setting required the participants to record their daily wrist activity movements in sleep during time in bed (TIB) i.e. from the time they went to bed to the time they got out of the bed. The total recording time (TRT) where the participants putted on the wrist actigraphs until removal in each night was therefore equal to their time in bed (TIB) and sleep period time (SPT) in the present experiments. The participants' total sleep time (TST) was then deduced from total recording time (TRT) minus the time they were awake including period of wake after sleep onset and wake after final awakening

during the night. Finally, sleep efficiency (SE) or the percentage of time in bed spent asleep was calculated.

3.7 Summary of Chapter

This chapter emphasised the research methods and design that were employed in the existing research. It is worth to address that there is no single research method is considered perfect in data collection. Each research technique has its own advantages and disadvantages and most importantly they are complementing each other. With the use of triangulation approach in this research, the reliability and validity of the research findings may guarantee better values. The research findings and interpretation of the collected data were further presented and discussed in Chapter 4, 5 and 6.

CHAPTER 4 – RESULTS AND DISCUSSIONS: QUESTIONNAIRE SURVEY

4.1 Introduction

This chapter sets out the statistical analysis and data display of the questionnaire survey results about the human preferences in bed arrangement in different prearranged bedroom scenarios based on *Feng Shui* approaches. The findings discussions were generally drawing relationships between an ideal bedroom *Feng Shui* arrangement and the human preferences in bed arrangement. The relationships were then reinforced by potential psychological impacts and subjective sleep quality evaluation attributed to their choices of arrangements. This chapter ended with a general summary and the structure of this chapter is illustrated in Figure 4.1.

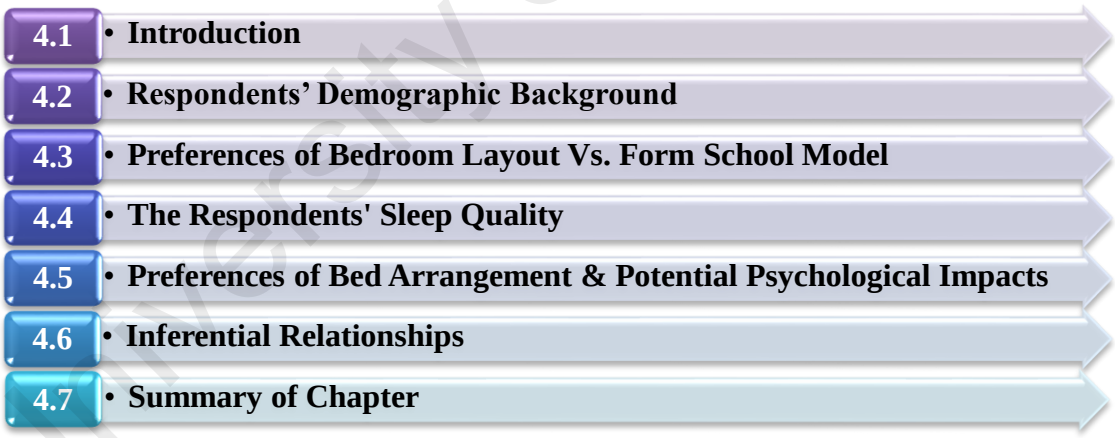


Figure 4.1: The framework of Chapter 4.

4.2 Respondents' Demographic Background

Table 4.1: The respondents' background information.

Variables	Scale/ Category	N	%
Race	**Chinese**	**206**	**50.9**
	Non-Chinese	**199**	**49.1**
	Arab	*2*	*0.5*
	Black/African-American	*2*	*0.5*
	Egyptian	*2*	*0.5*
	European	*1*	*0.2*
	French	*1*	*0.2*
	German	*1*	*0.2*
	Indian	*19*	*4.7*
	Indonesian	*2*	*0.5*
	Iranian	*9*	*2.2*
	Malay	*137*	*33.8*
	Multi-Racial	*2*	*0.5*
	Pakistani	*5*	*1.2*
	Ukranian	*1*	*0.2*
	Decline to Respond	*1*	*0.2*
	Other ---	*14*	*3.5*
Religion	**Buddhism**	**148**	**36.5**
	Christianity	**37**	**9.1**
	Hinduism	**17**	**4.2**
	Islam	**166**	**41.0**
	Shinto	**1**	**0.2**
	Taoism	**14**	**3.5**
	Other ---	**22**	**5.4**
Gender	**Male**	**141**	**34.8**
	Female	**264**	**65.2**
Age Group	**18-24**	**165**	**40.7**
	25-34	**168**	**41.5**
	35-44	**60**	**14.8**
	45-54	**11**	**2.7**
	55-60	**1**	**0.2**
Occupation	**Undergraduate/ Postgraduate Student**	**204**	**50.4**
	Working Adults	**201**	**49.6**
	Accounting / Finance / Banking	*15*	*3.7*
	Administration / Clerical / Reception	*3*	*0.7*
	Architecture / Design	*8*	*2.0*
	Beauty / Fashion	*1*	*0.2*
	Buying / Purchasing	*2*	*0.5*
	Construction	*26*	*6.4*
	Consulting	*8*	*2.0*
	Customer Service	*6*	*1.5*
	Distribution	*1*	*0.2*
	Education	*53*	*13.1*
	Health Care (Physical & Mental)	*5*	*1.2*
	Human resources management	*2*	*0.5*
	Management (Senior / Corporate)	*5*	*1.2*
	Operations / Logistics	*2*	*0.5*
	Planning (Meeting, Events, etc)	*1*	*0.2*
	Real Estate	*2*	*0.5*
	Research	*18*	*4.4*
	Restaurant / Food service	*1*	*0.2*
	Sales / Marketing	*13*	*3.2*
	Science / Technology / Programming	*13*	*3.2*
	Unemployed / Retired / Homemaker	*7*	*1.7*
	Other ---	*9*	*2.2*
Roommate/ Bed partner	**None**	**134**	**33.1**
	One	**160**	**39.5**
	Two	**71**	**17.5**
	Three or more	**40**	**9.9**

The open survey was conducted for one month through the online survey tool (Gizmo Survey). In total, there were 207 undelivered recipients, resulting in a final sample size of 1293. Upon the dateline, 183 futile responses and 405 full valid responses were collected, with a response rate of 27.0%.

In respond to *Question 1* to *Question 6* in Section I of the survey, Table 4.1 summarises the frequency and percentage distribution of the respondents' demographic data, which consists of race, religion, gender, age, occupation and number of roommate or bed partner. Among 405 respondents, half of the respondents (50.9%) were Chinese, while the remainder (49.1%) were non-Chinese, comprising mostly Malays and Indians. The sample comprises 41.0% of Muslim, 36.5% of Buddhist, 9.1% of Christians, 4.2% of Hindus, 3.5% of Taoist, 0.2% of Shintoist; and 5.4% of other religion followers. Female occupied almost 2/3 of the respondents (65.2%) whereas 34.8% of them were men. Most of the respondents were aged between 25 to 34 years (41.5%) and 18 to 24 years (40.7%). The respondents were partly working adults (49.6%) and partly a mixture of undergraduate and postgraduate students (50.4%). The variety of dissimilar professions ensured that a wide range of respondents was represented in this study. Majority of the respondents (39.5%) were accompanied by one roommate or bed partner; 33.1% of them sleep on their own; 17.5% and 9.9% of them had two and three or more roommates respectively.

4.3 Preferences of Bedroom Layout Vs. Form School Model

Question 7 and *Question 8* in Section II of the survey required the respondents to opt for their 'most preferable' and 'least preferable' bed arrangement among five different layouts with similar bedroom conditions. In agreement with the author's expectation, the result (see Figure 4.2) indicated majority of the respondents (52.1%) preferred to sleep in option B, i.e. the imitation of Form School *Feng Shui* model. The finding hence suggested

option B as the human most desirable paradigm in a sleep environment with potential visual comfort and related psychological needs criteria. The first research hypothesis has been achieved. There was only 3.0% of the respondents have an aversion to option B.

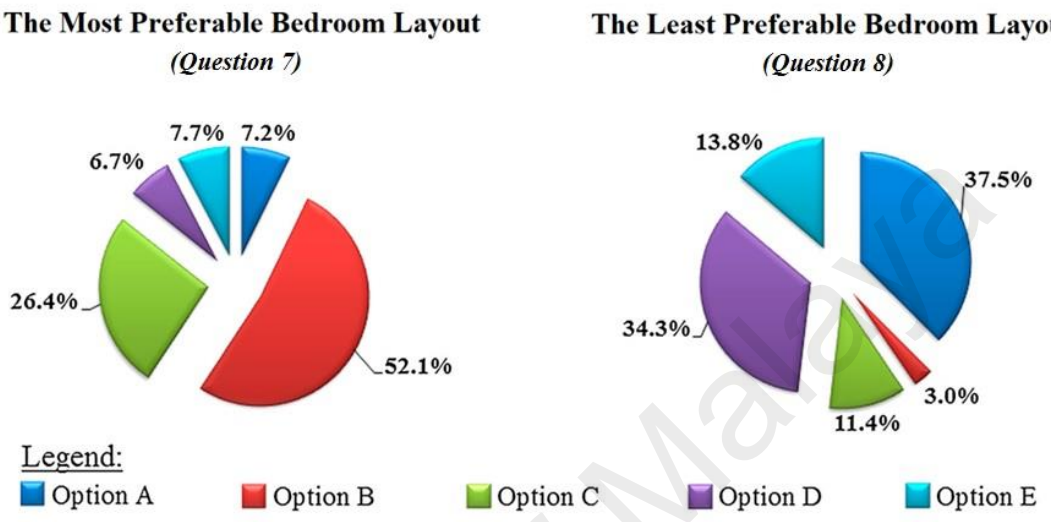


Figure 4.2: The respondents' choice of bed layout.

Referring back to Figure 3.9, bed B was ideally corresponding to the *Feng Shui* spot or 'cave' in the ancient *Feng Shui* model. It was supported by solid wall (1) which represents the Black Tortoise hill. The wardrobe (2), sofa seats (3) and TV sets (4) were correspondingly referred as Azure Dragon, White Tiger and Red Bird. Besides, the open space (7) in front of bed B was indicated as the bright court. The room openings (5) & (6) were referred as the *Qi* mouths which are not directly facing to the bed but observable from the bed. This permitted the Qi flows into the bedroom and meander through the open space before reaching to the bed while the four emblems (sand protections) served to capture and store *Qi* by blocking the wind that may scatter the *Qi*. The Form School *Feng Shui* concept of energy balance where *Yang* is enfolded by *Yin* was conveyed in such arrangement (option B) and it is expected to bring harmonization to the users of the sleep environment.

From the psychological viewpoint, sleeping at bed B may experience the optimum *Sand* protection and comforts; just like sleeping in a mother's loving embrace as proposed in Section 2.2.2.2. The sleeper may also experience better acoustic quality and governs visual command of the space because the room openings were visibly far from the bed. The chances of getting interrupted by potential cold wind, reflection of light, impact of intruders and traffic noises from the external were relatively low.

On the contrary, the result for the least preferable layout showed the highest for option A at 37.5% (see *Figure 4.2*). This indicated that majority of the respondents do not prefer to sleep backed by a window because the absent of Black Tortoise support in Form School *Feng Shui*. Bed A was located in a non-resting position with the presence of a window behind the bed head. Although there were sides and front guards present in Option A, the embraced arrangement concept in a sleep environment was not complete. The *Yang* energy (window) was not enfolded by *Yin* energy (furniture) and therefore it was challenging to capture benevolent *Qi* in bed A position. The overall situation was perceived as imbalanced and not harmonised.

Psychologically, the scenario in bed A generates unexpected, insecure and comfortless feelings that oppose to the stability sense in a sleep environment. The indoor air quality, thermal comfort, visual quality and acoustic quality were fully affected. The chances of getting disturbed by external disruptions and direct impact of intruders were reasonably high. The result strengthened the significance of *Feng Shui* concept about having Black Tortoise supports in bed placement.

The overall results revealed contrary frequency relationships between the most preferable and the least preferable choice of bed arrangement. Option C, D and E received relatively low response for the most preferable layout but getting higher response for the least preferable arrangement. In *Feng Shui* perspectives, although option C, D and E were equally supported by the Black Tortoise Mountain but presenting an incomplete embraced

protection as described in section 3.4.1. The White tiger protection was absent in option C and thus the bed location was imbalanced and easily exposed to excessive *Qi* flows. The same condition happened to option D and option E where the door was close to bed D and bed E, signified potential disruptions to accumulate good *Qi*. Psychologically, these sleeping positions were not well-protected and not harmonised as the situations concerned with uncertainty and instability.

4.4 The Respondents' Sleep Quality

Table 4.2: Resemblance of the respondents' actual bed arrangement and their choice of most preferable bedroom layout.

Cross-tabulation						
***Question 9*: Does you actual bed arrangement resemble to your choice of most preferable layout in Question 7?**	**Option A**	**Option B**	**Option C**	**Option D**	**Option E**	**Total**
Yes, almost the same	18 7.17%	142 56.57%	61 24.30%	11 4.38%	19 7.57%	251 61.98%
No, totally different	11 8.21%	62 46.27%	39 29.10%	12 8.96%	10 7.46%	134 33.09%
I am not sure	0 0.00%	7 35.00%	7 35.00%	4 20.00%	2 10.00%	20 4.94%
					Total:	**405 100%**

Section III of the survey discussed the respondents' sleep quality in the past month via subjective evaluation. In respond to *Question 9* in Section II, Table 4.2 presents there were 251 (61.98%) of the respondents claimed that their actual bed arrangement at home are concurring with their most preferable choice of bedroom layout. One third of them (33.09%) claimed that their actual bed arrangement is totally different with their preferable choice of bedroom layout. Only a small amount of them (4.94%) were indeterminate about the correspondence between their actual bed arrangement and their most preferable layout.

The respondents were then categorised into three groups namely (a) concurring with their actual bed arrangement, (b) totally different with their actual bed arrangement and (c) indeterminate whether concurring with their actual bed arrangement; followed by subjective sleep quality evaluation. Table 4.3, Table 4.4, Table 4.5 and Table 4.6 are cross-tabulations showing relationships between the group of respondents' who had their actual bedroom layout parallel with their choice of most preferable bedroom layout, and the related sleep quality assessment in the past month. These tables are to respond *Question 10, 11, 12 and 13* in the survey respectively. Among the 251 respondents where their choices of bedroom layout corresponded with their actual bedroom layout at home, 142 (56.57%) of them had their actual bed arrangement parallel with option B, that is the imitation of the Form School *Feng Shui* model (see Figure 3.9).

4.4.1 Subjective Sleep Quality Evaluation

Table 4.3 shows over 90% of the 142 respondents who had their actual bed arrangement parallel with option B had at least 'fairly good' sleep in the past month. Among these good sleepers (128 respondents), 20.4% of them claimed that they had 'very good' sleep in the past month.

The results also indicated that the 19 respondents who had their actual bed arrangement parallel with option E achieved 94.8% of good-quality sleep in the past month. Nonetheless, it was not possible to claim that option E can support better sleep quality among the five bed options, because the number of respondents whose their actual bed arrangement corresponded with option E were relatively low compared to other bed options. Such conclusion was somehow rejected.

Table 4.3: The respondents' subjective sleep quality evaluation.

Cross-tabulation						
Does you actual bed arrangement resemble to your choice of most preferable layout in Question 7?		***Question 10*: Subjective sleep quality in the past month**				**Total**
		Very good	**Fairly good**	**Fairly bad**	**Very bad**	
Yes, almost the same	**Option A**	1 5.6%	13 72.2%	2 11.1%	2 11.1%	18 100.0%
	Option B	**29** **20.4%**	**99** **69.7%**	13 9.2%	1 0.7%	142 100.0%
	Option C	5 8.2%	49 80.3%	5 8.2%	2 3.3%	61 100.0%
	Option D	1 9.1%	8 72.7%	1 9.1%	1 9.1%	11 100.0%
	Option E	4 21.1%	14 73.7%	1 5.3%	0 0.0%	19 100.0%
					Total	**251**

Besides, options A, C, and D showed slightly lower percentages of good sleepers (option A = 77.8%, option C = 88.5%, and option D = 81.8%), implying that the most ideal *Feng Shui* model (option B) has a little influence to better sleep quality but definitely not an apparent implication. This was probably due to sleep quality is affected by many other factors such as individual health conditions, emotions etc.

4.4.2 Estimated Time to Fall Asleep

A good sleeper typically falls asleep within 30 minutes once he or she has gotten into bed (Buysse et al., 1989 and Nicassio & Bootzin, 1974). Table 4.4 shows among the 142 respondents who had their actual bed arrangement corresponding to option B, 24.6% of fell asleep between 16 to 30 minutes in the past month. 65.5% of the same group of respondents fell asleep in 15 minutes or less. Such results revealed significant differences among the 5 bedroom options, showing more respondents (65.5%) who attached to option B, were able to fall asleep within 15 minutes. For the respondents who had their actual bed arrangement corresponding to other bedroom options, lower percentages were found in "falling asleep within 15 minutes" (option A = 55.6%, option C = 39.3%, option D = 45.5% and option E = 57.9). This implied that the sway of having embraced arrangement

in a sleep environment in option B (or the most ideal *Feng Shui* model) has certain implications to sleep latency.

Despite more respondents who attached to option B can fall asleep in 15 minutes or less compared to other options, nevertheless, good sleepers were relatively high for option E (94.7%), showing sleep latency of less than 30 minutes.

Table 4.4: The respondents' estimated time to fall asleep.

Cross-tabulation						
Does you actual bed arrangement resemble to your choice of most preferable layout in Question 7?		***Question 11*: Estimated time to fall asleep in the past month**				**Total**
		15 minutes or less	**16 to 30 minutes**	**31 to 60 minutes**	**above 60 minutes**	
Yes, almost the same	**Option A**	10 55.6%	4 22.2%	1 5.6%	3 16.7%	18 100.0%
	Option B	93 65.5%	35 24.6%	9 6.3%	5 3.5%	142 100.0%
	Option C	24 39.3%	28 45.9%	4 6.6%	5 8.2%	61 100.0%
	Option D	5 45.5%	3 27.3%	1 9.1%	2 18.2%	11 100.0%
	Option E	11 57.9%	7 36.8%	1 5.3%	0 0.0%	19 100.0%
					Total	**251**

4.4.3 Intake of Sleep Medicine

Table 4.5 demonstrates among the 142 respondents who had their actual bed arrangement parallel with option B, 97.2% of them did not consume sleep medicine in the past month. However, the number of respondents who attached to other bedroom layout options and did not seek for sleeping pills assistance were also high especially for option A = 100% and option C = 91.8%. The results hence revealed difficulty in distinguishing the relationships between sleeping pills intake and the types of bedroom layout experienced by the respondents.

Referring back to the results in section 4.4.1, the respondents who had their actual bed arrangement parallel with option E showed high percentage (94.8%) of good sleepers.

This is probably due to some of these respondents (10.5%) had consumed sleeping pills once or twice in a month.

Table 4.5: The respondents' intake of sleeping pills.

Cross-tabulation						
Does you actual bed arrangement resemble to your choice of most preferable layout in Question 7?		***Question 12*: Intake of Sleep Medicine in the past month**				**Total**
		None	**Once or twice in a month**	**Once or twice in a week**	**Three or more times in a week**	
Yes, almost the same	**Option A**	18 100.0%	0 0.0%	0 0.0%	0 0.0%	18 100.0%
	Option B	138 97.2%	3 2.1%	1 0.7%	0 0.0%	142 100.0%
	Option C	56 91.8%	3 4.9%	2 3.3%	0 0.0%	61 100.0%
	Option D	9 81.8%	2 18.2%	0 0.0%	0 0.0%	11 100.0%
	Option E	17 89.5%	2 10.5%	0 0.0%	0 0.0%	19 100.0%
					Total	**251**

4.4.4 Practice of Other Sleeping Aids

Among the 142 respondents who had their actual bed arrangement corresponding to option B, 90.1% of them did not exercise any other sleeping aids in the past month Simultaneously, Table 4.6 shows that other good sleepers whose actual bed arrangement matched options A, C, D, and E and practiced 'zero sleeping aids' were also high especially for option A (94.4%). The results again revealed difficulty in distinguishing the relationships between other sleeping aids and the types of bedroom layout experienced by the respondents.

Table 4.6: The respondents' practice of sleeping aids.

Cross-tabulation						
Does you actual bed arrangement resemble to your choice of most preferable layout in Question 7?		***Question 13*: Practice of Sleeping Aids in the past month**				**Total**
		None	**Once or twice in a month**	**Once or twice in a week**	**Three or more times in a week**	
Yes, almost the same	**Option A**	17 94.4%	1 5.6%	0 0.0%	0 0.0%	18 100.0%
	Option B	128 90.1%	6 4.2%	5 3.5%	3 2.1%	142 100.0%
	Option C	54 88.5%	3 4.9%	4 6.6%	0 0.0%	61 100.0%
	Option D	8 72.7%	3 27.3%	0 0.0%	0 0.0%	11 100.0%
	Option E	17 89.5%	2 10.5%	0 0.0%	0 0.0%	19 100.0%
					Total	**251**

4.5 Preferences of Bed Arrangement and Potential Psychological Impacts

Section IV of the survey firstly discussed about the ranking of criteria to be considered for bed arrangement. The subsequent discussions were about the respondents' most preferable and least preferable choice of bed arrangement in four (4) different scenarios (a), (b), (c) and (d). This section also discovered the potential psychological perceptions that may arise while sleeping in the respondents' selected bed arrangement of each stated scenario.

For the criteria considered for bed placement in Question 14 of the survey, the most significant criterion was found to be the "psychological comfort". The mode and median for this criterion ranking was '1' and the mean was 1.50 as shown in Table 4.7. Other criteria such as physical security, ergonomic & functionalism and aestheticism were getting the mode of '2' at the same time, while the mean reading of these criteria were very close, ranging from 2.37 to 2.58. This implied that the respondent's most desirable paradigm in bed arrangement was highly associated with intuition emphasizing on psychological implications given by the sleep environment. Ergonomics and functionalism were thought to be the most significant in architectural design but the

current results seems inclined toward the psychological comfort from the human perspectives. Such results in fact have strengthened the *Feng Shui* rules applied for a sleep environment as the concept of these rulings are providing calming and harmony effects rather than superstitious practices.

Table 4.7: The ranking of significant criteria considered for bed placement.

Question 14: Ranking of Significant Criteria Considered for Bed Placement					
STATISTICS		**Physical Security**	**Psychological Comfort**	**Ergonomics & Functionalism**	**Aestheticism**
N	**Valid**	405	405	405	405
	Missing	0	0	0	0
Mean		2.37	1.50	2.58	2.48
Median		2.00	1.00	3.00	2.00
Mode		2	1	2	2

4.5.1 Bed Choices in Scenario (a), (b), (c) and (d)

As discussed earlier in the research design in section 3.4.1, bed B was repeatedly set as the most ideal bed arrangement which is free of bedroom *Feng Shui* restrictions in all four (4) scenarios. In respond to *Question 15, 19, 23 and 27*, the results in Table 4.8 verified that bed B was majorly selected as the most preferable bed location to sleep in in all bedroom scenarios. For the least preferable choice of bed location in *Question 16, 20, 24 and 28*, the bed locations that tied with unfavourable *Feng Shui* conditions were largely selected in each bedroom scenario. The research first hypothesis was mainly achieved. The following sub-sections discuss the findings of all scenarios.

Table 4.8: The respondents' majority choice of bed arrangements in Scenario (a), (b), (c) and (d).

SCENARIOS	(a) Door & window are closed		(b) Door & window are opened		(c) L-shaped room & full body mirror		(d) Uncovered beams & low ceiling	
	Question 15	*Question 16*	*Question 19*	*Question 20*	*Question 23*	*Question 24*	*Question 27*	*Question 28*
Bed Options	**Most Preferable**	**Least Preferable**	**Most Preferable**	**Least Preferable**	**Most Preferable**	**Least Preferable**	**Most Preferable**	**Least Preferable**
Bed A	8.10%	29.40%	7.70%	**36.30%**	5.90%	**56.30%**	14.30%	**38.80%**
Bed B	**55.80%**	3.00%	**50.90%**	6.40%	**41.00%**	2.50%	**41.20%**	6.70%
Bed C	9.60%	5.70%	13.60%	6.70%	30.90%	2.70%	22.50%	4.90%
Bed D	12.60%	**40.20%**	18.50%	27.40%	19.80%	1.00%	7.40%	20.20%
Bed E	13.80%	21.70%	9.40%	23.20%	2.50%	37.50%	14.60%	29.40%

4.5.1.1 Door and Window are Closed

As per the research expectations, the results revealed that majority of the respondents (55.80%) were in favour of bed B in scenario (a), where the bedroom is unfilled with a closed door and a closed window with blinds. Bed B was arranged with its bed head supported by solid wall and having almost equilibrium distance to the side walls. Sleeping in bed B would have a window at the right and a door diagonally far from the bed. This is considered as the most ideal bed arrangement according to *Feng Shui* rules. Sleep users would be supported by the Black Tortoise Mountain while having better visual command to see the door and window concurrently. Despite the bedroom was unfilled with furniture, users of bed B may experience more comfortable rest, better readiness against potential aggressors and less psychological distress directed from the potential outdoor disruptions. Bed A was not an ideal *Feng Shui* location as it has no back supports but luckily covered with blinds. Bed C was somehow fulfilling the *Feng Shui* rules but the position was imbalanced for *Qi* to meander through. Bed E was in a position that does not allow the user to see the door although satisfying the main *Feng Shui* rules.

In opposition, the percentages for the least preferable bed location showed the highest in option D (40.20%) in scenario (a). This indicated that majority did not prefer to sleep in line with door, possibly to avoid direct impact of intruders. In the case of option A, the author deduced that the respondents were easily comforted by the blinds covering the window and therefore expressed more anxiety towards the arrangement that is in line with door. It seems that the solution of covering window with thick blinds (as proposed by the *Feng Shui* practitioners in section 2.3.3) has somehow reduced the adverse psychological impacts of sleeping under a window.

In short, the results indicated high values in two Feng Shui recommendations in bed arrangement i.e. "having solid back supports" and "avoid bed to be in line with door".

4.5.1.2 Door and Window are Opened

The room structure and bed options in scenario (b) were identical to scenario (a). Nonetheless, scenario (b) had its door and window opened, providing an apparent thought of higher exposure to environmental disruptions. Majority of the respondents (50.90%) were also in favour of bed B in scenario (b), no matter the room openings are closed or opened. As discussed in scenario (a), bed B is referred as the most ideal *Feng Shui* arrangement that binds with constant energy and uneasy to attach to *Yang* energies which is more suitable for sleep.

The previous section has discovered that a window fully covered with blinds has somehow removed the adverse psychological impacts of sleeping under a window. Conversely, when the door and window were opened in scenario (b), bed A (36.30%) became the least preferable option. Majority refused to sleep against an opened window, where the *Yang* energy source was more forceful behind the bed head as compared to the opened door where the user still can visualise. User in bed A may be at their most

discomfort level during bedtime that consequently burdened the psychological distress and sleeping process.

These findings again implied that solid wall support for a bed is significant in both *Feng Shui* and psychological viewpoint. The emphasis of this section was about sleeping under/ against an opened window may seriously affect the human emotions at bedtime, compared to the one covered with blinds.

4.5.1.3 Room Corner and Full Body Mirror

In agreement with the author's expectation, the results in scenario (c) showed majority of the respondents (41.00%) preferred to sleep in bed B, a bed location without sharp angle threats and mirror reflections. Psychologically, this placement allowed better visual command of the space without unpleasant sight disruptions that could affect the users' state of mind at bedtime. Although bed C was in a position that is in compliance with the basic *Feng Shui* rules but it does not allow the user to see the door and imbalanced with only single side access. Bed A was apparently threatened by the light reflection of full body mirror at the front while bed D and bed E were pointed by the room corner with in-built '*Sha Qi*'.

In contrast, majority of the respondents did not prefer to sleep in bed A (56.30%), followed by bed E (37.50%). This implied that majority have more aversion to the mirror reflection rather than be pointed by the room corner. It would be an uncomfortable visual and mind experience of having a mirror in front of the bed. Users sleeping at this position may be terrified by own image that reflected from the mirror in the dark. Besides, bed E was close to the sharp angle threats which may generate feeling of pierced and disturbed to the sleeper. Although the unfavourable arrangement in bed A, bed D and bed E hardly proven its impacts of misfortune as what have been discussed in section 2.3.4 and section 2.3.5, the findings implied that these unfavourable *Feng Shui* arrangements indeed

associated with psychological well-being and visual comfort that could affect the users' state of mind at bedtime.

4.5.1.4 Uncovered Beams and Low Ceiling

In line with the author's expectation, the results in scenario (d) showed majority of the respondents (41.20%) preferred to sleep in bed B; a bed location without suppressed forces and impact of falling objects. Users at this placement may not experience the sense of pressured and unpleasant view from the beam and low ceiling above the bed. Bed C was somehow not threatened from the bed above but the position was imbalanced for *Qi* to meander through. Bed A, bed D and bed E were in the positions that were threatened by beam and low ceiling with suppressed *Qi* flow.

In contrast, most of the respondents (38.80%) did not prefer to sleep in bed A of scenario (d), a location with 'chopping' threats and '*Sha Qi*' above the bed. The second least preferable arrangement was bed E (29.40%) where the *Qi* is pressured by the low ceiling and become imbalance in the room. In this case, the author deduced that the respondents basically feel more comfortable sleeping under a flatten ceiling compared to under a protruded beam. Perhaps the solution of covering up the beams with ceiling boards may reduce the negative psychological impacts in bed A.

These findings implied that the unfavourable *Feng Shui* arrangement in scenario (d) indeed producing visual and mind discomforts which the majority was trying to avoid. The potential adverse psychological impacts at bed A, C, D and E, such as the sense of pressured, narrow breath and impact of falling objects were always the concerns in bedroom *Feng Shui*. Whether these psychological impacts are over exaggerated, such arrangements undeniably change the mood and pre-sleep quality of most individual.

4.5.2 Potential Psychological Impacts

Further from the survey questions about the respondents' most preferable and least preferable choice in the four (4) bedroom scenarios, this section discusses the potential psychological perceptions claimed by the respondents for each of their selected bed option.

Table 4.9 demonstrates the potential psychological perceptions in the most preferable bed location claimed by the respondents for each of their selected bed option in scenario (a), (b), (c) and (d). There were nine (9) options of positive psychological perceptions and one 'others' perception for the respondents to fill in, as shown in *Question 17, 21, 25 and 29* in the questionnaire survey sample in Appendix II. The given options involved protected, secured, embraced, supported, balanced, convenient, stable, comfortable and visually satisfied. These options were repeated for all four (4) bedroom scenarios. The majority choice (bed B) of the most preferable bed arrangement in all bedroom scenarios and its related psychological perception were highlighted in red as shown in Table 4.9.

Table 4.10 displays the potential psychological perceptions in the least preferable bed location claimed by the respondents for each of their selected bed option in the four (4) bedroom scenarios. Nine (9) options of adverse psychological perceptions and one 'others' perception option were given for the least preferable question, as presented in *Question 18, 22, 26 and 30* in the questionnaire survey sample in Appendix III. The given options included anxiety, unsecured, imbalanced, disturbed, frightening, uncomfortable, suppressed, piercing and visually unsatisfied. These options were also repeated for the four (4) bedroom scenarios. The majority choice of the least preferable bed arrangement in all bedroom scenarios and its interrelated psychological responses were emphasised in red as shown in Table 4.10.

Table 4.9: Distribution of potential psychological perceptions claimed by the respondents for their most preferable bed arrangement in different bedroom scenarios.

Most Preferable Bed Options	Count	Protected	Secured	Embraced	Supported	Balanced	Convenient	Stable	Comfortable	Visually satisfied
Scenario (a): Door & window are closed (*Question 17*)										
Bed A	39	58.97%	48.72%	5.13%	28.21%	15.38%	25.64%	28.21%	56.41%	25.64%
Bed B	226	37.17%	46.02%	26.55%	17.26%	61.06%	34.96%	39.38%	63.27%	33.19%
Bed C	51	47.06%	49.02%	7.84%	17.65%	47.06%	27.45%	13.73%	52.94%	39.22%
Bed D	33	48.48%	51.52%	15.15%	12.12%	24.24%	30.30%	18.18%	57.58%	27.27%
Bed E	56	55.36%	48.21%	12.50%	16.07%	21.43%	30.36%	23.21%	53.57%	33.93%
Total:	**405**									
Scenario (b): Door & window are opened (*Question 21*)										
Bed A	55	43.64%	49.09%	12.73%	14.55%	27.27%	21.82%	12.73%	72.73%	40.00%
Bed B	206	31.07%	44.17%	26.70%	15.05%	59.22%	44.66%	34.47%	72.82%	48.54%
Bed C	75	68.00%	69.33%	5.33%	21.33%	12.00%	26.67%	20.00%	54.67%	37.33%
Bed D	31	29.03%	19.35%	6.45%	9.68%	41.94%	48.39%	19.35%	74.19%	45.16%
Bed E	38	50.00%	57.89%	18.42%	18.42%	34.21%	31.58%	21.05%	57.89%	36.84%
Total:	**405**									
Scenario (c): L-shaped room & full body mirror (*Question 25)*										
Bed A	24	20.83%	25.00%	12.50%	16.67%	33.33%	54.17%	12.50%	50.00%	33.33%
Bed B	166	12.65%	19.88%	5.42%	12.05%	51.20%	45.78%	28.31%	62.65%	37.95%
Bed C	125	31.20%	26.40%	4.00%	11.20%	31.20%	37.60%	35.20%	60.80%	35.20%
Bed D	80	21.25%	26.25%	7.50%	13.75%	48.75%	45.00%	16.25%	56.25%	28.75%
Bed E	10	20.00%	20.00%	0.00%	0.00%	10.00%	40.00%	20.00%	70.00%	10.00%
Total:	**405**									
Scenario (d): Uncovered beams & low ceiling (*Question 29*)										
Bed A	58	25.86%	29.31%	1.72%	15.52%	32.76%	20.69%	24.14%	44.83%	22.41%
Bed B	167	20.96%	25.15%	5.99%	13.77%	35.93%	23.35%	30.54%	50.90%	37.13%
Bed C	91	29.67%	28.57%	4.40%	13.19%	29.67%	15.38%	31.87%	48.35%	25.27%
Bed D	30	16.67%	13.33%	0.00%	26.67%	36.67%	10.00%	23.33%	53.33%	23.33%
Bed E	59	8.47%	16.95%	5.08%	11.86%	37.29%	20.34%	27.12%	40.68%	35.59%
Total:	**405**									

Table 4.10: Distribution of potential psychological perceptions claimed by the respondents for their least preferable bed arrangement in different bedroom scenarios.

Least Preferable Bed Options	Count	Anxiety	Unsecured	Imbalanced	Disturbed	Frighten-ing	Uncomfort-able	Suppressed	Piercing	Visually unsatisfied
Scenario (a): Door & window are closed (*Question 18*)										
Bed A	119	27.73%	55.46%	11.76%	44.54%	24.37%	47.06%	14.29%	1.68%	20.17%
Bed B	12	8.33%	50.00%	33.33%	41.67%	0.00%	41.67%	25.00%	8.33%	8.33%
Bed C	23	17.39%	43.48%	34.78%	43.48%	17.39%	39.13%	13.04%	4.35%	17.39%
Bed D	163	17.79%	30.06%	33.74%	27.61%	15.95%	52.15%	12.27%	6.13%	38.65%
Bed E	88	17.05%	29.55%	52.27%	36.36%	17.05%	44.32%	27.27%	3.41%	39.77%
Total:	**405**									
Scenario (b): Door & window are opened (*Question 22*)										
Bed A	147	29.25%	73.47%	14.29%	57.82%	35.37%	55.78%	12.93%	7.48%	27.21%
Bed B	26	30.77%	57.69%	15.38%	65.38%	19.23%	57.69%	11.54%	15.38%	26.92%
Bed C	27	18.52%	62.96%	14.81%	59.26%	29.63%	66.67%	3.70%	7.41%	22.22%
Bed D	111	20.72%	47.75%	23.42%	42.34%	17.12%	62.16%	15.32%	7.21%	45.95%
Bed E	94	19.15%	54.26%	35.11%	54.26%	19.15%	60.64%	18.09%	2.13%	40.43%
Total:	**405**									
Scenario (c): L-shaped room & full body mirror (*Question 26*)										
Bed A	228	24.56%	27.63%	27.19%	54.82%	32.89%	56.58%	17.11%	7.02%	39.47%
Bed B	10	10.00%	10.00%	20.00%	10.00%	20.00%	30.00%	30.00%	30.00%	40.00%
Bed C	11	9.09%	9.09%	27.27%	36.36%	36.36%	36.36%	9.09%	9.09%	36.36%
Bed D	4	25.00%	50.00%	25.00%	75.00%	25.00%	25.00%	0.00%	0.00%	0.00%
Bed E	152	8.55%	21.05%	52.63%	42.76%	6.58%	65.79%	18.42%	6.58%	47.37%
Total:	**405**									
Scenario (d): Uncovered beams & low ceiling (*Question 30*)										
Bed A	157	18.47%	35.03%	31.21%	38.85%	10.83%	48.41%	22.93%	7.01%	29.94%
Bed B	27	22.22%	25.93%	22.22%	29.63%	18.52%	77.78%	14.81%	3.70%	14.81%
Bed C	20	15.00%	20.00%	50.00%	50.00%	20.00%	70.00%	40.00%	10.00%	25.00%
Bed D	82	13.41%	23.17%	42.68%	32.93%	8.54%	42.68%	23.17%	0.00%	26.83%
Bed E	119	22.69%	28.57%	33.61%	41.18%	18.49%	60.50%	33.61%	7.56%	34.45%
Total:	**405**									

Figure 4.3 displays the percentages of potential psychological perceptions claimed by the respondents in majority choice (bed B) of the most preferable bed arrangement in scenario (a), (b), (c) and (d). The results showed high consistency on their psychological responses in bed B in all bedroom scenarios.

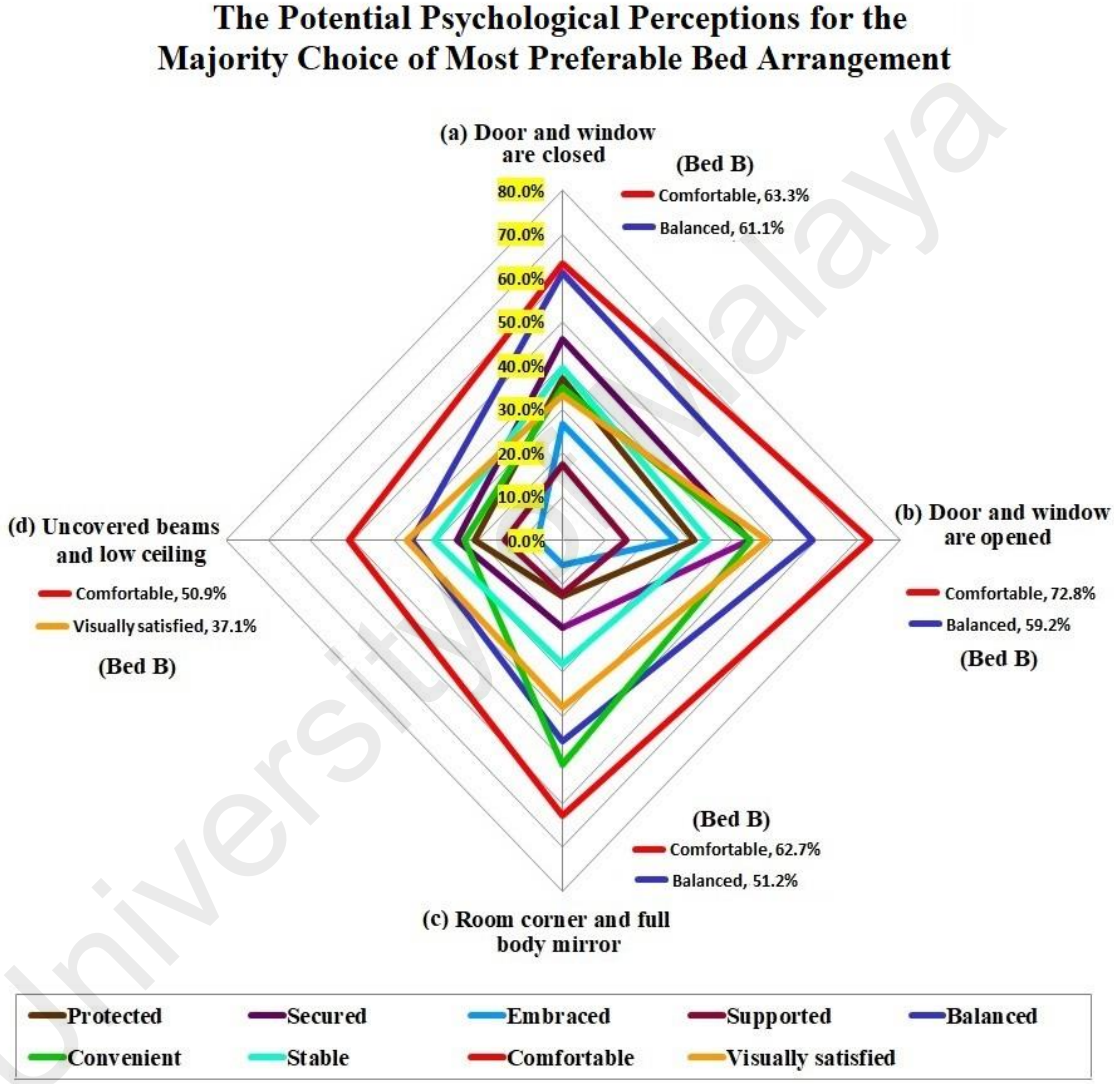


Figure 4.3: The potential psychological perceptions while sleeping in the majority choice of most preferable bed arrangement in scenario (a), (b), (c) and (d).

It was discovered that 'comfortable' was the most frequently selected perception in bed B in scenarios (a) - 63.27%, (b) - 72.82%, (c) - 62.65% and (d) - 50.90%, implying that bed arrangement with recommended *Feng Shui* rules (Bed B) is providing the

respondents with the greatest sense of comfort in the sleep environment. However, the lowest response of 50.90% in 'comfortable' in scenarios (d) does not imply that the respondents experienced lower effect to psychological perception compared to other scenarios. The results demonstrated there are lesser sense of comfort even in the majority preferable bed location (Bed B) in scenario (d) – uncovered beam and low ceiling, implying that scenarios (d) is a less favourable sleeping environment compared to other scenarios. On top of 'comfortable', majority of the respondents also highly experienced the sense of 'balance' in bed B in scenario (a) – 61.06%, (b) – 59.22% and (c) – 51.20%. For the bedroom designed with uncovered beams and low ceiling in scenario (d), other than 'comfortable', most of the respondents (37.13%) also highly perceived bed B as a 'visually satisfied' location that suit their foremost bedroom design requirements.

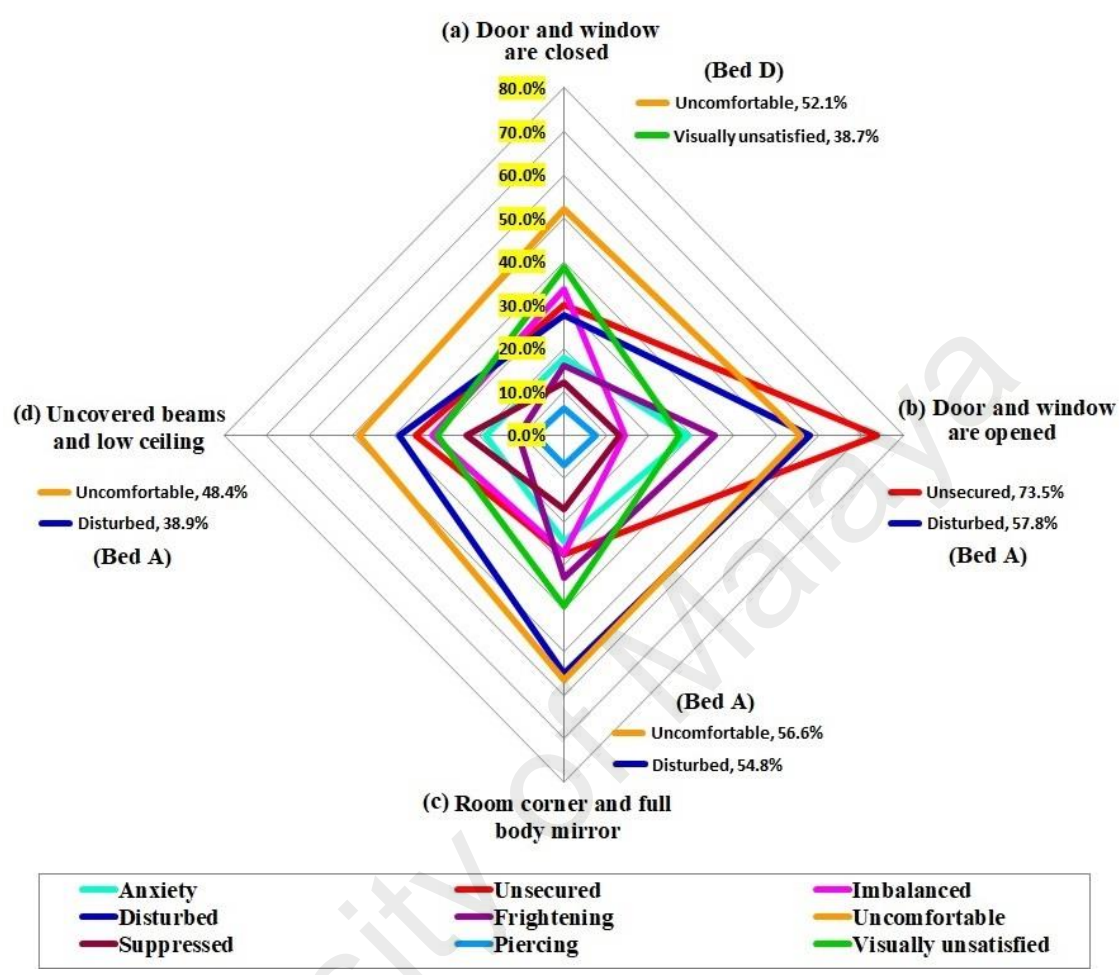


Figure 4.4: The potential psychological perceptions while sleeping in the majority choice of least preferable bed arrangement in scenario (a), (b), (c) and (d).

As presented in Table 4.8, the majority choice for the least preferable bed arrangement was different in different bedroom scenarios. Figure 4.4 displays the percentages of potential psychological perceptions claimed by the respondents in majority choice of the least preferable bed arrangement in scenario (a), (b), (c) and (d).

It was apparent that the perception of 'uncomfortable' was the most frequently selected, when the respondents imagined themselves sleeping in bed D of scenarios (a) - 52.15%, bed A of scenario (c) - 56.58% and bed A of scenario (d) - 48.41%. The results implied that bed arrangement with restricted *Feng Shui* rules i.e. bed in line with door in

scenario (a), bed directly facing to the mirror in scenario (c) and bed directly under a roof beam in scenario (d); indeed provided the respondents with the greatest uneasiness in psychological perspective.

On top of 'uncomfortable', the perception of 'visually unsatisfied' was also highly perceived (38.65%) among the respondents who imagined themselves sleeping in bed D in scenario (a). This was probably due to the unsatisfactory view of door that close to the bed. Besides, overwhelming responses about 'unsecured' (73.47%) were found in bed A of scenario (b), where the bed head was against an opened window. Other than that, most of respondents consistently felt 'disturbed' when sleeping against an opened window in scenario (b) - 57.82%, directly facing to mirror in scenario (c) - 54.82% and directly under a roof beam in scenario (d) - 38.85%.

As a whole, the selections of bed arrangement in all bedroom scenarios were highly associated with psychological factors, rather than other functional design. It was apparent that the 'sense of comfort' and 'sense of balanced' in the most recommended *Feng Shui* bed arrangement is not only limited to physical observation in design but truly from the psychological point of view of the users.

4.6 Inferential Relationships

Table 4.11: The relationships between respondents' demographic variables and their preferences in bedroom layout in Section II of the survey.

Inferential relationship [Sig. < 0.05 → Inference exists]	Monte Carlo Sig. (2-sided) : (Lower bound– Upper bound)	
	The most preferable bedroom layout	The least preferable bedroom layout
Race	0.622 (.609-.634)	0.797 (.787-.808)
Religion	0.518 (.505-.531)	0.219 (.208-.229)
Occupation	0.806 (.796-.816)	0.817 (.807-.827)
Gender	0.395 (.382-.407)	0.651 (.639-.664)
Age	0.451 (.438-.464)	0.808 (.798-.818)
No. Of roommate/ bed partner	0.500 (.488-.513)	0.444 (.431-.456)

Table 4.12: The relationships between respondents' demographic variables and their preferences in bed arrangement in different bedroom scenarios.

Inferential relationship [Sig. < 0.05 → Inference exists]		Bedroom Scenarios			
		(a) Door and window are closed	(b) Door and window are opened	(c) Room corner & f/b mirror	(d) Uncovered beams & low ceiling
Respondents' preferences Vs. demographic variables		Monte Carlo Sig. (2-sided) : (Lower bound – Upper bound)			
The most preferable bed location	Race	0.082 (.075-.089)	0.105 (.097-.113)	0.174 (.164-.183)	0.584 (.571-.597)
	Religion	0.172 (.162-.182)	0.154 (.145-.164)	0.278 (.266-.289)	0.506 (.494-.519)
	Occupation	0.599 (.587-.612)	0.540 (.527-.553)	0.496 (.483-.509)	0.427 (.414-.439)
	Gender	0.446 (.433-.459)	0.288 (.276-.299)	0.227 (.217-.238)	0.455 (.443-.468)
	Age	0.718 (.706-.729)	0.339 (.327-.352)	0.089 (.081-.096)	0.582 (.569-.595)
	No. of roommate/ bed partner	0.247 (.236-.258)	0.575 (.563-.588)	0.840 (.830-.849)	0.050 (.045-.056)
Respondents' preferences Vs. demographic variables		Monte Carlo Sig. (2-sided) : (Lower bound – Upper bound)			
The least preferable bed location	Race	0.001 (.000-.002)	0.077 (.070-.084)	0.126 (.117-.134)	0.286 (.275-.298)
	Religion	0.137 (.128-.146)	0.358 (.345-.370)	0.092 (.085-.100)	0.318 (.306-.330)
	Occupation	0.936 (.930-.943)	0.675 (.663-.687)	0.644 (.631-.656)	0.805 (.795-.815)
	Gender	0.267 (.255-.278)	0.880 (.872-.888)	0.547 (.534-.560)	0.233 (.222-.244)
	Age	0.990 (.987-.992)	0.931 (.924-.937)	0.850 (.841-.859)	0.775 (.764-.786)
	No. of roommate/ bed partner	0.388 (.376-.401)	0.237 (.226-.248)	0.109 (.101-.117)	0.648 (.636-.660)

By combining the survey data in Section II and Section IV, the inferential relationships between the ten (10) human preferences and the six respondents' characteristics were tested via Monte Carlo approach. A matrix of 60 significant values was composed via SPSS. Among the 60 computations as shown in Table 4.11 and Table 4.12, 59 *p*-values were greater than 0.05, implying that the relationships were not insignificant. This confirmed the independent relationships between different respondents' background and their choice of sleeping places.

For the test of the least preferable bed arrangement in scenario (a), the *p*-value (0.001) defined a strong significant relationship for 'race'. This implied that there were significant differences between the 'race' perceptions in determining the least preferable bed locations in scenario (a).

In short, the respondents' most preferable bed arrangements in all bedroom conditions were predominantly not affected by demographic variables and supportive to the research hypothesis.

4.7 Summary of Chapter

The survey findings revealed high statistical significance in showing the corresponding relationship between human preferences in bed arrangement and *Feng Shui* conceptions applied to a sleep environment. The relationship was criticised constructively throughout the chapter from multiple perspectives.

The majority choice of most preferable bedroom layout was verified as the ideal bedroom *Feng Shui* model. There was also sleep quality assessment showing that the most ideal bedroom *Feng Shui* model may efficiently reduce the respondents' time to fall asleep but have no apparent implications to better sleep quality. Besides, the bed arrangements that tied with recommended *Feng Shui* rules were majorly selected as the most preferable bed location to sleep in, while the arrangements that tied with

unfavourable *Feng Shui* rules were mostly declined. These major selections of bed arrangements in different prearranged bedroom scenarios were supported by psychological impacts claimed by the respondents.

CHAPTER 5 – RESULTS AND DISCUSSIONS: INTERVIEWS

5.1 Introduction

This chapter sets out descriptive analysis and data display of interview findings about the modern architects' perceptions in design procedures and design criteria for an ideal bedroom interior. The findings discussions were mainly drawing relationships between an ideal bedroom *Feng Shui* arrangement and the architect's design practice which is more scientific in nature. Besides, the interview findings about the architects' insights in design procedures would serve as the basis for the development of bedroom design protocol in Chapter 7.

The interviews were conducted for approximately five (5) months, including two (2) months of invitation and response waiting period. It was the interview appointments that delayed up to 5 months due the busy schedule of the selected interviewees. As mentioned in section 3.5.3.1 and section 3.5.3.2, stratified and snowballing methods were used in sampling selection. All interviews were completed using face-to-face and phone interviews. Further clarifications on selected matters were done by phone interviews. Consequently, the study has successfully approached and interviewed 16 architects and collected thirty (30) bedroom floor plan drawings. Each interview session consume about 40 to 60 minutes, including the provision of ideal bedroom layout drawings. As stated in section 3.5.4, thematic content analysis was used to analyse qualitative data from the interviews, to report common patterns across a data set. The phenomenological data from the architect perceptions about the design procedures for bedroom interior was extracted for its significant meaning and concepts followed by a report based on common patterns across a data set.

This chapter ended with a general summary and the structure of the chapter is demonstrated in Figure 5.1.

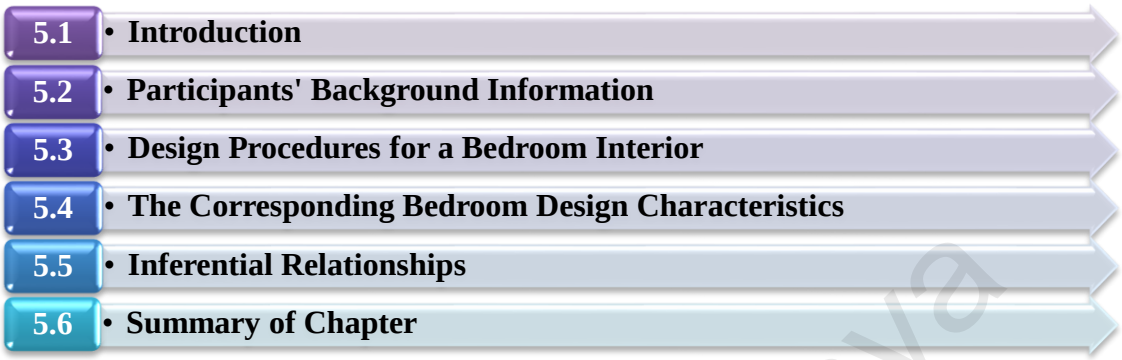


Figure 5.1: The framework of Chapter 5.

5.2 Participants' Background Information

The research has successfully interviewed a total of 16 professional architects including three (3) interior architects and one (1) academician cum architect. Generally, the interview participants had an average of 12 years working experience. The longest working experience was up to thirty-three (33) years and the shortest was only two (2) years. Among the 16 interviewees, seven (7) of them were Chinese architects who are probably familiar and aware of bedroom *Feng Shui* practices. The remainder participants were other races who have not been exposed to Chinese *Feng Shui* knowledge. For the religion analysis, there were eight (8) Muslims, four (4) Buddhists, three (3) Christians and one Hindu. The male participants (56.3%) were generally more than female (43.7%) participants. The summary of interview participants' demographic background is given in Table 5.1.

Table 5.1: The classification of interview participants.

Interviewee	Job Specialisation	Working Experience	Race	Religion	Gender	Contribution
Interviewee I	Interior Design	15y	Chinese	Buddhism	Male	1 layout
Interviewee II	Residential Design	8y	Chinese	Buddhism	Female	2 layout
Interviewee III	Residential Design	8y	Malay	Islam	Female	1 layout
Interviewee IV	Residential Design	10y	Iranian	Islam	Female	1 layout
Interviewee V	Residential Design	17y	Chinese	Christian	Male	4 layout
Interviewee VI	Residential Design	2y	Iranian	Islam	Male	1 layout
Interviewee VII	Residential Design	16y	Chinese	Buddhism	Male	4 layout
Interviewee VIII	Residential Design	5y	Chinese	Christian	Male	2 layout
Interviewee IX	Residential Design	11y	Yemeni	Islam	Male	1 layout
Interviewee X	Academic & Residential Design	33y	Indian	Hinduism	Female	2 layout
Interviewee XI	Residential Design	2y	Iranian	Islam	Female	1 layout
Interviewee XII	Residential Design	20y	Chinese	Christian	Male	1 layout
Interviewee XIII	Residential Design	19y	Chinese	Buddhism	Male	3 layout
Interviewee XIV	Interior Design	6y	Malay	Islam	Female	1 layout
Interviewee XV	Residential Design	22y	Malay	Islam	Male	3 layout
Interviewee XVI	Interior Design	2y	Malay	Islam	Female	2 layout

5.3 Design Procedures for a Bedroom Interior

This section discusses how a sleep environment is designed in order to get a restful retreat that everyone desire. It was satisfied that the overall design procedures described by the 16 interviewees were somehow corresponding to each other. Only several exceptional considerations in bed arrangement were reported.

According to all the responded architects, there were no fixed procedures for the design of a bedroom interior. In general, the design and arrangement for a bedroom interior is based on common sense and the past design experiences. All of them claimed that the commencement of a space interior arrangement is strictly dependent on the building structural design. Interviewee IX, VI and XIII concurrently mentioned about the attached bathroom location may affect the decision made for a bedroom interior. However, the

room dimension, shape and form, door and window facing direction and furniture sizes are always the predetermined factors before the decision is made for the interior arrangement. Consequently, these factors are no longer the sturdy limitations for the architects but become the main challenge to an interior arrangement exertion.

The shared perspectives of architects about the design procedures of a bedroom interior are divided into two phases i.e. consideration phase and implementation phase. These phases are outlined in Figure 5.2 and discussed in the following sub-sections.

5.3.1 Consideration Phase

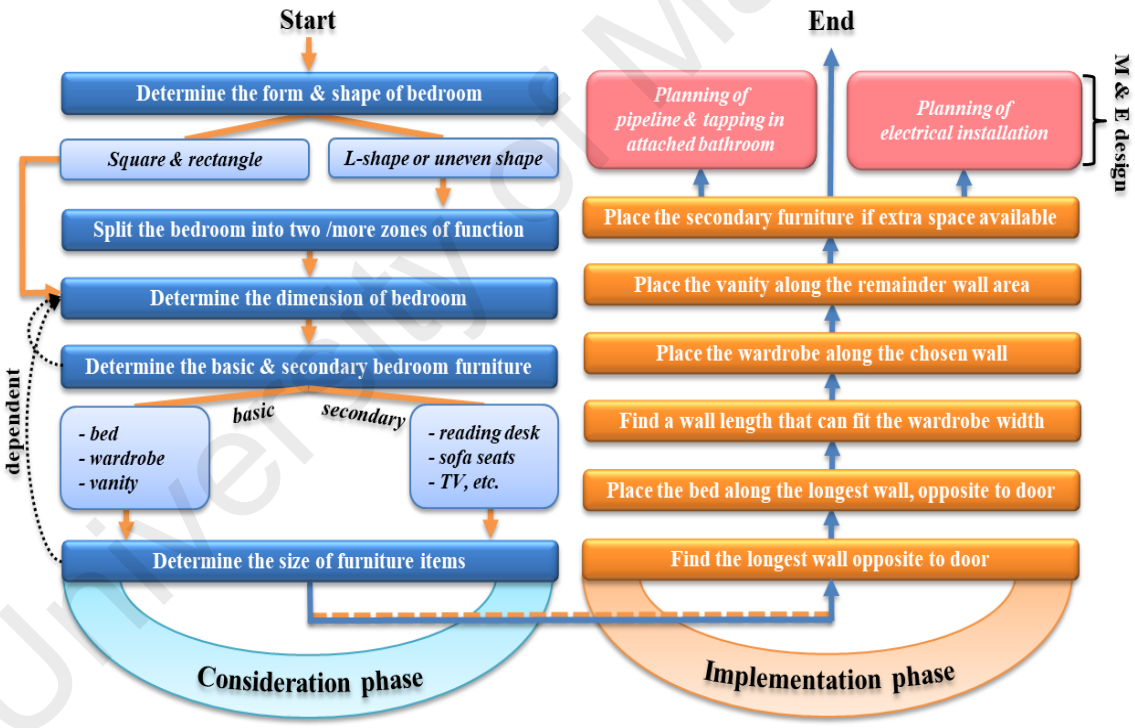


Figure 5.2: The reciprocal and intersecting perspectives of architects in the design procedures for bedroom interior.

The mutual understanding of all interviewees begins with the consideration of the bedroom floor plan that giving an idea of how the room is taking shape. Majority of them (except interviewee VI) claimed that bedrooms in square or rectangular form are the most

simple and ideal for interior arrangement. However, they have no aversion to L-shaped, T-shaped and Z-shaped room unless the room dimension is odd for the settlement of basic furniture. These forms usually involve room corners which will be the challenge for the architects to do interior arrangement. When they are given such cases, the most common solution claimed by them is to split the room into two zones of function. On top of that, interviewee VI and XI mutually talked about irregular quadrilateral room such as trapezium room, which is unusual and not easy to configure internally. It requires custom-made furniture to cover up the inclined wall area in order to create the sense of harmony and balance in bedroom.

Further from the decision in bedroom shape and functional zones, the room dimension is considered subsequently by all architects. All architects have matching thoughts that an ideal bedroom doesn't have to be too spacious, but it does need to afford to fit in all basic amenities. As the dimension of bedroom is particularly important for furniture arrangement, some of the architects have proposed the ideal bedroom size specifically for a double bedroom. Interviewee I, V, XII and XIII concurrently reported that an ideal Master or double bedroom size shall be around 150 square feet, or a minimum 14.0m^2 based on the property size. Interviewee XIII proposed that:

> *The common dimension combination such as 10'x14', 12'x13'; 12'x14'; 13'x16'; etc. Anything over 300 square feet shall be a luxury bedroom and shall intended for houses with over 2,500 square feet for whole living space. It is too spacious in design perspectives unless walk-in wardrobe occupies a fraction of the area.*

Other than bedroom sizes, the furniture and its measurement are the next considerations in bedroom interior arrangement in the architects' point of view. According to fifteen (15) interviewees, the basic furniture that must be involved in a sleep

environment involves of a bed, a closet and a vanity. Half of them (Interviewee I, II, III, V, VII, VIII, XII and XV) concurrently advised a bedroom shall not be congested with furniture. They argued the basic furniture in a bedroom is simply a bed and a closet. For a small and narrow bedroom, these architects used to prefer tailor-made or space-saving storage concepts while the secondary furniture such as sofa seats, TV rack and reading desk shall be avoided.

Most of the architects (except Interviewee II, VI) had the mutual insights that a bed is the key piece of furniture which naturally becomes the focal point inside a bedroom. They have the same thoughts that bed occupies the biggest on plan area inside a bedroom and therefore shall be placed into the room at the outset followed by the smaller one. In case the size of bed is smaller compared to other furniture, the bed placement remained the primary step because the main function of a bedroom is for sleeping while the secondary function is for dressing and storage. A sleeping place requires a sense of stability, comfort, and peace of mind. However, interviewee VI and XVI had an aversion about this perception, highlighting that the key element inside a bedroom is more often to be the wardrobe as the modern bedroom design tends to have walk in closet. To agree with this viewpoint, the bedroom that applied shall have a larger space.

Other than the above comments, Interviewee V highlighted that:

> *Interior arrangement is one of the most powerful approaches to convert an unfavourable bedroom into a pleasing setting. The number of furnishing items and its measurement are highly dependent on the bedroom dimension.*

5.3.2 Implementation Phase

To implement the design procedures, the location of bed and other furniture shall be determined. It is common to place the bed and other furniture aligned with walls, either parallel or at its right angles. All architects stated that they typically find the longest piece of wall place for bed placement. Majority of the architects (except Interviewee III, IV, VI, VII, XI and XIII) proposed to place the bed along the central area of the longest wall to create sense of balance and harmony. They claimed that visual balance is the most important inside a bedroom. Majority of the architects (except Interviewee III, IV, VII, XI and XVI) described they usually place the bed aligned to the wall and at the same time having visual command of the door and window. Besides, the space beside and in front of the bed shall be accessible and functional. This is to support visual satisfaction and easy circulation to access to other furniture.

Majority of the architects (except Interviewee III, IV, XIV) of the interviewees refused to place the bed against the window as it may create uncomfortable draughts. Interviewee II and IX described an exceptional situation to ignore this rule, provided that the window is infrequently opened and well covered with blinds. But of course, the sunlight directed from windows shall be duly utilised provided that it is not too disturbing at the bed location. In addition, Interviewee VI said that:

> *The bed shall not be located opposite to the window, if a large window faces east. This is due to the direct sunlight may disrupt human sleep in the morning. The distance between the window and the bed shall also be ideal for access.*

After the bed location is determined, majority of the architects (except Interviewee III, XI) said the wardrobe location shall be considered, usually along the wall area which can fit its size. Subsequently, vanity is sited along the remainder wall area after the wardrobe

placement. These architects did not comment about the size and direction of closet and vanity from the bed. As interviewee VI and XVI already highlighted that walk in closet is the modern design trend, they remained their perception that bed location is decided after the build-in closet and the vanity would be inside the walk in closet.

After the location of basic furniture have been confirmed, Interviewee I to XVI concurrently consent the placement of secondary furniture if the remainder bedroom space is permitted for these items to be slotted in. The secondary fittings are such as writing desk, sofa, TV and chair.

From the majority architects' design practice (except Interviewee VI), electrical planning is not the main concern in bed arrangement. They claimed that bed placement is not to suit the electrical layout but it happens before the electrical point is decided. The electrical point setting is approved subsequent to the approval of interior configuration by the architects in the past and recent construction projects. Whenever there are requirements to reorganise the bedroom fittings in the architectural design phase, electrical points will be altered consequently in the Mechanical & Electrical design phase with the intention not to cover up any electrical switches and plug-in.

Interviewee II, IV, VIII, XI and XVI highlighted that the bed shall not be located near bathroom pipeline and exterior taps location. The same group of architects also highlighted the bedroom location that require special maintenance or future maintenance. They advised the not moveable furniture shall not be placed at these locations based on their past experience. Other than the abovementioned issues for bed arrangement, these architects usually seek for additional viewpoint from others to make sure the arrangement is practical with better sense of comfort before the bedroom drawing is confirmed.

For additional comments, majority of them (except Interviewee VI, VIII, IX, X, XII and XIV) described bedroom interior arrangement is about visual composition. They claimed that a good composition emphasizes the sense of balance and symmetry of

furniture items. The feeling of stable and harmony is very important in a bedroom. They also claimed that visual balance is more important than the room dimensions.

5.4 The Corresponding Bedroom Design Characteristics

The study accumulated thirty (30) bedroom layout drawings upon the completion of 16 interviews as shown in Appendix IV. Among the submitted drawings, each was designed with an attached bathroom in a blend of master bedroom, middle room and single room. The collected floor plans were totally different in terms of its size, form, window facing direction, as well as bathroom location. All floor plans and furniture were not to scale and not indicated with its door facing direction. Thus the author assumed that bedroom door facing direction is not significant in the architectural design practice.

The submitted bedroom drawings (exclude attached bathroom) were mostly in L-shaped and rectangular form. Only a few bedrooms were designed in T-shaped and Z-shaped. However, most of the L-shaped room have been detached into two or more functional speciality spaces. These room cut-offs were intended for bed placement in the larger quadrangle area while the smaller area was intended for dressing. Such design trend implied that the job of interior arrangement would be simpler if a quadrilateral form of space is provided. The detached design concept is supportive to the *Feng Shui* thoughts that a square or rectangular space has better *Feng Shui* as it is expected to afford more constant *Qi* flow.

Table 5.2: The scoring analysis of architects' bedroom layout design based on the five main *Feng Shui* criteria.

BEDROOM LAYOUT	Bed head supports	Window direction from the bed	Door direction from the bed	Sharp angle pointing to the bed	Mirror in line with bed	Total Scores
SCORING SYSTEM (Maximum score / layout = 5.0)						
Score: 1	*Solid wall*	*Sides/ front*	*Diagonal*	*No*	*No*	
Score: 0	*Window*	*Back*	*In line with bed*	*Yes*	*Yes*	
L1	solid wall	right	diagonal	table	nil	4.0
L2	solid wall	left	diagonal	nil	nil	5.0
L3	solid wall	left	diagonal	nil	nil	5.0
L4	window	back	diagonal	nil	nil	3.0
L5	solid wall	right	diagonal	table	nil	4.0
L6	solid wall	left, right	diagonal	nil	vanity area	4.0
L7	solid wall	left	diagonal	nil	nil	5.0
L8	solid wall	left	diagonal	nil	nil	5.0
L9	solid wall	left, right	diagonal	nil	nil	5.0
L10	solid wall	front	back, not seen	room corner	closet area	2.0
L11	solid wall	left, right	diagonal	nil	nil	5.0
L12	solid wall	left, right	diagonal	nil	vanity area	4.0
L13	solid wall	diagonal, left	diagonal	nil	nil	5.0
L14	solid wall	left	diagonal	nil	vanity area	4.0
L15	solid wall	left	diagonal	wardrobe	nil	4.0
L16	solid wall	left, front	diagonal	wardrobe	nil	4.0
L17	solid wall	right	diagonal	nil	nil	5.0
L18	solid wall	left	diagonal	nil	vanity area	4.0
L19	solid wall	right	diagonal	nil	vanity area	4.0
L20	solid wall	front	diagonal	table	nil	4.0
L21	solid wall	left, right, front	diagonal	nil	nil	5.0
L22	solid wall	right	diagonal	nil	nil	5.0
L23	solid wall	right	diagonal	nil	vanity area	4.0
L24	solid wall	left	diagonal	table	vanity area	3.0
L25	solid wall	left, right	diagonal	table	vanity area	3.0
L26	solid wall	left, right	diagonal	nil	vanity area	4.0
L27	solid wall	right, front	back, not seen	nil	vanity area	3.0
L28	solid wall	left	diagonal	table	vanity area	3.0
L29	solid wall	right	diagonal	nil	nil	5.0
L30	solid wall	left	diagonal	nil	vanity area	4.0
(N = 30)						
Total scores:	***29/30***	***29/30***	***28/30***	***21/30***	***17/30***	***124/150***
Mean score:	***0.97***	***0.97***	***0.93***	***0.7***	***0.57***	***4.13***
Std. Dev.:	***0.18***	***0.18***	***0.25***	***0.47***	***0.50***	

The values of each submitted bedroom layout were assessed based on its bed placement by particular bedroom *Feng Shui* rules. Table 5.2 demonstrates a scoring analysis of the 30 layouts with reference to the five main *Feng Shui* design criteria. Almost 37% (11 out of 30) of the layouts achieved the maximum score at 5.0, implying

the bed arrangement ideas of the participated architects' were fully in compliance with the five significant *Feng Shui* criteria. There were 43.3% (13 out of 30) of the layouts compatible with four of the *Feng Shui* design criteria, getting high scores at 4.0. Another five (5) layouts scored 3.0 while only one (1) layout getting the lowest score at 2.0.

Figure 5.3 shows two samples of bedroom layout (*Layout 13 & Layout 22*) submitted by the architects which were assigned with full score. Both the bed locations are in compliance with the five main *Feng Shui* rules. The beds are backed by solid wall, not arranged in line with door and having windows at either side of bed. The room angles are not pointing to the beds while the mirrors at the vanity area are not facing to the sleeper.

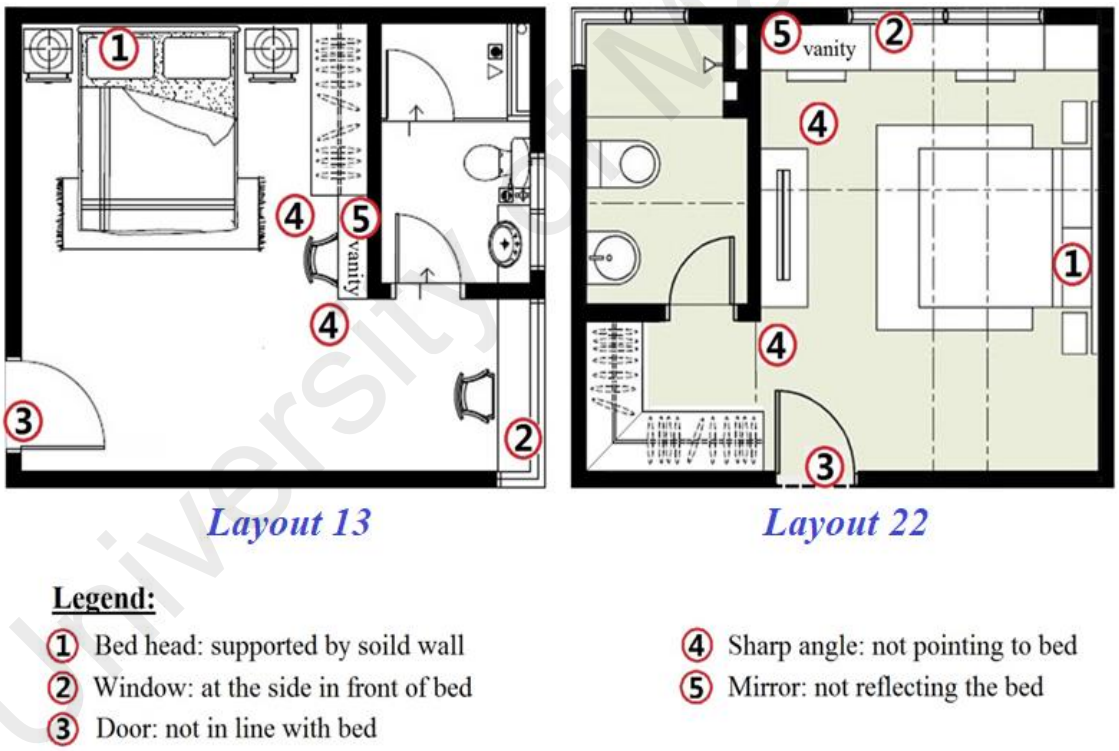


Figure 5.3: The samples of bedroom layout (*Layout 13 and Layout 22*) that scored full score at 5.0, based on the assessment of *Feng Shui* design criteria.

The mean score for all submitted bedroom layouts was moderately high at *4.13*. From the analysis of total score based on each *Feng Shui* design criteria, the scores of 'bed head

supports', 'door direction' and 'window direction' were almost achieving full score. It seems that most of the architects have subconsciously applied *Feng Shui* rules in bed arrangement. The relationships between the bed, the wall and the room openings were largely emphasized. The *Feng Shui* criteria for 'sharp angles threats' and 'mirror threats' were lower in total score due to these circumstances are usually unavoidable in the architectural perspectives. Mirror facing to bed appeared to be the more common practice among the architects, perhaps there is no serious issue about image and light reflection in the dark in their design perspectives.

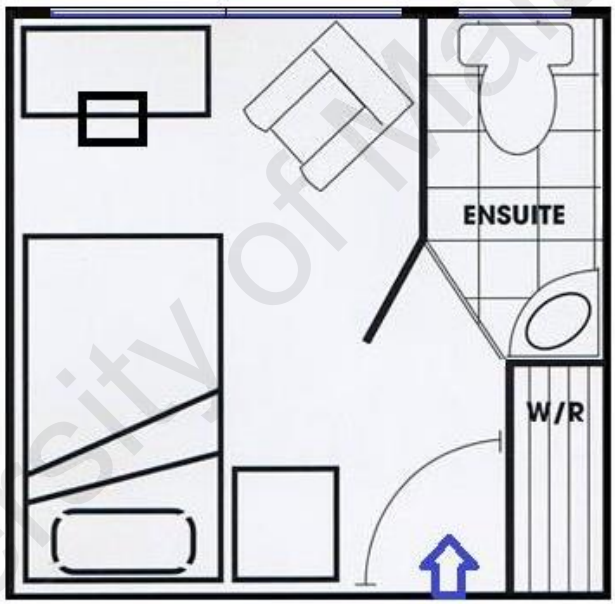


Figure 5.4: The sample of bedroom layout (*Layout 10*) that scored 2.0, based on the assessment of *Feng Shui* design criteria.

However, among the thirty (30) collected designs, *Layout 10* is observed as a single bedroom which is not so spacious compared to other bedrooms (see Figure 5.4). It is noticeable that the bed in *Layout 10* is arranged to be backed by solid wall and facing a window but it was restricted to have view to the door. Besides, the bed is forced to be arranged in a way that is pointed by room corner and concurrently having mirror threats due to the bedroom form and measurement. It is strongly believed that bedroom

measurement becomes the main reason for such layout scoring the lowest (2.0) in Feng Shui assessment. In short, non-spacious bedroom may restrict the bed arrangement options that hardly to comply with all the five main Feng Shui rules but it demonstrated the significance of placing bed head to be backed by solid wall rather than a window.

In view of the architects were not inform about the research theme is regarding bedroom *Feng Shui*, the interview results substantiated that architectural practices for bedroom interior arrangement are parallel with most of the *Feng Shui* thoughts in bed arrangement. The following sub-sections review the bed arrangement proposed by the architects based on the five bedroom *Feng Shui* design criteria. Figure 5.5 displays the scoring distribution of bedroom layouts based on the five bedroom *Feng Shui* rules.

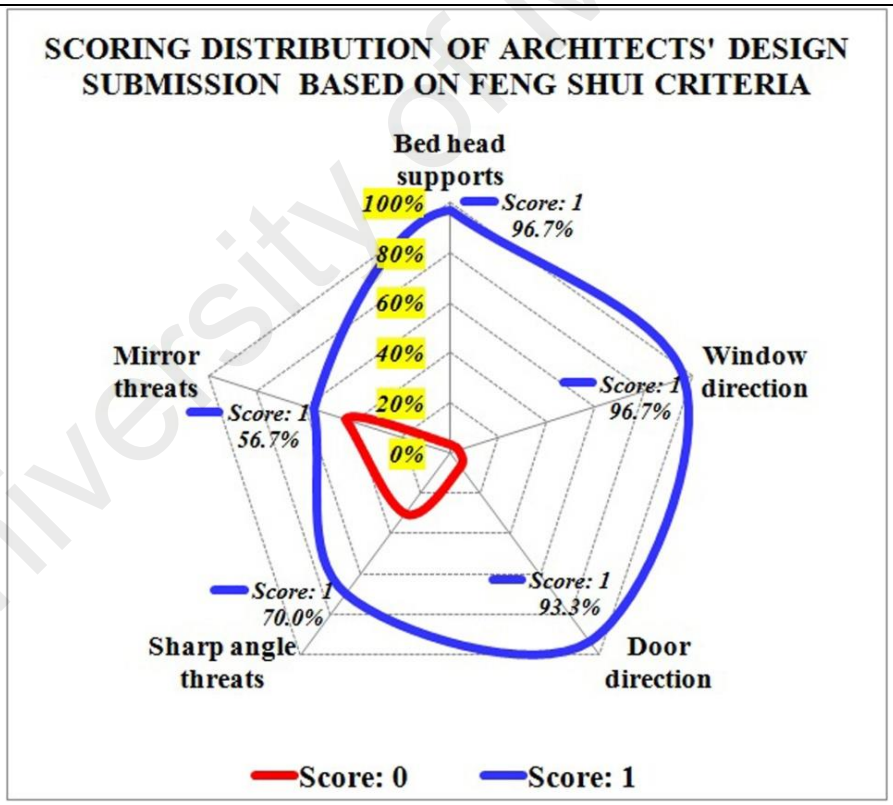


Figure 5.5: Scoring distribution based on *Feng Shui* criteria.

5.4.1 The Bed Head Supports

Among the proposed bedroom layout, 96.7% of the bed heads were supported by solid wall, except *Layout 4* was designed with its bed head attached to the window. From the review to *Layout 4* bedroom structure in Appendix IV, the bedroom was designed with short brick wall length, connecting to large area of window and two panels of glass sliding door at the balcony area. It was predicted that due to such reasons, the bed placement has very limited option.

The results implied that the most of the architects were trying to keep the bed away from the fragile glass window that may lead in potential *Yang* disruptions (noise, lighting, wind, etc.). In addition, it was found that the most of the brick walls that used to support the bed are without openings such as window, bedroom door and bathroom door. Such practice is expected to support better sleep quality by offering positive intuition of being supported and secured, at the same time providing better visual command of the space from the bed position.

5.4.2 The Window Direction

Among the submitted bedroom layouts, 96.7% of the beds were located in a way that allowed one to see the window, despite the window is in front or by the side of the bed. The only exceptional case is in *Layout 4* where the window is behind the bed head (see Appendix IV). The results showed majority of the architects' practised to offer the bed user with distant view to window probably to ensure visual satisfaction inside the bedroom. The practice also conceivably to reduce impact of intruders and external disruptions such as wind hit, light reflection and traffic noise that may affect the users' emotion at bedtime.

5.4.3 The Door Direction

There were 93.3% of the bedroom layouts having its room entrance diagonally far from the bed. None of the bed was located in line with door. However, the bed position in *Layout 10* and *Layout 27* were not allowed to see the bedroom door. The bedroom entrance was located at the same piece of brick wall that supports the bed head in a relatively short distance (see Appendix IV).

Majority of the architects preferred having the bedroom door diagonally far from the bed as it probably allows users to have clear but indirect sight to the door and better readiness against potential intruders. From the *Feng Shui* perspectives, such placement is expected to impede hustle *Qi* flow (energy that is too *Yang*) that directly enter into the sleep area and allow *Qi* to meander within the room before reaching the bed location.

5.4.4 The Sharp Corner

The results show 70% of the beds were arranged in a way that not threatened by room corners and furniture sharp angles. The results discovered most of the architects attempted to keep the bed away from sharp angles threats but there were some exceptional cases where the threats are unavoidable. As presented in Appendix IV, *Layout 10* is the only example of bed pointed by room corner. *Layout 15* and *Layout 16* show their beds pointed by wardrobe angle in a distant position. *Layout 1*, *Layout 5*, *Layout 20*, *Layout 24*, *Layout 25* and *Layout 28* are having the beds pointed by table and vanity corners in the farther distance.

From the *Feng Shui* perspectives, the destructive impacts of bed pointed by sharp angles are not really significant when the distance between the threats and the bed is reasonably far, and when the sharp corner is at the table height level. From the thorough review to the submitted bedroom layouts, it is apparent that bedroom corners and furniture sharp angles are regularly found inside a bedroom. The art of arrangement by the

architects is therefore very important to void unpleasant visual implications by the sharp angles and to void circulation. Avoiding sharp angle threats may not be one of the most significant design criteria in architectural perspectives as compared to door and window direction.

5.4.5 The Mirror Position

More than half (56.7%) of the proposed layouts arranged the bed away from direct mirror contact, but the remainders were unavoidable. As presented in Appendix IV, 33.3% of the bed locations were affected by the reflection of mirrors from the side while another 10% were having mirror in front of the bed. The results revealed part of the architects attempted to keep the bed away from mirror threats but in some conditions such as room size and mirror size, mirror facing to bed is unavoidable. In such unavoidable cases, the arrangement is not always giving destructive impacts as it is usually dependent on the distance between the bed and the mirror. Hence, avoiding mirror threats in bed arrangement may not be a significant design criterion as compared to door and window direction in the architectural perspectives.

5.5 Inferential Relationships

Fisher's Exact test was carried out and has successfully evaluated 12 pairs of relationships between the architects' demographic background and the five *Feng Shui* criteria for bed arrangement. Table 5.3 presented all p-values were much greater than 0.05, implying that there were no relationship between race, religion and gender of the architects with the five *Feng Shui* design criteria for bed arrangement. The bedroom layouts designed by the architects were mainly corresponding to the five recommended *Feng Shui* criteria for bed arrangement but not affected by their demographic variables. The interview findings were reinforced by the relationship tests.

Table 5.3: The relationships between architects' demographic background and *Feng Shui* design criteria for bed arrangement.

FISHER'S EXACT TEST		*Feng Shui* Design Criteria for Bed Arrangement				
[Sig. < 0.05 → Inference exists] [Sig. ≥ 0.05 → No Inference]		Bed head supports	Window direction	Door direction	Sharp angle threats	Mirror threats
RACE	*Exact Sig. (2-sided)*	*0.179*	*0.433*	*0.179*	*0.443*	*0.138*
RELIGION	*Exact Sig. (2-sided)*	*1.000*	*1.000*	*0.409*	*0.495*	*0.130*
GENDER	*Exact Sig. (2-sided)*	*0.103*	*0.333*	*0.540*	*1.000*	*1.000*

5.6 Summary of Chapter

The architects' design experiences and perceptions relating to the bedroom interior were explored interactively via interviews and the values of their design outputs were assessed by the five particular *Feng Shui* rules applied to a sleep environment.

The research findings presented mutual perspectives of architects in design procedures of a bedroom interior and concurrently verified the common design criteria in bed arrangement. Despite each of the submitted bedroom layout were different in terms of their form and size in nature, the architects shared the common design criteria in bed arrangement, which are in compliance with the five bedroom *Feng Shui* rules. The architects' common design criteria revealed a strong relationship between the bed, wall, door and window, which can be explained by the bedroom *Feng Shui* rules.

The overall results were inclined towards achieving the research objective (ii), showing high correspondence relationships between the architects' design perspectives and the ideal *Feng Shui* conceptions applied to a sleep environment. The interview findings from a more scientific deviation from the architects' perceptions have undeniably reinforced the bedroom *Feng Shui* theories to a higher extent.

CHAPTER 6 – RESULTS AND DISCUSSIONS: SLEEP EXPERIMENTS

6.1 Introduction

This chapter mainly presents data analysis and interpretation of sleep quality measurements by wrist actigraphy and weekly PSQI survey within the area of investigation and the identified variables. The analysis at the same time recorded the participants' daily sleep log and daily activities that may affect individual nocturnal sleep quality. The experiments were carried out to verify whether the five recommended *Feng Shui* rules in bed arrangement are practically supportive to greater sleep quality. The significance level of each *Feng Shui* rule in bed arrangement was then identified in sequence based on the results in both experimental tools.

The experiments were conducted and completed for approximately two (2) months, commenced on a date where the group of participants conform with. Specifically, the experiment of the group commenced on 30th September 2014 and ended on 3rd November 2014. The group consists of five (5) participants who spent five (5) weeks to complete the assessment for the five (5) *Feng Shui* rules in bed arrangement in different predetermined bedroom scenarios.

The structure of the chapter is demonstrated in Figure 6.1.

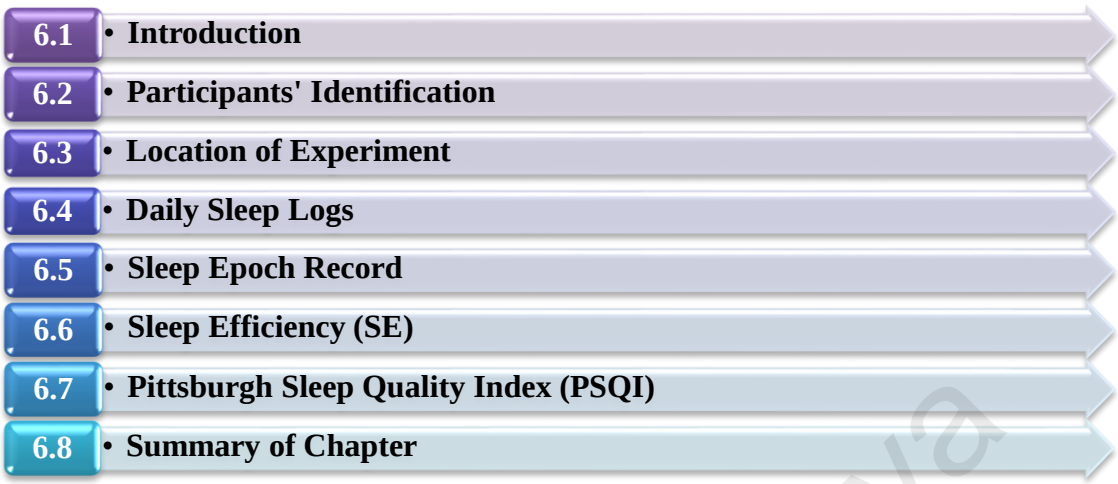


Figure 6.1: The framework of Chapter 6.

6.2 Participants' Identification

After two months of efforts, five young female adults were convinced to participate in the sleep experiments. As shown in Table 6.1, the five participants namely C1; C2; C3; C4 and C5 were aged between 18 to 26 years old. C1 and C2 were college students; C3 was an interior designer while both C4 and C5 were administrative persons. All participants in this group claimed that they were bodily and mentally fit, and not suffering from any chronic or acute illness. C1, C2 and C5 were using right hand as their dominant hand whereas C3 and C4 were left-handed.

All participants were having normal and healthy BMI, except C2 who was slightly overweight but not up to the extent of obesity. The past research concerned that an increased BMI is proportional to decreased sleep quality (Kalak et al., 2015 and Taheri et al., 2004). The study of Vargas, Flores, & Robles (2014) also reported that 51% of the college students who had BMI ≥ 25 were poor-quality sleepers (PSQI > 5). Accordingly, the BMI of participant C2 will potentially have minor effect to sleep quality.

Table 6.1: The participants' personal information.

PERSONAL INFORMATION	PARTICIPANTS				
Sample participant:	**C1**	**C2**	**C3**	**C4**	**C5**
Sex:	Female				
Age:	18	25	26	22	20
Dominant hand:	right	right	left	left	right
Occupation:	S	S	W	W	W
Weight (kg):	54	65	63	48	44.5
Height (cm):	160	150	164	158	155
Body Mass Index (BMI):	21.1	28.9	23.4	19.2	18.5
Legend: **S = university/ college student** **W = white collar worker**	**BMI Categories:** Underweight = <18.5 Normal weight = 18.5–24.9 Overweight = 25–29.9 Obesity = BMI of 30 or greater				

6.3 Location of Experiment

Due to ethical principles in research with human participants (detailed in section 3.6.2), the selected location of experiments for the participants' is their existing accommodation – an intermediate linked house with controlled environment. The location of experiment for the five (5) participants is situated in a crowded city, Petaling Jaya as shown in Figure 6.2. According to Form School *Feng Shui*, when there is a hill or mountain within 10km radius from the living place (Yap, 2006b), the inhabitant of the place may accept favourable *Qi* generated from the mountain. The selected experimental location is therefore located in the favourable external *Feng Shui* condition, as Bukit Kiara - the Black Tortoise Mountain is within 10km radius from the spot of experiment (see Figure 6.2). As reviewed before the experiment commenced, the main entrance of the experiment location was also not threatened by unfavourable *Feng Shui* elements such

as electrical pylons and poison arrows. The requirements for external conditions of location of experiment as stated in section 3.6.2 were fulfilled.

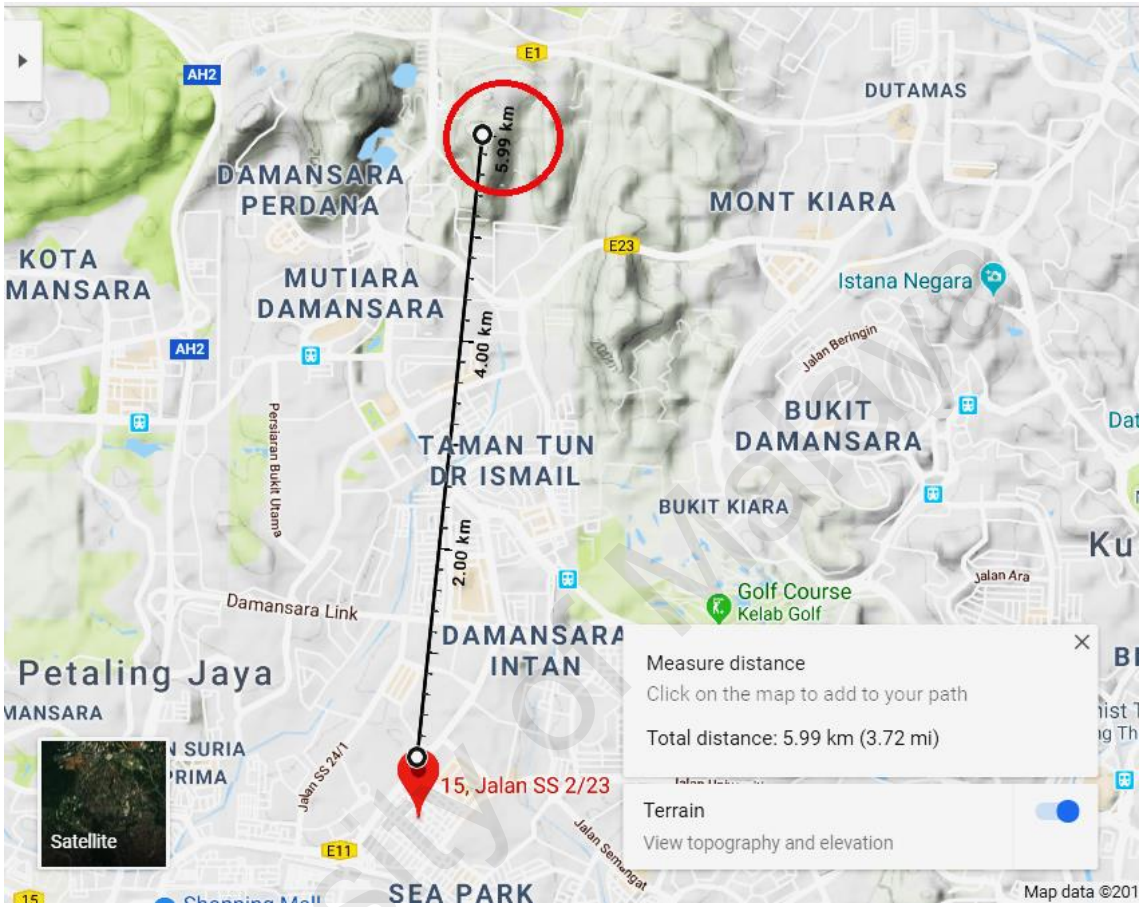


Figure 6.2: External landform around the experiment location – Mont Kiara is the Black Tortoise Mountain of the experiment location and located just within 6 kilometres from SS2 area.

Source: Adapted from Google map (n.d.).

After reviewing the external conditions of the house of experiment, the bedroom condition is reviewed subsequently. According to ancient Chinese Feng Shui, there are no records on how crucial the bedroom entrance facing direction will affect its interior *Feng Shui* based on Form School analysis. There are only strong emphases on house entrance facing direction as it can direct either favourable or harmful *Qi* from the external to the building internal including bedrooms. If a house entrance is facing a favourable

direction, it couldn't have all bedrooms' entrance facing the same direction in the same house. *Feng Shui* followers only choose the favourable direction for their house entrance and ready-made houses are having different bedroom entrance facing directions which are not under controlled. Consequently, the factor of bedroom entrance facing direction is not considered for all experiments.

Table 6.2: Bedrooms details and external conditions for the selected experiment location.

DETAILS OF EXPERIMENT LOCATION	BEDROOM 1	BEDROOM 2
Occupants:	C1, C2 & C3	C4 & C5
Room area:	19.43 m^2	12.70 m^2
Room shape:	L-shape	rectangle
Window dimension:	1680 x 1200mm	2240 x 1200mm
Address of experiment location:	Jalan SS2/23, Petaling Jaya, Selangor.	
House facing direction:	South West	
Bed dimension:	910 x 1910mm	
Door dimension:	900mm x 2100mm	
Surrounding Feng Shui criteria:	a) Within 10km radius from Bukit Kiara b) No visible electricity pylon c) No poison arrow pointing to the house/ building entrance	

Table 6.2 shows the overall bedrooms details and external conditions for the selected experiment location in SS2 residential area in Petaling Jaya. The participants have been accommodating in the same house for some years and their bedrooms were located at the first floor of the residential unit. The house main entrance is facing southwest as per detailed in Table 6.2 and Figure 6.3 - the satellite view. C1, C2 and C3 were sleeping in bedroom 1 while C4 and C5 were residing bedroom 2, next to bedroom 1. Bedroom 1 and bedroom 2 were not same in physical size and shape. Room 1 was 19.43m^2, L-shaped

(excluding the attached bathroom) and equipped with 3 panes louvered windows. Room 2 was 12.70m^2 in rectangle shape, with 4 panes louvered windows and a door sized 900mm x 2100mm. All beds were in standard single size (910mm x 1910mm).

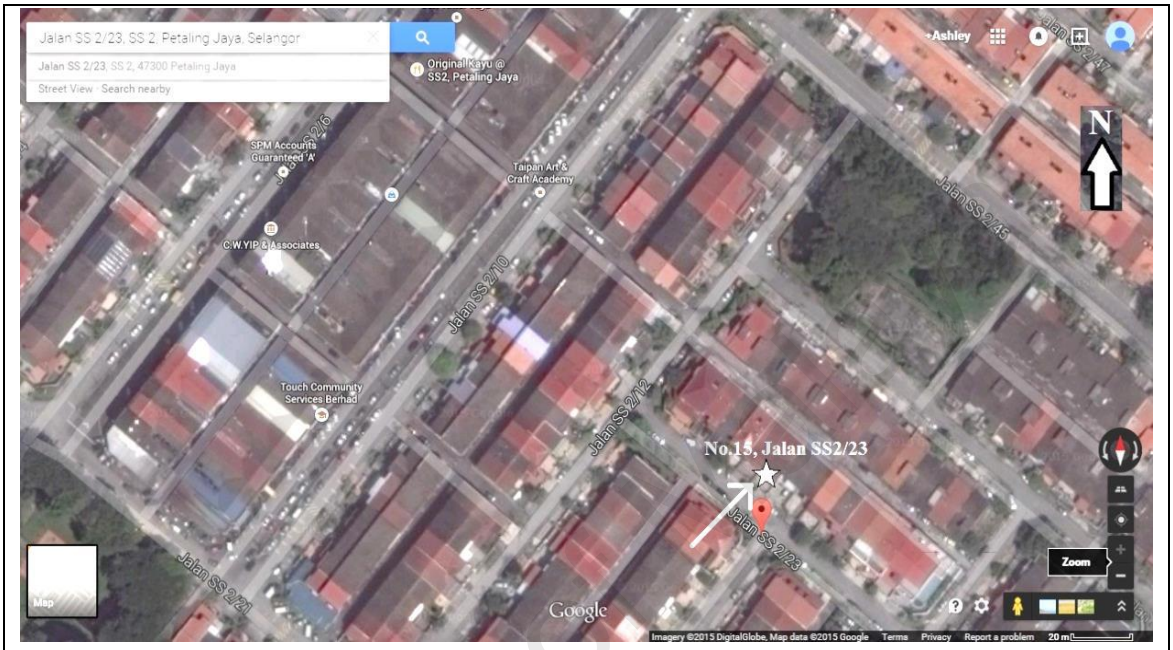
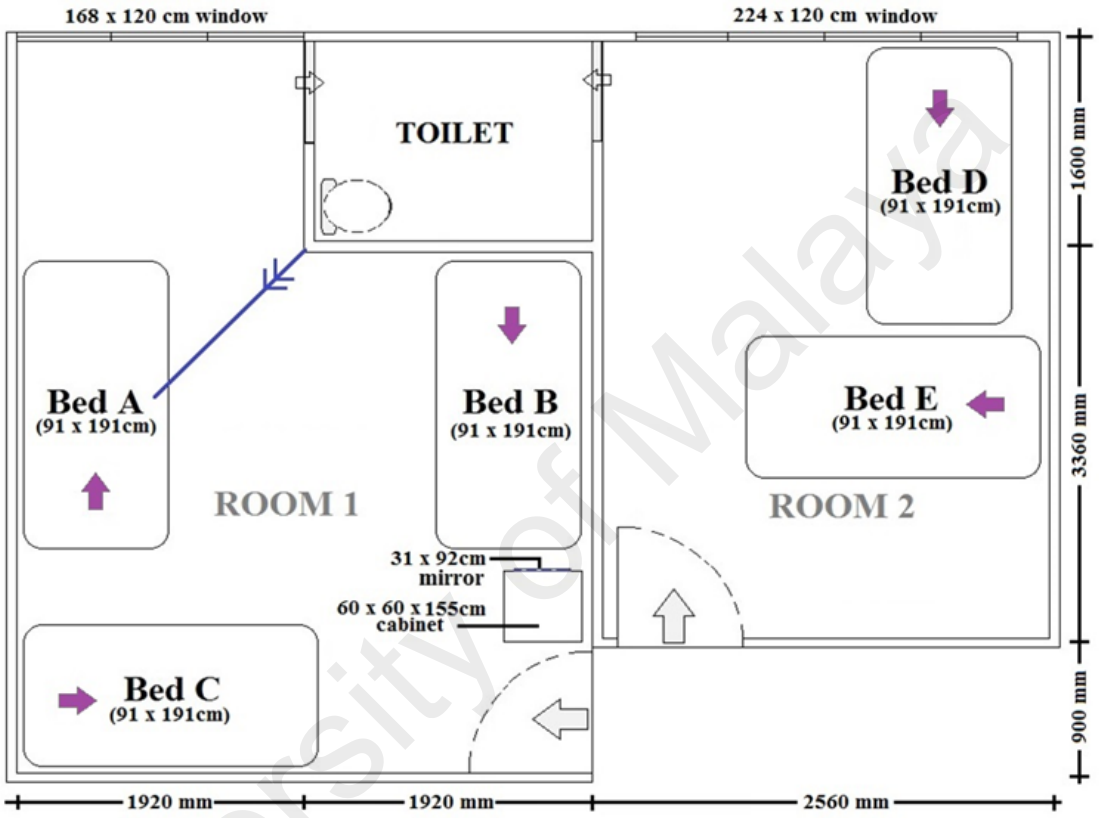


Figure 6.3: Satellite view of experiment location, an intermediate unit in SS2 residential area. The house main entrance is facing southwest. (Google map, n.d.).

As mentioned in section 3.6.2, the original setting of the participant's existing bedrooms is remained unchanged except the test variables – five (5) different predetermined bed arrangements. Figure 6.4 demonstrates the predetermined bed arrangement (Bed A to Bed E) inside the experimental bedrooms of the young female group based on the five *Feng Shui* rules in bed arrangement. The sleep experiments have been carried out in these bedroom settings following the sleep arrangement rotation chart as discussed in Table 3.5. All participants have been monitored to obey the experiment design and procedures in section 3.6.4. They were all required to sleep at one (1) type of conditioned bed arrangement every single week and complete the sleep assessment of the five stated bed arrangements along the five (5) weeks of research period. The sleep

environments were controlled with constant air-conditioning temperature at 24°C (the most satisfactory operative temperature proven by Zhang, Cao and Zhu, 2018) along the sleep assessment period. The number of existing roommates was unaffected in both Bedroom 1 and Bedroom 2.



Legend:

Bed A - Pointed by sharp angle | Bed B - Facing to mirror | Bed C - In line with door

Bed D - Backed by window | Bed E - Backed by wall | Head facing direction

ROTATION CHART FOR PARTICIPANT'S SLEEP ARRANGEMENT

PARTICIPANTS	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5
C1	BED A	BED B	BED C	BED D	BED E
C2	BED B	BED C	BED D	BED E	BED A
C3	BED C	BED D	BED E	BED A	BED B
C4	BED D	BED E	BED A	BED B	BED C
C5	BED E	BED A	BED B	BED C	BED D

Figure 6.4: The bedroom layout and weekly sleep arrangement of young female group in SS2 residential area.

6.4 Daily Sleep Logs

Individual sleeping diaries have been collected from all participants upon the completion of the experiments. There were no missing sleep logs for the reason that the author monitored the completion of diaries every single day during the period of experiment. The recorded bedtime and wake time in sleep logs were perfectly matching with the sleep actigraphy records. There were minimal records of daily activities that may affect the participant's emotion or bodily condition which have chances to affect the whole sleep measurement process. However, none of these records provided information for more than five (5) consecutive days and hence did not show major implications to the experiment results. The stated minimal records in sleep logs were incorporated into the Sleep Epoch Summary in Appendix XI, showing the daily activities with marked symbols. The following sections will discourse the associated sleep logs records when an unexpected sleep indicator is detected in data analysis. Relationships between the sleep logs data and unusual sleep indicator shall be identified.

6.5 Sleep Epoch Record

The experiments were running smooth during the selected period. It was so fortunate that there were no missing sleep epoch record either due to failure during initialization, download or technical malfunction of the devices. No participants withdrew from the study and all sleep records were fully collected. A total of 57,029 epochs of 60 seconds were scored either sleep or wake using Cole-Kripke algorithms. The Cole Kripke algorithm was derived from research performed by Roger Cole, and Daniel Kripke in the technical note *Automatic Sleep/Wake Identification from Wrist Actigraphy* (Cole, et al., 1992). It is predominantly used to score adult populations while Sadeh algorithm is mostly used for children or younger adolescents (Actigraph Support Knowledge Base, n.d.).

The mean of total recording time (TRT) is 345 epochs per night, indicating average sleep duration (excluding afternoon nap) per night is 345 minutes (5 hours 45 minutes) for the group. These data demonstrating poor sleep duration at night for the group. In total, each wrist actigraph was worn for mean of 33 nights with standard deviation (SD) wear-time of 18.34 min/night between bedtime and wake up time.

Table 6.3: The weekly sleep epoch distribution for the group (C1 – C5).

Bed Arrangement	Sleep Epoch (based on 60-second epoch)					Mean
	C1	C2	C3	C4	C5	
Backed by window	*2529*	*2447*	*2413*	*1745*	*1995*	2462
In line with door	*2886*	*2473*	*2238*	*2376*	*2180*	2427
Facing to mirror	*1822*	*2444*	*1831*	*2513*	*2686*	2372
Pointed by sharp angles	*2830*	*2480*	*2521*	*1880*	*2547*	2452
Backed by wall	*2254*	*1977*	*2059*	*1533*	*2370*	2292
Total recording nights:	33	34	33	31	34	34
Total epoch:	12321	11821	11062	10047	11778	12005
Mean epoch/ week:	2464	2364	2212	2009	2356	2401
Mean epoch/ night:	373	348	335	324	346	353

Table 6.3 shows the distribution of recorded weekly sleep epoch for the five (5) individual participants. The group generally scored low average sleep epoch (345 epochs) per night as compared to the minimum sleep hours of 6. Apparently, this group of participants were categorised as sleep deprived young adults, or some of them may be habitual short sleepers (< 6 hours habitual bedrest duration - HBD). According to Klerman & Dijk (2005), the ideal sleep hours of young adults are around 7 to 9 hours. However, University Health Center (2015) reported that College students are generally sleeping less, with an average record of 6 - 6.5 hours of sleep per night. A survey carried

out by National Sleep Foundation (2005) found out that college/university-aged students only get an average of 6.7 hours of sleep each night as they are facing stress of different dimensions particularly from overloaded academic activities and social activities. Since young adults are almost having similar trend of lifestyle, consequently sleep deprivation is common among them. It is acceptable and logical that they 'habitually' sleep less than the exact hours they supposed to sleep as habitual short sleepers and long sleepers do not differ with respect to the homeostatic sleep regulatory mechanisms (Aeschbach, Cajochen, Landolt, & Borbely, 1996).

6.6 Sleep Efficiency (SE)

Sleep efficiency refers to the percentage of time in bed (TIB) that is spent sleeping, or in another word the sleep-ratio of total sleep time (TST) to time in bed (TIB) or Total Recording Time (TRT). The formula of Sleep Efficiency Index is simplified as below:

Total Sleep Time (TST) ÷ Total Recording Time (TRT) x 100%

The sleep efficiency index provides visible data for sleep-wake ratio as the time not spent for sleeping is the period of awake within the time in bed.

6.6.1 The Group Results

Figure 6.5 present the examinees' sleep data for average sleep-wake ratio per 100 minutes, activity count and the vector magnitude of activity along the sleep recording period for the group. The figure is to be read in conjunction with Table 6.4, Table 6.5 and Table 6.6.

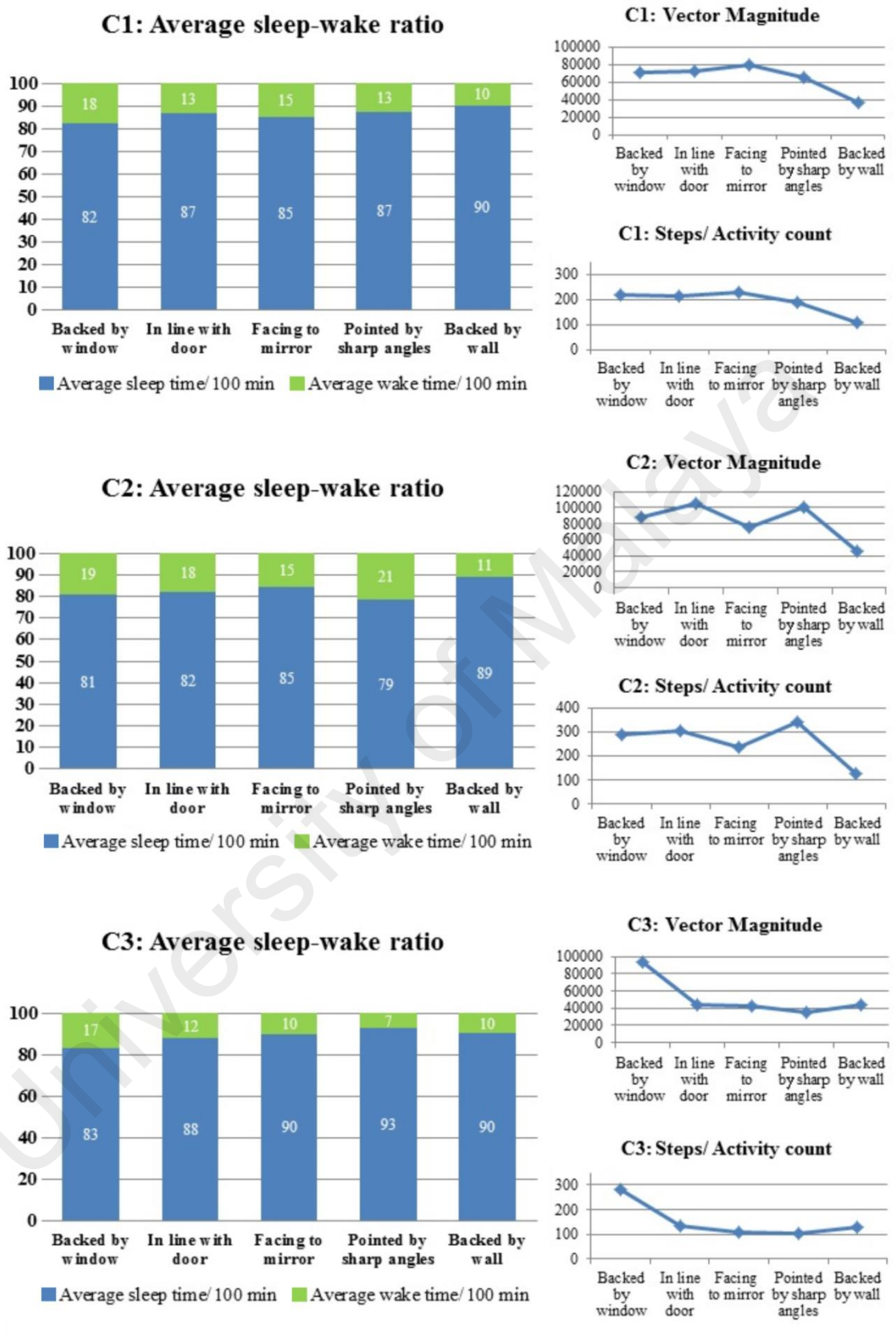


Figure 6.5: The average sleep-wake ratio per 100 minutes, total activity count and total vector magnitude of movement based on different bed arrangement for the examinees.

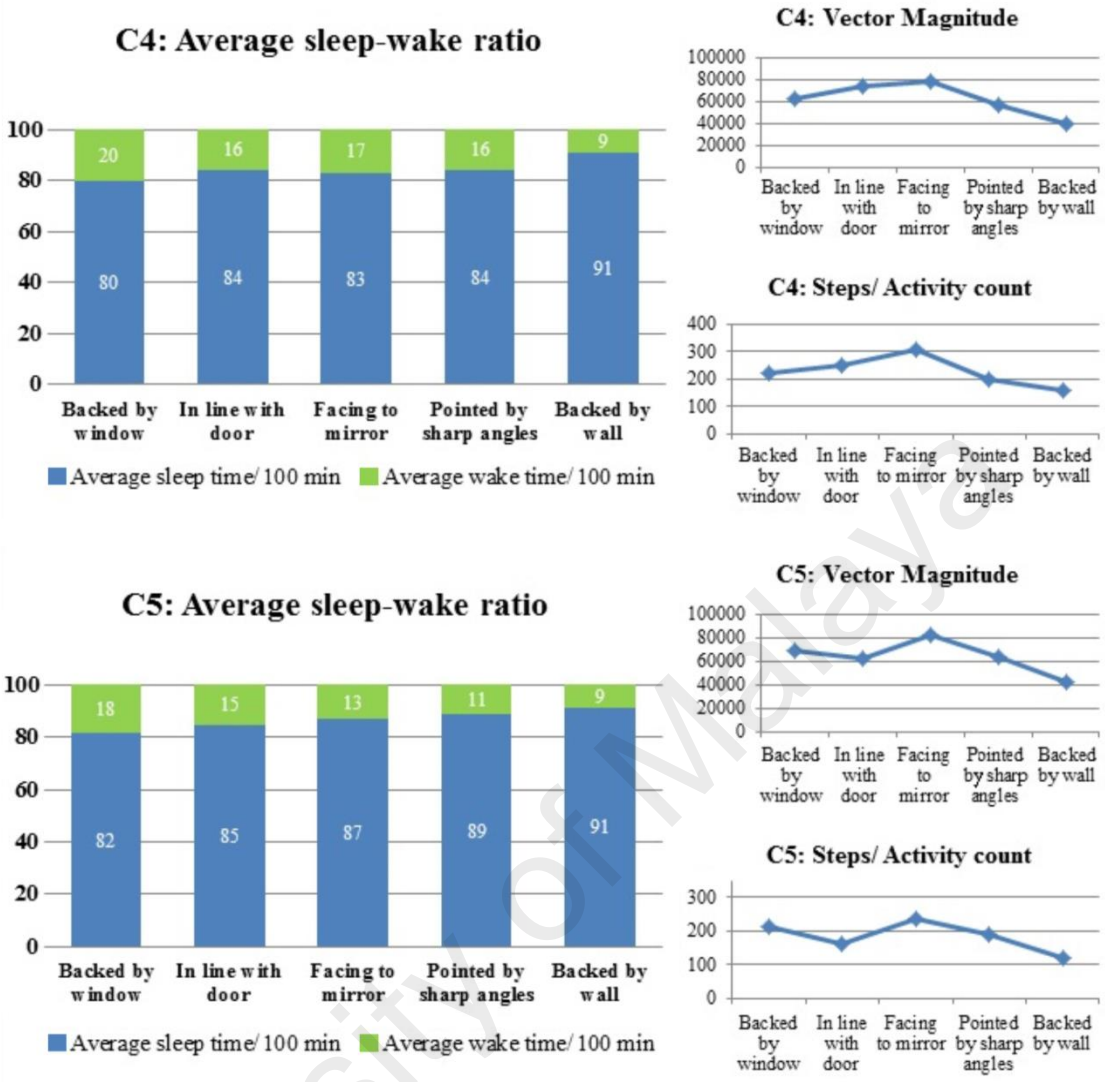


Figure 6.5: The average sleep-wake ratio per 100 minutes, total activity count and total vector magnitude of movement based on different bed arrangement for the examinees (cont'd).

Table 6.4: The comparison of weekly sleep efficiency based on different bed arrangement for different individual.

Bed Arrangement by week	Weekly Sleep Efficiency (%)					Mean (%)	Standard Deviation
	C1	C2	C3	C4	C5		
Backed by window	82	81	83	80	82	81.60	1.14
In line with door	87	82	88	84	85	85.20	2.39
Facing to mirror	85	85	90	83	87	86.00	2.65
Pointed by sharp angles	87	79	90	84	89	85.80	4.44
Backed by wall	90	89	93	91	91	90.8	1.48
X = sleep efficiency < 85%, poor sleep quality.							

Table 6.5: The comparison of weekly activity count based on different bed arrangement for different individual.

Bed Arrangement by week	Weekly Activity Count					Mean (%)	Standard Deviation
	C1	C2	C3	C4	C5		
Backed by window	215	287	282	221	215	244	37.05
In line with door	211	303	136	251	163	213	67.23
Facing to mirror	226	236	110	306	237	223	70.88
Pointed by sharp angles	187	341	102	200	191	204	86.02
Backed by wall	107	124	127	160	119	128	19.71

Table 6.6: The comparison of weekly vector magnitude of movement based on different bed arrangement for different individual.

Bed Arrangement by week	Weekly Vector Magnitude of Movement (N)					Mean (%)	Standard Deviation
	C1	C2	C3	C4	C5		
Backed by window	70951	88438	93497	61746	69169	76760	13540
In line with door	72808	104589	43842	73529	61997	71353	22113
Facing to mirror	79350	75057	42867	77543	81491	71262	16048
Pointed by sharp angles	65578	100270	35715	56742	63515	64364	23293
Backed by wall	36448	44893	44533	39951	41959	41557	3494

As shown in Table 6.4, the data indicates majority of the participants attained their most efficient sleep (average SE = 90.8%) in the week they slept with solid wall as back support, without any other direct interruptions from door, window, sharp angle and mirror threats. The mean of weekly sleep efficiency for this particular bed arrangement was 90.8% for the group and this data has high reliability as the standard deviation is one of the lowest at 1.48.

Conversely, most of the participants experienced their least efficient sleep in the week they slept with an opened window behind the bed head. The average weekly sleep efficiency for this particular bed arrangement was only 81.60% for the group, indicating low sleep efficiency (< 85%) according to the studies in Buysse, et al. (2006) and Øyane & Bjorvatn, (2005). The data revealed the severity of having such bed arrangement will decrease individual sleep quality. This data had high reliability as the standard deviation is the lowest at 1.14.

The mean SE of sleeping in line with door, threatened by mirror and sharp angles were very close between 85%-86%. Nonetheless, the level of dispersion for the bed arrangement pointed by sharp angles was the highest. This was due to examinee C2 was heavily stressed by coursework submission in that particular week for a period of 3 days as per the sleep diary records in Sleep Epoch Summary in Appendix XI.

There are more detailed data about the involved daily vector magnitude, movement steps, sleep-wake ratio and minor sleep diary record demonstrated in the Sleep Epoch Summary for all participants in Appendix XI.

Table 6.5 and Table 6.6 show the average activity count and average vector magnitude of movement per week. Concurrently, both data were presenting the lowest count for the arrangement ‘backed by wall’. These results revealed there were minimum number of awakening and movements in average while the examinees were sleeping with a solid wall as the back support. In addition, sleeping ‘backed by window’ was again indicated

as the most disruptive arrangement as majority slept at this position encountered the highest count of movements and the greatest vector magnitude. Both graphs line for activity count and vector magnitude were somehow parallel to each other for all participants.

Although there were different individual practising the same bed arrangement in the same bedroom scenario; the results strongly supported that sleeping with a solid wall behind our bed head (mean SE = 90.8%) can boost total sleep time (TST) while sleeping with an opened window behind our head can worsen sleep efficiency (mean SE = 81.6%) by 9.2%.

The bed arrangements such as 'in line with door' and 'threatened by mirror' were somehow potential disruptions to sleep efficiency but the consequences are not as serious as the arrangement to sleep with an opened window behind the bed head. In compare to the arrangement of 'backed by wall', the results revealed the degradation of average weekly SE at 4.8% to 5.6% when sleeping 'in line with door', 'threatened by sharp angles' and 'threatened by mirror'. There were very petite in SE differences among the 3 bed arrangements.

6.6.2 Summary of Results

In summary, the experiments have successfully validated the five bedroom *Feng Shui* rules with consistent results. *Feng Shui* rules in bed arrangement undeniably contain robust scientific basis which is not merely an art or superstitious. The statistical significance of each bedroom *Feng Shui* rule from the experiment results indicates the important value of Chinese *Feng Shui* thoughts established for more than 3000 years ago. The results also verified the theory of *Yin & Yang* where the bed leans more towards *Yin* energy (solid wall) and simultaneously not in line with the *Yang* elements such as door, window; mirrors and sharp angles. Besides the human preferences and architects' design

perceptions in bed arrangement; the human actual sleep efficiency as discussed in this section has correspondingly supported these *Feng Shui* rules to be a complement to comprehensive set of interior design protocol in bedroom.

6.7 Pittsburgh Sleep Quality Index (PSQI)

For the collection of weekly PSQI survey, there were two participants did not complete the minor sections of survey. Participant C4 did not record the "conditions of bed partner or roommate" for five weeks. Besides, C1 and C4 did not estimate the minutes they took to fall asleep each night for most of the weeks (although it was traceable in sleep actigraphy data). After further clarifications, the participants recalled and reconfirmed the missing records with roommates and subsequently resubmit the survey sheets. Consequently, the resubmission of survey sheets showed robust confirmation on their answers in "conditions of bed partner or roommate" and the records of "estimated time to fall asleep".

Based on the collected data from weekly PSQI survey, a summary of total sleep scores for each participant along the 5 weeks of experiments was presented in this section. The total sleep scores were calculated based on Pittsburgh Sleep Quality Index (PSQI) scoring method, delivered from the six sleep components namely: subjective sleep quality, sleep disturbances; use of sleeping medication; daytime dysfunction; habitual sleep efficiency and sleep duration.

Subjective sleep quality refers to the examinees' appraisal of their sleep quality instead of using an instrument to quantify sleep quality. Unlike the 'sleep disturbances' stated in PSQI, the sleep disturbances measured in this survey refers to both bodily and environmental interference with sleep including factors such as emotion, illness; noise; excess heat or cold and third party movement. The survey carry such a way to define sleep disturbances is because all these factors have had chances to impede or improve the

examinees' sleep quality other than the test variables - bed arrangement. The use of sleeping medication was referred as the intervals they were taking medicine (prescribed or "over the counter") to help them to sleep, including narcotics used to relieve pain, paracetamol; cough and flu relief; certain antianxiety medications and certain antidepressants. Daytime dysfunction was defined as the troubles of staying awake in daytime activities including eating, driving and social activities. Habitual sleep efficiency refers to the usual time in bed that is spent sleeping while sleep duration refers to the hours of actual sleep per night.

Sleep onset latency was not taken into account as one of the sleep components in the scoring system. This is due to the responses for the section of 'sleep onset latency' in the weekly self-reported survey was mostly uncompleted. Even the section was filled by some of the participants, their estimation on sleep latency were imprecise compared to the actigraphy movement detection. Supportively, Tryon (2004) indicated that sleep logs can overestimate sleep latency but actigraphy usually underestimates sleep latency, in addition to Cole, et al. (1992); Martin and Hakim (2011) and Sadeh (2011) statement about actigraphy has low validity on the estimation of sleep latency. As a result, without prejudice the author decided not to consider the component 'sleep onset latency' from the sleep scoring system, ensuing only six sleep components tested in the survey.

As designated in the sleep scoring instruction in Appendix VI, the total Global sleep score is equal to the summation of all six component scores together. Since the score value for each component is 0 to 3, the minimum total Global score is 0 while the maximum score is 18. Any participant scores > 5 demonstrating he/ she has poorer sleep in the week with particular bed arrangement.

6.7.1 The Group Results

Figure 6.6 presents the PSQI sleep scoring distribution across different bed arrangements for all participants. This figure is to be read in conjunction with Table 6.7. The total PSQI score from the sum of six components scores in the area graphs defined whether an examinee was having good (scores $\leq$ 5) or poor (scores > 5) sleep quality over the week.

According to Figure 6.6, participant C1 scored the highest in the week while sleeping 'backed by window' (score = 5); representing she had the poorest sleep while having an opening behind her head. The weeks that she was sleeping with 'mirror threats', 'sharp angle threats' and 'solid wall as back supports' were equal in scores (score = 4). In opposition to the common results, the graph of C1 shows the lowest score in the week for sleeping 'in line with door' (score = 3), indicating she had the best sleep in such bed arrangement. C1 encountered some minor sleep disturbances; consistently for five weeks along the sleep experimental period. She claimed that she had 'fairly bad' sleep quality in the week while sleeping with 'sharp angles threats', and had 'fairly good' sleep in the leftover weeks. She did not consume any medication to assist in sleep along the sleep recording period. Daytime dysfunction was slightly a problem for C1 during the weeks she slept 'backed by window', 'threatened by mirror' and 'backed by wall'. There was no dysfunction problem occurred in the weeks for 'in line with door' and 'pointed by sharp angles'. Although C1 had average sleep duration below 7 hours, the sleep efficiency was considered good (SE $\geq$ 85%) for all weeks except for the week while she was sleeping 'backed by the window' (75% $\leq$ SE < 85%).

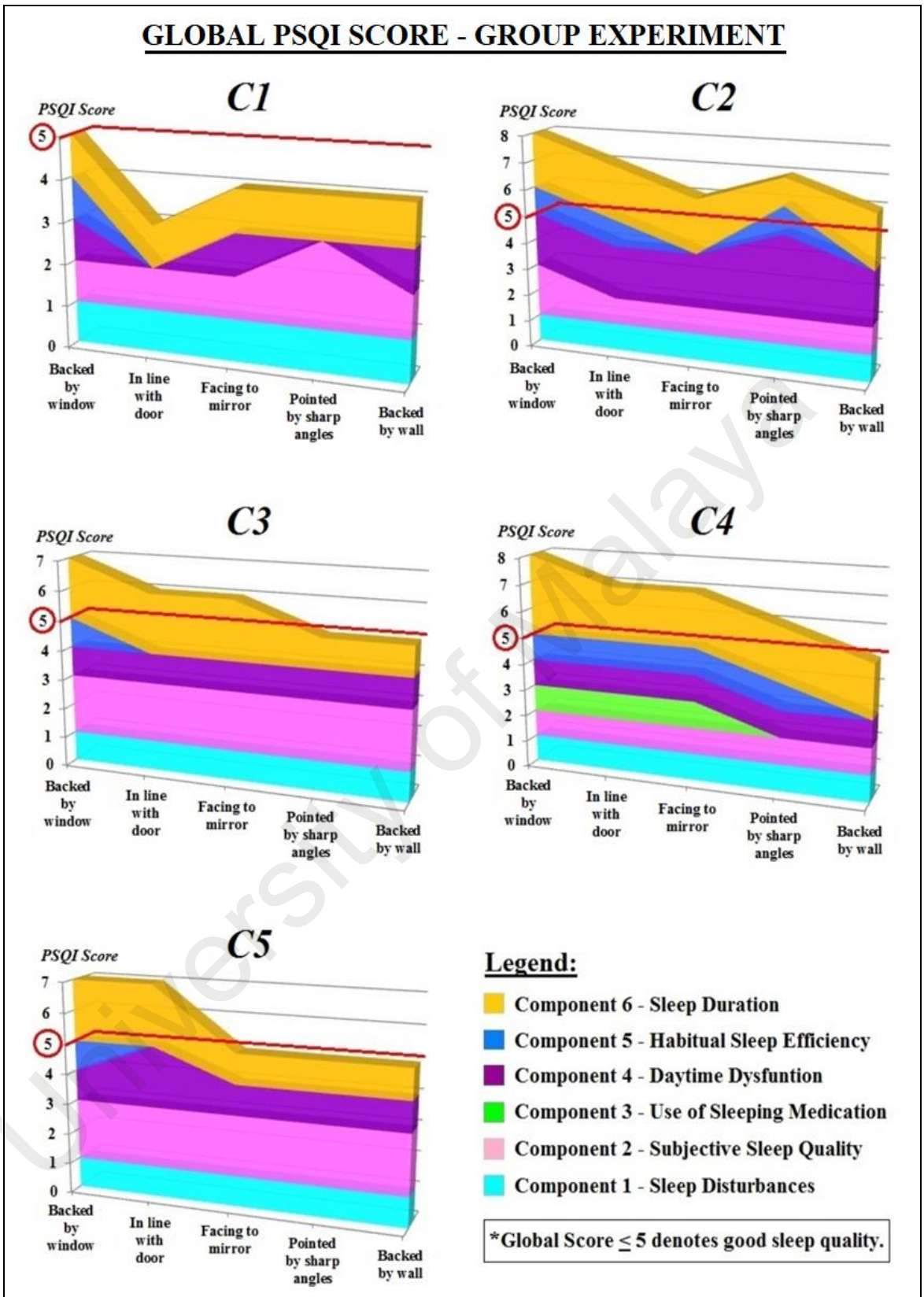


Figure 6.6: Sleep scoring distribution based on Pittsburgh Sleep Quality Index across different bed arrangements for the participants (C1 to C5).

The stacked area graph for C2 shows that she had the poorest sleep in the week while sleeping 'backed by window' (score = 8). The weeks that she was sleeping 'in line with door' and 'pointed by sharp angle threats' were equal in scores (score = 7). The graph shows the lowest score in the weeks for 'facing to mirror' and 'backed by solid wall' (score = 6), indicating these bed arrangements encouraged better sleep quality. Nonetheless, C2 is generally a poor sleeper as she scored more than 5 for PSQI in all five weeks. C2 also had having minor sleep disturbances consistently for five weeks along the sleep recording periods. She claimed that she had 'fairly bad' sleep in the week for 'backed by window' while the remainder weeks she reported she had 'fairly good' sleep. She did not consume any medicine to assist her in sleeping along the experimental period. Daytime dysfunction was a serious problem for C2 when she was sleeping in the week for 'pointed by sharp angle' as she could not concentrate well for most of the daytime activities. Dysfunction problem were somewhat a problem for C2 in the remainder weeks. Sleep efficiency of C2 was 'good' (SE $\geq$ 85%) in the weeks for 'backed by wall' and 'facing to mirror'. The leftover weeks revealed lower sleep efficiency (75% $\leq$ SE < 85%), i.e. poorer sleep quality. The average sleep duration for C2 was below 6 hours, and it does reveal that C2 was a sleep deprived examinee supported by the high PSQI score along the sleep recording period. The actual factors that leading to her sleep deprivation is undefined.

The stacked area graph for C3 illustrates she had the poorest sleep in the week while sleeping 'backed by window' (score = 7). She also had poorer sleep while sleeping 'in line with door' and 'facing to mirror' (score = 6). The weeks that she spent for 'sharp angle threats' and 'backed by solid wall' were the best in sleep (score = 5). C3 was having little sleep disturbances consistently for five weeks along the sleep recording period. However, she claimed that her sleep was 'fairly bad' consistently for five weeks along the sleep recording period. Besides, she did not consume any pills or practise any sleeping

aids to assist her in sleeping. She came across slight daytime dysfunction problems for all five weeks. The average sleep efficiency was generally 'good' (SE $\geq$ 85%) in all weeks except for the week she slept 'backed by the window' (75% $\leq$ SE < 85%), indicating poorer sleep quality. The average sleep duration for C3 was below 6 hours, but it does not really reflect the examinee's sleep quality as young adults habitually having shorter sleep duration.

C4 scored the highest (score = 8) in the week while she was sleeping 'backed by the window' (see Figure 6.6). The weeks that she spent for 'in line with door' and 'facing to mirror' were equal in scores (score = 7), while the week she spent for 'pointed by sharp angle' was slightly better (score = 6). The results show the lowest score in the week for 'backed by solid wall' (score = 5), indicating she had the best sleep quality in the stated bed arrangement compared to other types of tested variables. C4 was having some minor sleep disturbances for each of the experimental weeks. She also claimed that her sleep was 'fairly good' in all weeks. She took some flu medicine (which may cause drowsiness) in the weeks while she slept 'backed by window', 'in line with door' and 'facing to mirror threats'. C4 encountered minor daytime dysfunction problems equally in every week she spent for the experiments. In addition, she had shorter average sleep duration (5 to 6 hours) compared to the recommended sleep duration. The average sleep efficiency was generally 'not ideal' (75% $\leq$ SE < 85%) for all weeks except the week she slept for 'backed by wall' (SE $\geq$ 85%).

Stacked area graph of C5 (see Figure 6.6) delineates that she had the poorest sleep in the weeks for 'backed by the window' and 'in line with door' (score = 7). The weeks that she was sleeping with 'mirror threats', 'sharp angle threats' and 'backed by wall' were equally good (score = 5), indicating the bed arrangements without direct interaction with room openings are more secure for better sleep. C5 was having minor sleep disturbances consistently for five weeks along the sleep recording periods. However, she claimed that

she had 'fairly bad' sleep in every week along the sleep recording period. She did not consume any medicine to assist her to sleep along the experimental period. There were more times of daytime dysfunction problems happened for the week when she slept 'in line with door', while there were only minor dysfunction problems in the leftover weeks. Sleep efficiency of C5 was described as good (SE ≥ 85%) in all weeks but slightly lower (75% ≤ SE < 85%) for the week she spent for 'backed by window', indicating poorer sleep quality. The average sleep duration for C5 was below 6 hours, but it does not reflect the examinee's sleep efficiency.

Table 6.7: The summarised PSQI scoring distribution across different bed arrangements based on *Feng Shui* Criteria for the group (C1 – C5).

	Weekly PSQI Scoring based on *Feng Shui* Criteria in Bed Arrangement (maximum score per week: 18)					**Individual Cumulative PSQI Scoring/ 5 weeks**
Participants	**V1**	**V2**	**V3**	**V4**	**V5**	
C1	5	3	4	4	4	20
C2	8	7	6	7	6	34
C3	7	6	6	5	5	29
C4	8	7	7	6	5	33
C5	7	7	5	5	5	29
Total Combined Score:	35	30	28	27	25	145
Combined Mean Score:	7	6	5.6	5.4	5	29
Standard Deviation:	1.22	1.73	1.14	1.14	0.71	5.52

Interpretation:

Weekly PSQI score ≤ 5 associated with good sleep quality

> 5 associated with poorer sleep quality

Legend :

V1: Backed by window

V2: In line with door

V3: Facing to mirror

V4: Pointed by sharp angle

V5: Backed by wall

Table 6.7 displays the weekly PSQI scores of all participants, total combined score, combined mean score and standard deviation for PSQI across different bed arrangements based on the tested *Feng Shui* Criteria. The individual cumulative PSQI scores for five consecutive weeks were also presented. The total combined score and combined mean score for PSQI across different test variables (*V1 to V5*) delivered the increase significance of these *Feng Shui* practices in sequence, from the highest score (V1) to the lowest score (V5). A poorer individual sleep quality is happened when the combined mean score is more than 5 and this is apparently happened to V1 (backed by window), V2 (in line with door), V3 (facing to mirror) and V4 (pointed by sharp angle). Therefore, on average, good sleep quality is highly associated with bed arrangement (V5) that is backed by solid wall (without direct connection to room openings) with the combined mean score of 5 of lower. Besides, a smaller standard deviation for V5 as shown in Table 6.7 reflects the data are clustered closely around the mean and therefore more reliable.

From the individual cumulative PSQI scores perspective, the assessment of individual sleep quality across different tested Feng Shui Criteria revealed the sleep quality of the group were generally poor, except C1. The results is especially pointing to C2 and C4 who have scored much higher than the stated PSQI benchmark (scores > 5: poor sleep quality) in majority of the weeks. As discussed in section 6.2, C2 was slightly overweight and she might experience poorer sleep quality compared to the participants who have normal BMI. The assessment of weekly PSQI in this section has proven her sleep quality evidently by the highest cumulative score of 34. Besides, C4 was observed as a poor sleeper (cumulative PSQI score = 33) during the experiment period except the week she slept with arrangement V5 – backed by wall. The response of C5 to room openings was observable. Her sleep quality was potentially influenced by the location and distance between the bed and the room openings. The interaction between door and window and

the bed became the major concern and hence sleeping in line with door and backed by a window were not recommended.

On the other hand, sleeping facing to mirror threats (V3) and sharp angle threats (V4) were somehow not encouraged based on the results as shown in Table 6.7. Participants such as C2, C3 and C4 shows minor reactions in the PSQI scores for V3 and V4 in compared to V5. However, there were also participants who had shown consistency of PSQI score while sleeping in V3, V4 and V5. This implied that sleeping facing to mirror and sharp angle were not certainly a major threat to better sleep but it is always not an ideal practice in most of the conditions. In such a case, the author would like to further investigate if there are some potential hidden factors that shall be identified but probably missed out.

6.7.2 Summary of Results

In summary, the PSQI sleep scoring distribution among the five (5) examinees was somehow consistent based on the analysis by bed arrangement. Consequently, the overall PSQI results supporting to *Feng Shui* conception in bed arrangement, i.e. sleeping 'in line with door' and 'backed by a window' were not recommended for better sleep quality. Bed arrangement with solid wall as back supports (V5) was remained as the most comfortable arrangement for sleep. As a result from the conducted sleep experiments, analysis of mean PSQI scores and mean SE Index denoted corresponding relationships for the significance order of the tested *Feng Shui* rules. Both analyses supported V5 as the most ideal Feng Shui practice and V1 and V2 as the less ideal Feng Shui practices.

6.8 Additional Validation for Group Experiment

Based on the results presentation and discussions for the completed group experiments in the previous sections, an additional sleep experiment for validation was conducted. The experiment was carried out for the purpose to reinforce the group experiment outcomes which were somehow not consistent for a few tested Feng Shui variables such as sleeping with mirror threats and sharp angle threats.

The validation was initiated with the finding of one (1) suitable examinee to carry out the similar sleep experiment by sleep actigraphy for a period of 35 nights, in a single room. All other experiment settings such as sampling method, the use of experiment tools (wrist actigrapghy, daily sleep log and weekly PSQI survey), experiment design and procedures and data analysis method (from section 3.6.1 to section 3.6.5) were required to be the same with the group experiments.

6.8.1 Selection of Participant and Experiment Location

Table 6.8: The personal information of S1.

PERSONAL INFORMATION	PARTICIPANTS
Sample participant:	**S1**
Sex:	Female
Age:	19
Dominant hand:	right
Occupation:	College Student
Weight (kg):	54.5
Height (cm):	160
Body Mass Index (BMI):	21.3
BMI Categories:	*Underweight = <18.5* *Normal weight = 18.5–24.9* *Overweight = 25–29.9* *Obesity = BMI of 30 or greater*

A young female adult was convinced to participate in the sleep experiment. Table 6.8 recorded the participant's personal information. The participant, *S1* was a 19 years old college student. She claimed that she was bodily and mentally fit, and not suffering from any chronic or acute illness. She was using right hand as her dominant hand. The participant was having normal and healthy BMI at 21.3 and therefore the results of sleep quality assessment will not be affected by this factor.

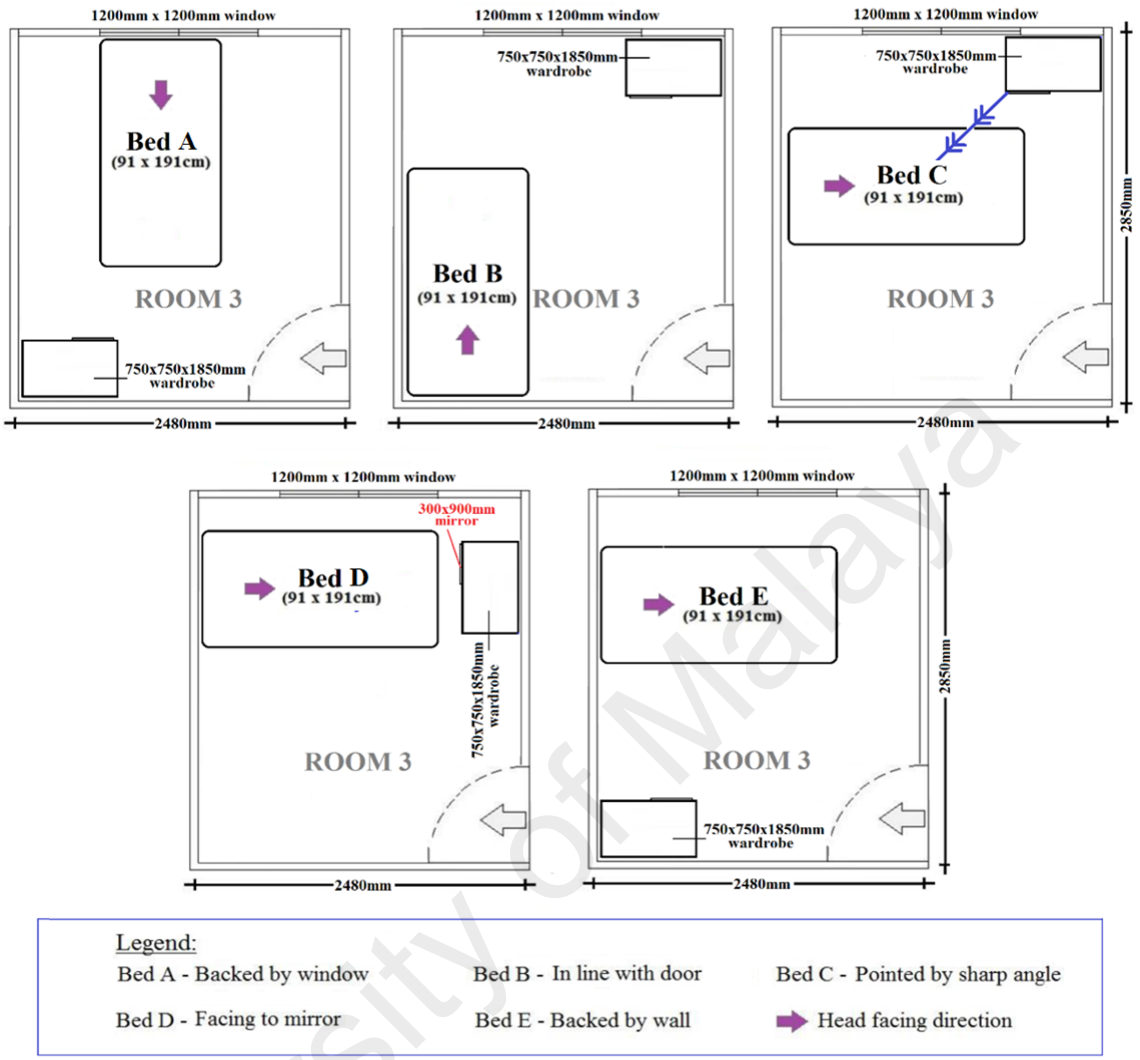
The experiment location for the single participant was her existing accommodation, situated in SS2 residential area in Petaling Jaya. The house main entrance is facing southwest. It was the same intermediate linked house that the group experiments were conducted. For that reason, the *Feng Shui* condition of the single-person experiment location was considered favourable with the Black Tortoise Mountain support which is about 6km away and free from electrical pylons and poison arrows threats near the main entrance. The entire external environment was well controlled and has fulfilled the requirements as stated in section 3.6.2.

The bedroom details and the external conditions for the experiment location is outlined in Table 6.9. Based on an informal survey, participant *S1* have been accommodating in the house for 2 years and her bedroom was located at the ground floor of the residential unit. The single bedroom for the experiment is labelled as *Room 3* as illustrated in Figure 6.7. The bedroom was 7.07m^2 in rectangle shape (2.48m x 2.85m), with 2 panes louvered windows and a door sized 900mm x 2100mm. The single bed was in standard size (910mm x 1910mm).

Table 6.9: Bedrooms details and external conditions for the single-person experiment location.

DETAILS OF EXPERIMENT LOCATION	BEDROOM 3
Occupants:	S1
Room area:	7.07 m^2
Room shape:	Rectangular
Bed dimension:	910 x 1910mm
Window dimension:	1800 x 1200mm
Door dimension:	900mm x 2100mm
Address of experiment location:	Jalan SS2/23, Petaling Jaya, Selangor.
House facing direction:	South West
Surrounding Feng Shui criteria:	a) Within 10km radius from Bukit Kiara b) No visible electricity pylon c) No poison arrow pointing to the house/ building entrance

In order to test the five (5) *Feng Shui* variables, *Bedrooms 3* was arranged with different bed arrangement (Bed A to Bed E) from week to week based on the five *Feng Shui* rules. The participant's sleep arrangement was according to the planning as shown in Figure 6.7. During the five (5) weeks of research period, different bed arrangement was prearranged by the author every week. The examinee was required to complete the sleep assessment at one (1) conditioned bed arrangement every single week in the same room. She had first started the experiment with arrangement of Bed A (backed by window) in week 1, followed by Bed B (in line with door) in week 2, Bed C (pointed by sharp angle) in week 3, Bed D (facing to mirror) in week 4 and lastly Bed E (backed by wall) in week 5. The experiment has been well monitored to obey the experiment design and procedures as stated in section 3.6.4. The sleep environment was controlled with constant air-conditioning temperature at 24^{o}C (the most satisfactory operative temperature proven by Zhang, Cao and Zhu, 2018) along the sleep assessment period.



PARTICIPANT	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5
S1	BED A	BED B	BED C	BED D	BED E

Figure 6.7: The bedroom layout and participant's weekly sleep arrangement for single-person experiment.

6.8.2 Daily Sleep Logs

Participant S1 had completed the sleep diaries upon the completion of the experiment. There was no missing record for the reason that S1 has been monitored to complete the sleep logs along the period of experiment. The recorded bedtime and wake time in sleep

diaries were ideally matching with the sleep measurement device records. There were minimal records of daily happenings or bodily condition that may affect the participant's sleep measurement process. These records provided information less than five (5) consecutive days and therefore did not show major implications to the experiment final results. These records in sleep logs were incorporated into the Sleep Epoch Summary in Appendix XI, showing the daily activities with marked symbols. The following sections will discuss the associated sleep logs records when an unexpected sleep pointer is detected in data analysis.

6.8.3 Sleep Epoch Record

The experiment was successfully completed with no missing sleep epoch record either due to failure during initialization, download or technical malfunction of the devices. A total of 14,432 epochs of 60 seconds were scored either sleep or wake using Cole-Kripke algorithms (predominantly used to score adult populations). The mean of total recording time (TRT) for participant S1 is 412 epochs per night, indicating average sleep duration (excluding afternoon nap) per night is 412 minutes (6 hours 52 minutes). It was usual to have a college student (S1) 'habitually' sleep less than the exact hours (7 – 9 hours) they supposed to sleep (National Sleep Foundation, 2005). The wrist actigraph was worn for 35 nights in total without failure.

Table 6.10 shows the distribution of weekly sleep epoch for participant S1 and the prior group (C1 – C5). S1 has scored better sleep epoch (412 epochs) per night as compared to the members in the group experiments (average 345 epochs). The experiment conducted for S1 had been showing good attempts in delivering more reliable data as the preceding sleep experiments conducted in group could have some embedded factors that might affect the individual sleep duration and sleep efficiency.

6.8.4 Sleep Efficiency (SE)

As discussed in section 6.6, sleep efficiency refers to the percentage of time in bed (TIB) that is spent sleeping. The sleep efficiency index indicates the sleep-wake ratio as the time not spent for sleeping is the period of awake within the time in bed.

On top of sleep epoch data, Table 6.10 also present other sleep data of S1, showing her average sleep-wake ratio per 100 minutes, average movement count and average vector magnitude of movement per 60 minutes and per week. These data were also compared with the group experiments data in the same Table. The graphs in Figure 6.8 shall be read in conjunction with Table 6.10.

Table 6.10: The weekly sleep epoch distribution, average sleep efficiency, average vector magnitude and average movement count based on different bed arrangement for S1 and the group (C1 - C5).

Bed Arrangement by Week	Average Sleep Epoch (based on 60-second epoch)		Average Sleep Efficiency (%)		Average Vector Magnitude		Vector Magnitude per 60-minutes		Average Movement Count		Movement count per 60-minutes	
	S1	C1-C5 (Mean)	S1	C1-C5 (Mean)	S1	C1-C5 (Mean)	S1	C1-C5 (Mean)	S1	C1-C5 (Mean)	S1	C1-C5 (Mean)
Backed by window	3304	2226	[76.00]	[81.60]	179313	76760	3256	2069	529	244	9.61	6.58
In line with door	2919	2431	[82.00]	85.20	114000	71353	2343	1761	333	213	6.84	5.26
Facing to mirror	2880	2259	[84.00]	86.00	65368	71262	1362	1893	179	223	3.73	5.92
Pointed by sharp angles	2682	2452	88.00	85.80	65231	64364	1459	1575	177	204	3.96	4.99
Backed by wall	2647	2039	90.00	90.80	61477	41557	1394	1223	170	128	3.85	3.77
Total recording nights:	35	33										
Total epoch:	14432	11407										
Mean epoch/ week:	2886	2281										
Mean epoch/ night:	412	346										

[X] → sleep efficiency < 85% = poor sleep quality.

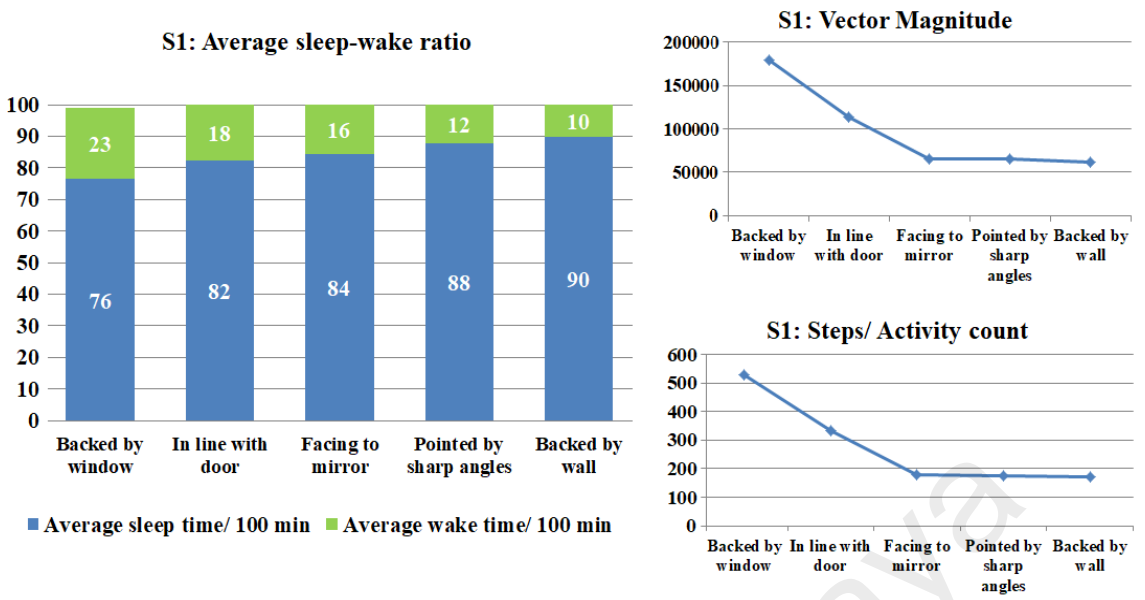


Figure 6.8: The graph of sleep-wake ratio per 100 minutes, average movement count and average vector magnitude of movement based on different bed arrangement per week, for examinee S1.

As shown in Table 6.10, S1 attained her most efficient sleep (average SE = 90.0%) in the week while she was sleeping with solid wall as back support. The result was in agreement with the group experiments (average SE for backed by wall = 90.8%). S1 also experienced her least efficient sleep (average SE = 76.0%) in the week she slept with an opened window behind the bed head, indicating poor sleep quality (SE < 85%) according to the studies in Buysse, et al. (2006) and Øyane & Bjorvatn, (2005). Hence, the result was again in agreement with the group experiments (average SE for backed by window = 81.60%) for this particular bed arrangement. Both results from single and group experiments revealed the severity of not having solid back support in bed arrangement.

Unlike the results for group experiments, the average SE of sleeping in line with door, threatened by mirror and sharp angles were distinguishable for the single experiment (see Table 6.10). Sleeping in line with door was the second least efficient (average SE = 82.0%) sleep arrangement for S1, which is parallel to the group experiment results. For the bed arrangement threatened by mirror and sharp angle, the average SE for S1 was 84.0% and

88.0% respectively. This implied that sleeping facing to mirror has greater impact (by 4.0%) to S1 in degradation of sleep efficiency compared to sleeping threatened by sharp angle. Conversely, the group experiment only showed negligible differences by 0.2%.

The graph in Figure 6.9 illustrates the distribution of average SE record based on the five tested *Feng Shui* variables for participants in both single and group experiments. An additional line of mean record for all participants was inserted in the graph for better analysis. It was visible that the graph line of mean score showed a pattern which was majorly parallel with other participants' SE scores except C2 who had experience vast stresses by coursework submission in the week she slept with 'pointed by sharp angles'.

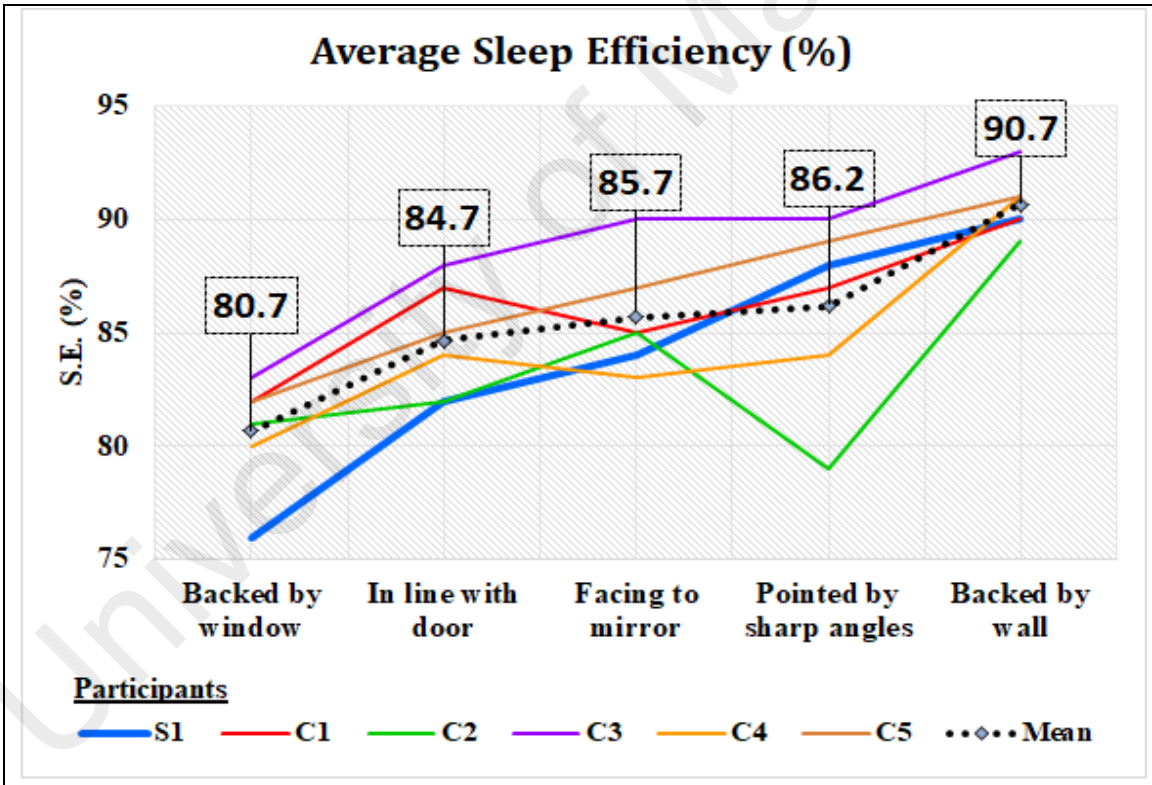


Figure 6.9: The graph of average sleep efficiency based on different bed arrangement for examinees S1, C1, C2, C3, C4 and C5.

Table 6.10 also outlines the data of average movement count and vector magnitude of movement per week, as well as per 60 minutes for S1 and group (C1 – C5). These data were highly associated with the SE results discussed in the previous paragraphs. The results of S1 were presenting the lowest movement count and lowest vector magnitude of movement for the arrangement 'backed by wall'. This was corresponding to the group results that revealed minimum number of awakenings and movement in average while sleeping with the arrangement 'backed by wall'. Again, the highest count of movements and the greatest vector magnitude were observable for the arrangement of 'backed by window' in both single and group experiments, implying that this was the most disruptive bed arrangement. The daily detailed data for vector magnitude, movement steps and sleep-wake ratio for S1 are displayed in Appendix XI - Sleep Epoch Summary.

6.8.5 Pittsburgh Sleep Quality Index (PSQI)

The collection of weekly PSQI survey was successful upon the completion of the single experiment as S1 has completed all required survey on time without any missing response. Based on the collected PSQI survey data, a summary of total sleep scores for S1 was presented in this section. The calculation and analysis of total sleep scores were based on Pittsburgh Sleep Quality Index (PSQI) scoring method, delivered from the six sleep components as discussed in section 6.7. If a participant scores total Global score > 5, he/ she has poorer sleep in the week with that particular bed arrangement.

Figure 6.10 presents the PSQI sleep scoring in a stacked area plot across different bed arrangements for S1. This figure is to be read in conjunction with Table 6.11. The total PSQI score from the sum of six components scores in the area graphs defined whether an examinee was having good (scores ≤ 5) or poor (scores > 5) sleep quality over the week. Based on Table 6.11, participant S1 had the poorest sleep in the week while sleeping 'backed by window' and 'in line with door' (score = 6). The week that she was sleeping

with ‘mirror threats’ (score = 5) was slightly better while the weeks she spent for ‘sharp angle threats’ was much better (score = 3). The best sleep score was obtained in the week she slept with ‘backed by solid wall’ (score = 2), indicating this bed arrangement indeed promoted better sleep quality.

S1 claimed that she had minor sleep disturbances; consistently for majority of the weeks along the sleep experiment period, except the week she was sleeping with V5 – backed by wall. She claimed that she had ‘fairly bad’ sleep quality in the weeks while sleeping with ‘backed by window’ and ‘in line with door’. However, she reported ‘fairly good’ sleep in the leftover weeks. She did not consume any medication to assist in sleep along the sleep recording period. Daytime dysfunction was slightly a problem for S1 except the week she slept with ‘backed by solid wall’ and ‘pointed by sharp angle’.

Although S1 had average sleep duration below 7 hours, her sleep efficiency was considered good (SE $\geq$ 85%) for ‘backed by solid wall’ and ‘threatened by sharp angles’. She claimed that she had less efficient sleep in the weeks while sleeping with mirror threats and in line with door (75% $\leq$ SE < 85%). The least efficient sleep fall on the week she slept with V1 – backed by window. Besides, S1 had her sleep duration which is more than 7 hours on the week she tested on V1 but the total PSQI score (score = 6) remained the highest among all other weeks. With reference to the individual weekly sleep duration, PSQI assessment has identified S1 as a good sleeper unless she was placed to sleep in an unfavourable arrangement such as having the bed without solid back support. Her BMI was very ideal and therefore this is not the issue in affecting her sleep quality.

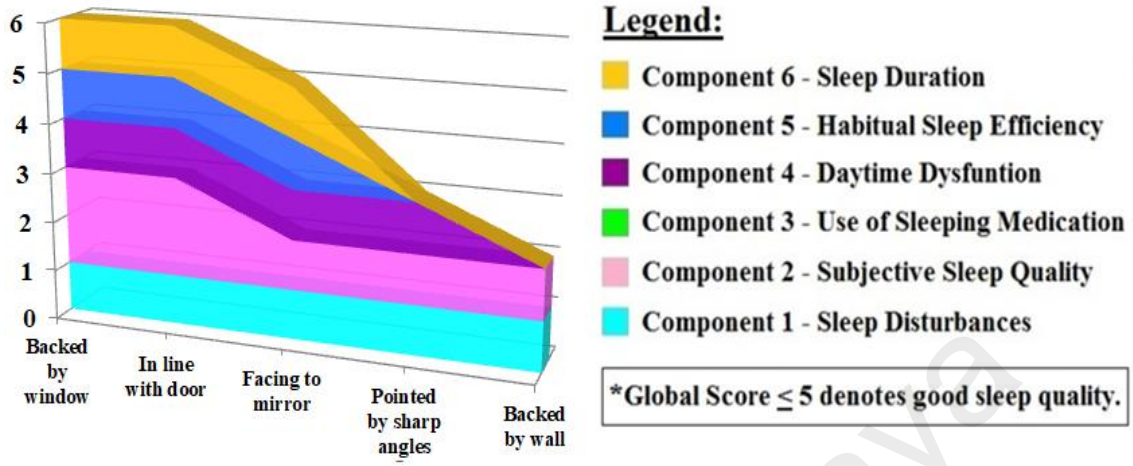


Figure 6.10: Sleep scoring distribution based on Pittsburgh Sleep Quality Index across different bed arrangements for the participant S1.

Table 6.11: The PSQI scoring distribution across different bed arrangements based on *Feng Shui* Criteria for S1.

Participant S1	Weekly PSQI Scoring based on *Feng Shui* Criteria in Bed Arrangement (maximum score per week: 18)				
	V1	V2	V3	V4	V5
Component 1 - Sleep Disturbances	1	1	1	1	0
Component 2 - Subjective Sleep Quality	2	2	1	1	1
Component 3 - Use of Sleeping Medication	0	0	0	0	0
Component 4 - Daytime Dysfunction	1	1	1	0	0
Component 5 - Habitual Sleep Efficiency	2	1	1	0	0
Component 6 - Sleep Duration	0	1	1	1	1
Total PSQI Score:	**6**	**6**	**5**	**3**	**2**

Interpretation:

Weekly PSQI score =
≤ 5 associated with good sleep quality
> 5 associated with poorer sleep quality

Legend:

V1: Backed by window
V2: In line with door
V3: Facing to mirror
V4: Pointed by sharp angle
V5: Backed by wall

In comparison, the PSQI scoring distribution across different test variables (*V1 to V5*) for S1 and the group (see Table 6.7) demonstrated a corresponding trend in identifying the significance of these *Feng Shui* practices in order. The increase significance these *Feng Shui* practices started from the highest score (V1) to the lowest score (V5). Apparently, good sleep quality is highly associated with bed arrangement with solid back support (V5). The interaction between door and window and the bed became the major concern and hence sleeping in line with door (V2) and backed by a window (V1) are always not ideal practices in most of the conditions. Sleeping facing to mirror threats (V3) and sharp angle threats (V4) were somehow not recommended as well although there were not bringing major threats to better sleep.

6.9 Summary of Chapter

Based on the results presentation and discussion for the sleep experiments, the findings of the study were inclining towards achieving the research objectives (iii). The research findings indicated *Feng Shui* rules in bed arrangement have clear implications to sleep efficiency, especially the *Feng Shui* rule with respect to bed head supports. There were apparent differences in SE and PSQI readings among the five tested variables, especially the bed arrangement associated with bed head supports. The results of the single experiment for validation showed even more supportive evident for the stated conclusion.

As a result, *Feng Shui* rules in bed arrangement undeniably contain robust scientific basis which is not merely an art or superstitious. The statistical significance of each bedroom *Feng Shui* rule from the experiment results indicates the important value of Chinese *Feng Shui* thoughts established for more than 3000 years ago. The results also verified the theory of *Yin & Yang* where the bed leans more towards *Yin* energy (solid wall) and simultaneously not in line with the *Yang* elements such as door, window;

mirrors and sharp angles. The arrangements associated with *Yang* energy had undeniably bringing unpleasant consequences to the participants by decreasing individual sleep quality.

Besides the human preferences and architects' design perceptions in bed arrangement; the human actual sleep efficiency as discussed in this section has correspondingly supported these *Feng Shui* rules to be a complement to comprehensive set of interior design protocol in bedroom. These results are contributing to the development of design protocol for bedroom interior in the following chapter.

CHAPTER 7 – DEVELOPMENT OF BEDROOM DESIGN PROTOCOL

7.1 Introduction

This chapter mainly presents the methods to develop a set of design protocol for bedroom interior based on *Feng Shui* knowledge applied to a sleep environment. The final output of this chapter would be a design protocol created with hierarchical structure of *Feng Shui* knowledge which can contribute significantly to the current practice of architectural design.

In respond to the research objective (iv), the major aim to develop such protocol does not propose to challenge the freedom of arts and arrangement in architectural design. It intended to give bedroom *Feng Shui* validity from the Western science perspectives, blending the viewpoints from architectural design, psychology and human preferences and sleep quality evaluation. It also provided an alternative system of analysis for bedroom interior arrangement.

The outline of the chapter is displayed in Figure 7.1.

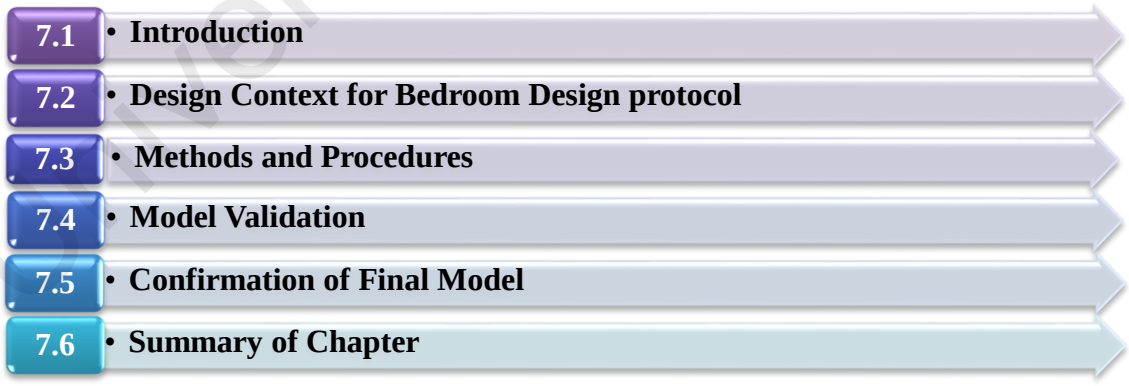


Figure 7.1: The framework of Chapter 7.

7.2 Design Context for Bedroom Design Protocol

It was truly understand that the design theories and contexts in Architecture as detailed in section 2.4 and section 2.6 shall be considered for developing a design protocol.

In the case for a bedroom interior, the related visual contexts such as bedroom form and size, visual balance, alignment and focal point shall be strongly emphasized. These design context data have been ideally incorporated in the questions of questionnaire survey and interview (see Appendix II and III). They are expected to be discussed among the architects in the interviews in seeking the design procedures and considerations for a bedroom interior (see section 5.3 and section 5.4).

For the formal contexts such as local climate data, building orientation and topographical characteristics, these are indeed important for a building structure design which involve considerations in external or macro environment. They are mostly not emphasized in the spatial interior arrangement studies except the bedroom openings' direction. The main challenge of bedroom interior arrangement is to provide the users a functional environment without threatening their physical and psychological comfort, in a predetermined building structure which could not be altered with external conditions. Moreover, the survey and interview are purposely designed to test the users and architects' preferences and responses in bed arrangement in relation to the bedroom's door and window, with the consideration that the external environment is constant. The orientation of bedroom openings are expected to be discussed among the architects in the interviews in seeking the design procedures and considerations for a bedroom interior (see section 5.3 and section 5.4).

The human contexts such as cultural and historical factors will also be examined in both survey and interviews. The users and architects' preference in bed arrangement will be tested its inferential relationships with the respondents' demographic variables such as

gender, race and religions, to see whether the bedroom interior design preferences are really governed by human cultural background (see section 4.6 and section 5.5).

On top of the triangulation study design, the following sections in this chapter (section 7.3.1 to section 7.3.8) will discuss the procedures of developing the design protocol for bedroom interior based on a number of design contexts. These contexts been reviewed (in literature review chapter) and verified (by architects and bedroom users) as similar to the main considerations in an ideal *Feng Shui* arrangement for a sleep environment. They are mainly visual factors such as bedroom size, form and shape, window direction from door location, visual command and sense of balance in the sleeping place. For that reason, these visual factors in architectural design contexts are in fact the embedded scientific elements that have been considered for an ideal bedroom *Feng Shui*.

7.3 Methods and Procedures

The development of bedroom design protocol was based on the procedure of grounded theory approach. Grounded theory is referred as the systematic generation of theory from thorough and rigorous research procedures leading to the emergence of theoretical conceptions (Strauss & Corbin, 1994). It provides researchers with analytical understanding, justifications, interpretations and applications. It can be used with either qualitative or quantitative data, but this research applied them both because the author believed that each form of data is valuable for both verification and generation of theories. Most of the time, quantified data requires supplementary qualitative analysis and vice versa.

In grounded theory, theoretical concepts are generated and analytically developed, conceptual relationships are posited, accentuating on multiple perspectives. The ideology about multiple perspectives with patterns and processes of interaction/action (inclusive of lay conceptions) must be systematically hunted during the research investigation in order

to formulate theories (Corbin & Strauss, 1990). In this research, the multiple perspectives for theory formulation were sought through triangulating data i.e. the perspectives from architectural design, human preferences and psychology and sleep quality evaluation.

The procedures of developing the bedroom design protocol based on *Feng Shui* knowledge are detailed as follows:

i. Review and recap the pertinent concepts of *Feng Shui* knowledge applied for a bedroom interior.

ii. Review the trends and patterns of architects' design for bedroom interior and its corresponding relationships with bedroom *Feng Shui* conceptions.

iii. Review the trends and patterns of general bed users' desired paradigm for bedroom interior and its corresponding relationships with bedroom *Feng Shui* conceptions.

iv. Review the implications of the applying bedroom *Feng Shui* conception to sleep efficiency through sleep experiments.

v. Develop an appropriate conceptual framework with hierarchies based on the above verified *Feng Shui* theories.

vi. Validate the developed framework by Feng Shui practitioners and modern architects.

vii. Confirm the final design protocol.

First and foremost, the fundamental concepts of the bedroom *Feng Shui* (integrating Form School concepts and recommended bedroom *Feng Shui* rules) were derived from the analysis of literature review.

Subsequently the trends and patterns of architects' design and human desired paradigm for bedroom interior were analysed and identified and its corresponding relationships (or concept of parallelism) with the bedroom *Feng Shui* knowledge were discussed and

established. It is an uneasy job to comply all the five *Feng Shui* rules simultaneously in a bedroom, probably due to the limitation in bedroom structure, form and size as well as the furniture dimension. The architects' reciprocal design procedures and design criteria for a bedroom interior commenced the concept of hierarchical structure for the development of such design protocol. On top of the perceptions from human preferences and architectural design, the assessment of sleep quality played the role to strengthen the design theory by validating the implications of applying the recommended bedroom *Feng Shui* conception.

The compliance level of the results to the five recommended *Feng Shui* rules in bed arrangement is very significant in the development of bedroom design protocol. The results indicator of multiple perspectives based on statistical significance are extracted from Chapter 4, 5 and 6, and presented in Table 7.1. These indicators are used to determine the significance level of the five *Feng Shui* rules in bedroom in the design protocol.

Table 7.1: The results indicators for the five recommended *Feng Shui* rules in bed arrangement from three (3) different perspectives.

Results Indicator/ Compliance Level	**Recommended *Feng Shui* Rules for Bed Arrangement**			
	Backed by solid wall, not window	**Not in line with door**	**Away from sharp angles**	**Away from mirror threats**
Human preferences in bed arrangement	55.80%	50.90%	41.00%	41.20%
Architects' design criteria for bedroom interior	96.70%	93.30%	70.00%	56.70%
Sleep efficiency of young female adults	90.70%	84.70%	86.20%	85.70%
Mean:	**81.07%**	**76.30%**	**65.73%**	**61.20%**

As shown in Table 7.1, wall supports became the most significant criteria (average indicator: 81.07%) in bed arrangement from both human and architects' design perspectives, and the sleep-wake ratio delivered by sleep experiments. Door direction from the bed (average indicators: 76.30%) were also the important rules in deciding bed arrangement. Besides, keeping the bed away from sharp angle threats (average indicator: 65.73%) was somehow an important design consideration but unavoidable in some bedroom conditions. Preventing the bed to be threatened by mirror reflection (average indicator: 61.20%) was the least important design consideration as it is not majorly highlighted by the architects and human perceptions.

Finally, a conceptual framework for bedroom design with embedded scientific elements in *Feng Shui* was developed and finalised using the concept hierarchy approach. Concept hierarchy categorising all of the similar data sets to create subcategory and refine the subcategories according to scope or other relevant criteria. The following sub-sections demonstrate the concept hierarchy for the development of bedroom design protocol with the aid of diagrams.

7.3.1 Bedroom Size, Form and Shape

The design protocol commenced with the identification of bedroom form and shape; bedroom on plan area; types and number of principal and supplementary furnishings to fit into the bedroom. From the observation in literature studies in section 2.4 and the architects' drawing submission in Appendix IV, the author discovered five potential types of bedroom shape or form i.e. (1) square, (2) rectangle; (3) L-shaped; (4) T-shaped and (5) Z-shaped. The five types of bedroom shapes were subsequently sketched with different on plan area ranging from 14 m^2 to 15 m^2 as shown in Table 7.2. The proposed bedroom sizes were according to the architects' insight as discussed in section 5.3.1,

where each of these bedrooms can ideally fit a double bed, two side tables, two sofa seats, a wardrobe, a vanity table and a TV console.

Table 7.2: Bedroom sizes, forms and shapes determined for the development of bedroom design protocol.

Bedroom form and shape		Area (m2)	Area (sf)
Square		14.00 – 15.00	150 - 160
Rectangle			
L-shaped			
Z-shaped			
T-shaped			

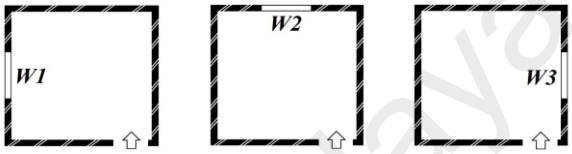
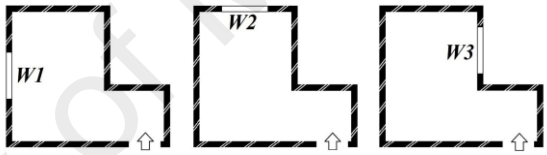
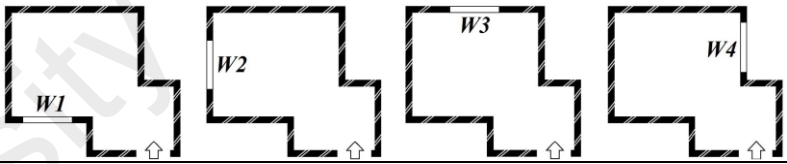
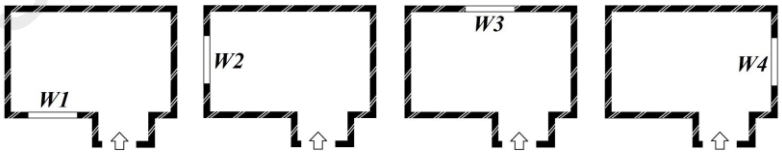
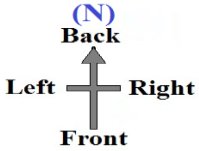
7.3.2 Window Direction from a Fixed Door Location

The second stage of the protocol considered the potential window direction(s) in relation to a door. From the five common types of bedroom shape as drafted in Table 7.2, each bedroom was fixed with a door (sized 900mm x 2100mm) at south east area of the bedroom; facing to south.

A window (sized 1200mm x 1200mm) was then given to each type of bedroom; and these bedrooms were further divided into more choices based on different window directions in relation to the door position. The window was located at either one of the bedroom wall, facing to the north or east or west, or the wall piece that can fit the window size at the south. The window facing directions of east, west, south and north are correspondingly referred as left, right, front and back according to the practice of Form School *Feng Shui*. As a result, a combination of seventeen (17) potential window

arrangements were derived based on different bedroom form and shape as illustrated in Table 7.3. The varieties of window arrangement allowed the person who refers to this design protocol to select a most identical bedroom condition in terms of its room openings direction.

Table 7.3: The potential window directions based on different bedroom forms/ shapes.

Bedroom form and shape	Potential Window Directions
Square	
Rectangle	
L-shaped	
Z-shaped	
T-shaped	
Notes: *The window facing directions of east, west, south and north are correspondingly referred as left, right, front and back according to the practice of Form School.*	

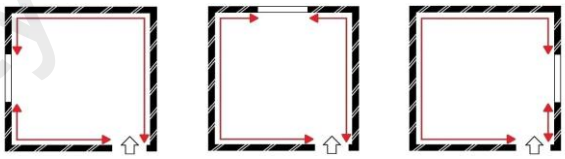
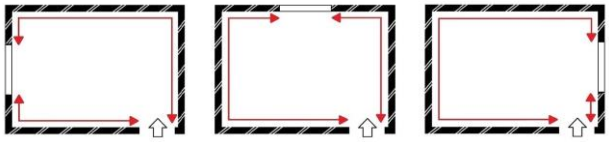
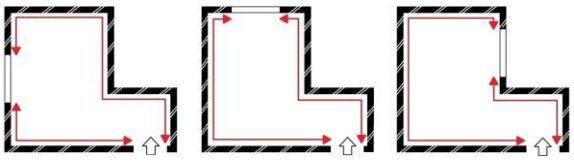
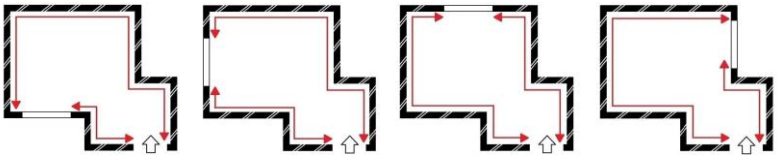
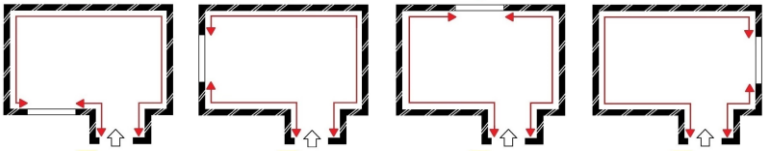
7.3.3 Wall Area for Back Supports

After the bedrooms were categorised according to different forms and shapes, and different opening directions; the third stage of the protocol proceeded to select the wall area for bed placement. As discussed in section 5.3.2, majority of the architects claimed

that a bed shall be aligned with solid wall and located along the longest piece of wall to allow easy access to other furniture. 96.7% of the architects' proposed drawings showed the bed is backed by a solid wall. In addition, the discussions of questionnaire survey in section 4.5 also validated the importance of having solid wall as the back support while sleeping. The respondents highly preferred (55.8%) such arrangement in a sleep environment in terms of its physical and psychological comfort viewpoint. Lastly and most importantly, the sleep experiments verified that sleeping with solid wall as the back supports will improve individual sleep efficiency, with average SE indicator of 90.7%.

As a result, the wall area in each bedroom was marked on plan, stating the potential zone to place the bed along. Table 7.4 shows how the wall lines are marked as potential zones for bed placement.

Table 7.4: The bed shall be placed along the marked wall line for bed head supports.

Bedroom form and shape	Potential Zones for Bed Placement
Square	
Rectangle	
L-shaped	
Z-shaped	
T-shaped	

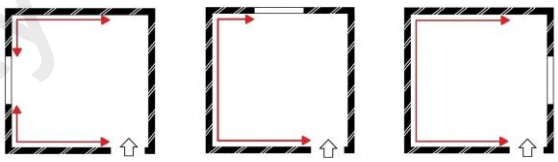
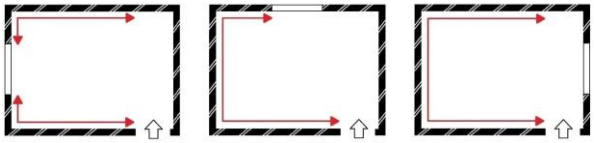
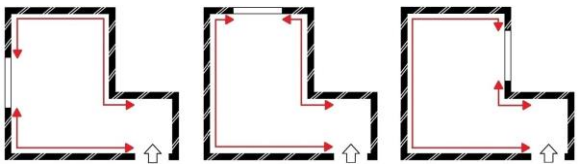
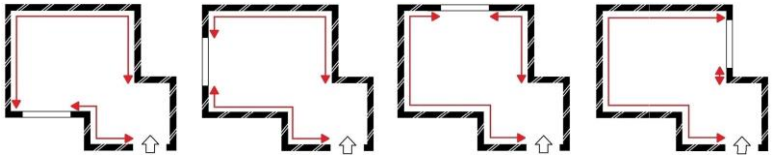
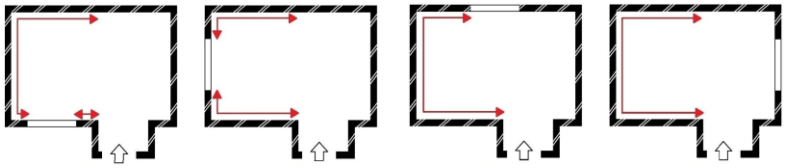
7.3.4 Avoid Bed to be In Line with Door

In the fourth stage, the marked wall line in each bedroom was then reduced to avoid the bed in line with door, with the intention of minimising threats from outside the bedroom.

As discussed in before, 93.3% of the architects did not practise to place the bed in line with a door. The questionnaire survey results in section 4.5 showed 50.9% of the respondents declined to sleep in line with door, supported with undesirable psychological impacts. Moreover, the sleep experiments also verified that sleeping in line with door will degrade individual sleep efficiency, with average SE indicator of 84.7%.

Table 7.5 shows how the marked wall lines are reduced in the seventeen (17) potential bedroom arrangements to avoid the bed to be placed in line with door.

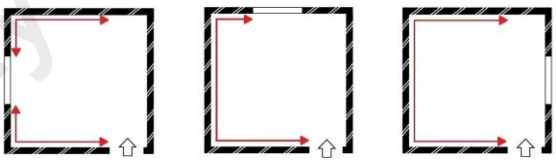
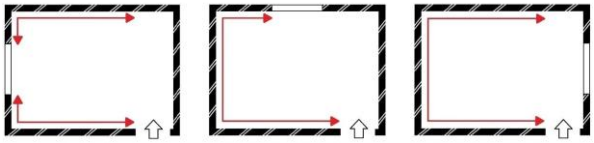
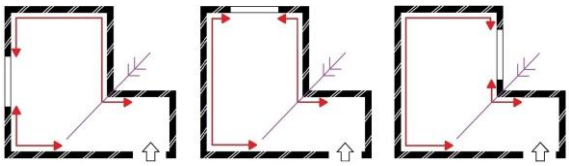
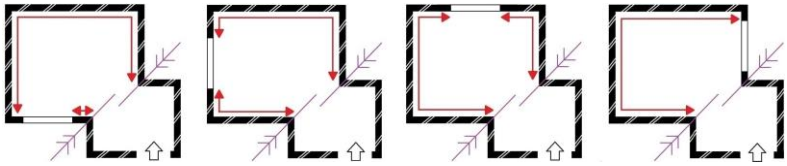
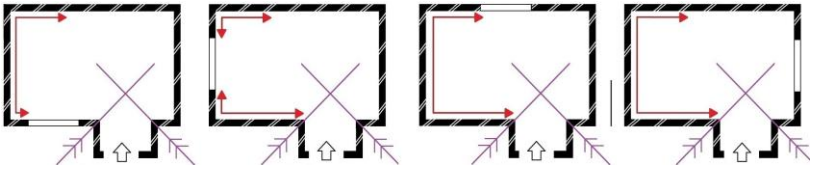
Table 7.5: The bed shall be placed along the wall but not to be in line with door.

Bedroom form and shape	Potential Zones for Bed Placement
Square	
Rectangle	
L-shaped	
Z-shaped	
T-shaped	

7.3.5 Avoid Bed to be Pointed by Sharp Angles

In stage five, the remainder marked wall lines in Table 7.5 were then reduced to avoid the sharp angle threats. The sharp angles of room corners, columns and tall furniture are typically eyesores or 'poison arrows' to the bed users when the bed is arranged to face them. The results in architects' design criteria showed 70% of them did not arrange the bed to be threatened by sharp angles. 41% of the survey respondents declined to sleep with sharp angle threats, supported with unwanted psychological impacts. Besides, the sleep experiments verified that sleeping with sharp angle threats will somehow affect individual sleep efficiency with average SE indicator of 86.2%. Table 7.6 shows how the marked wall lines are reduced to avoid the room corner threats.

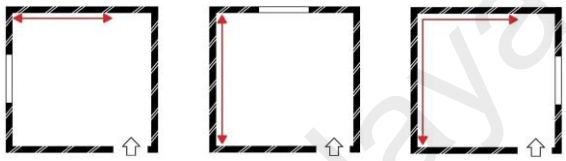
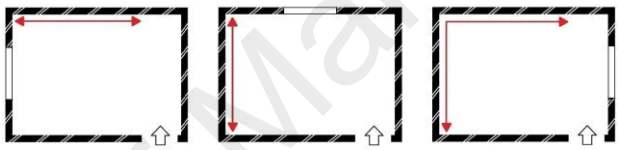
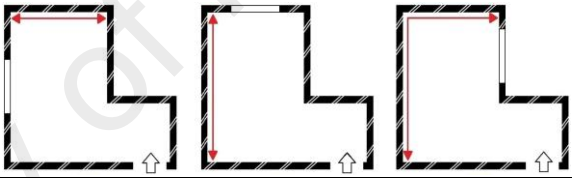
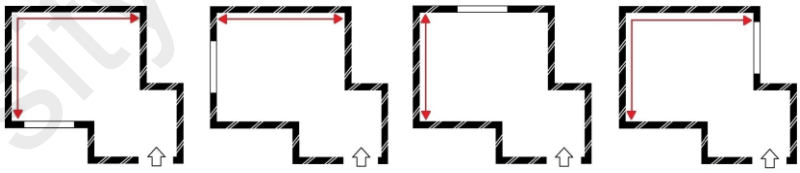
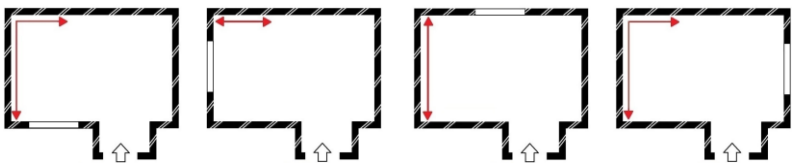
Table 7.6: The bed placement shall avoid from 'poison arrow' threats i.e. the room corners.

Bedroom form and shape	Potential Zones for Bed Placement
Square	
Rectangle	
L-shaped	
Z-shaped	
T-shaped	

7.3.6 Visual Command from the Bed Direction

The remainder marked wall lines in Table 7.6 were then further reduced to allow better visual command of the sleeping place. Any room openings shall be visible from the bed direction in the sixth stage.

Table 7.7: An ideal bed location shall be a place that is visible to door and window.

Bedroom form and shape	Potential Zones for Bed Placement
Square	
Rectangle	
L-shaped	
Z-shaped	
T-shaped	

As discussed in section 2.5.1, Spörrle & Stich's (2010) verified that human prefers to sleep in a way that allowed them to see the door (toward which the door opened) and as distant as possible from the door. Psychologically, the study shows humans prefer to sleep in a place that could promise protection against potential aggressors and night-time predation. Concurrently, the study also implied that humans desire better visual command

in a sleeping place, from the bed direction. The results in Table 5.2 of section 5.4 showed most of the architects arranged the bed in a way that was visible to door and window.

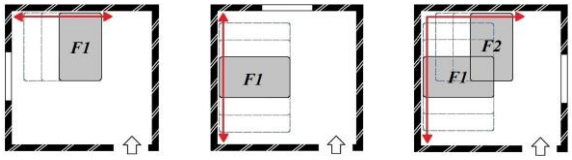
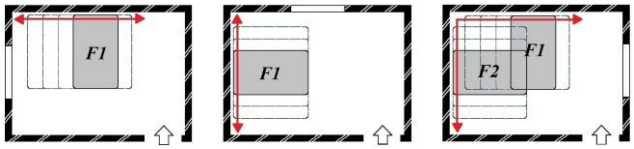
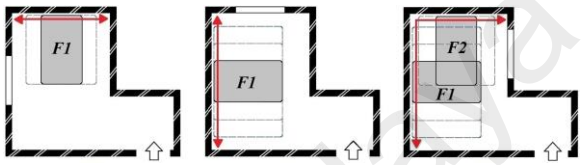
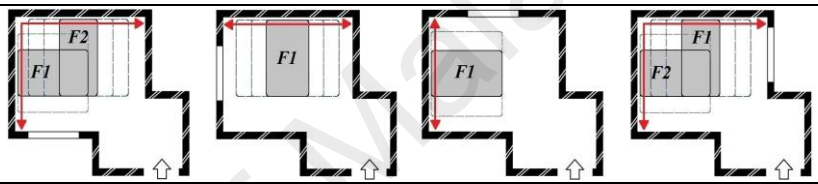
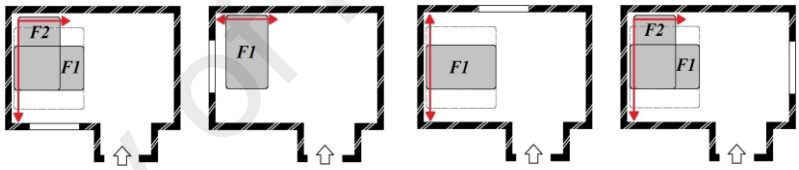
Table 7.7 shows how the marked wall lines are further reduced to allow better visual command, where door and window shall be visible and as distant as possible from the bed direction.

7.3.7 Sense of Balance in the Sleeping Place

In stage seven, decision shall be made for an ideal bed location in the seventeen (17) bedroom arrangement based on the potential zones for bed placement in Table 7.7. Based on the interview findings in section 5.3.2, the bed shall be located in the middle of the room to create a sense of balance, but restricted along the wall lines. This is highly supported by 62.5% of architects' proposed drawings and 52.1% of survey respondents' preferences.

Table 7.8 shows how the ideal bed locations were identified with a sense of balance, from the remaining marked wall lines. In most cases, more than one ideal bed locations (e.g. F1 and F2 shown in Table 7.8) with different facing directions are found. Bed users have freedom to choose the ideal bed locations from these options (F1 and F2) provided the bedroom has sufficient space to do so. Nonetheless, limited bedroom space will somehow restrict the number of choices in selecting an ideal bed location.

Table 7.8: The sense of balance is required for bed placement.

Bedroom form and shape	Potential Zones for Ideal Bed Placement
Square	
Rectangle	
L-shaped	
Z-shaped	
T-shaped	

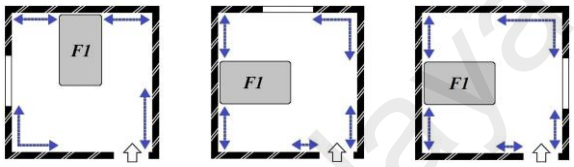
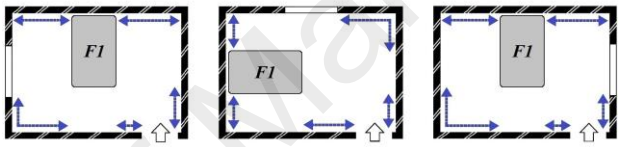
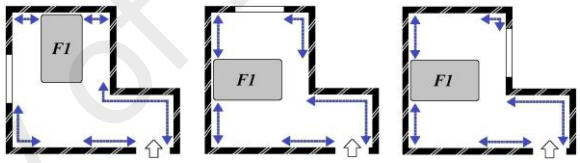
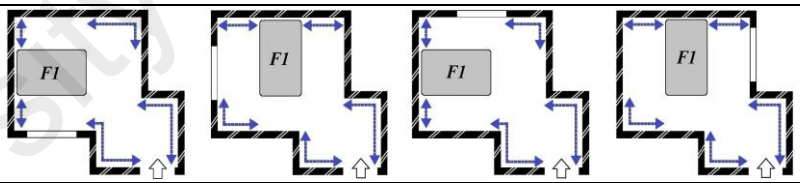
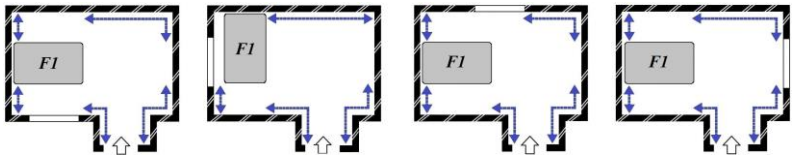
7.3.8 Supplementary Furniture and Reflective Surface

Subsequent to the placement of bed, the supplementary furniture such as wardrobe, side tables; sofa seats and TV console were placed into the bedroom in stage eight. The room size and shape may determine the freedom to locate these furniture but it is not advisable to place them in a way that may block the window view and walkway.

Although there are freedoms in placing supplementary furniture, an important step in this protocol is to avoid the bed to be threatened by mirror reflection. The step was supported by the 56.7% of architects in the interviews and 41.2% of survey respondents with additional psychological impacts. Besides, the sleep experiments also verified that sleeping with mirror threats will somehow degrade individual sleep efficiency, with average SE indicator of 85.7%.

As a result, any reflective surface, mirror or vanity shall be located in a way that is not threatening the bed user in an ideal bed location. Table 7.9 indicates potential areas to locate mirror or vanity in relation to the ideal bed location (F1). The potential mirror and vanity placement were marked along the wall lines.

Table 7.9: The placement of mirror or vanity in relation to the bed location.

Bedroom form and shape	Potential Zones for Mirror Placement from the Bed
Square	
Rectangle	
L-shaped	
Z-shaped	
T-shaped	

Besides, according to the mutual architects' design procedures specified in section 5.3.2, the largest piece of supplementary furniture shall be placed at first, followed by the smaller pieces in a balanced manner. Majority of the survey respondents (52.1%) have verified that the idea of balance is important from their response to the imitation of Form School *Feng Shui* model in a sleep environment. The four emblems protection was the concerns for an ideal bedroom interior as it created sleep-inducing environment from the

psychological perspectives. As a result, the ideal bed locations (e.g. F1) as indicated in Table 7.10 were proposed with example of placement of supplementary furniture based on Form School *Feng Shui* concept. The integrated design protocol which combining all stages is demonstrated in Appendix IX.

Table 7.10: The placement of supplementary furniture and mirror after the bed locations are fixed.

Bedroom form and shape	Potential Zones for Mirror Placement from the Bed (e.g. F1)
Square	
Rectangle	
L-shaped	
Z-shaped	
T-shaped	

7.4 Model Validation

This section reports the model validation of the developed design protocol for bedroom interior in the previous section. The transformation of the previous developed model into an improved model will be discussed. This transformation involves validation based on a pool of experts' comments i.e. the modern architects and *Feng Shui* practitioners. Such validation is called face validity or logical validity where superficial and subjective assessment was applied. The validation will assess the expert's feedback to the items of an assessment instrument, deciding whether these measures are relevant in measuring what the author intended to measure. It is the easiest form of validity to apply in social science research. It doesn't general involve much (if any at all) in the way of objective measurements. Although it sounds like a weaker form of validation approach, in essence, face validity is only weaker for a layperson, but stronger for an expert in the field (Hardesty & Bearden, 2004).

7.4.1 The Experts for Validation

There is no rigid rule about how to exactly decide on face validity. It is usually a subjective assessment based on experts' opinion because it is more easily respected by other people. Studies that reported experts' opinion are more likely to benefit from a reflected respect and so be more credible at least with an audience who unquestionably accepts those people as experts. The key part of the reported study may again reflect the expertise of the selected people in the model validation study.

Expert sampling, an example of purposive sampling and a non-probability method was used in model validation as the research requires to capture knowledge rooted in a particular form of expertise. The model validation involved several measures of agreement from the 'experts' to ensure objectivity in the author's decision is determined.

The experts for this model validation include *Feng Shui* practitioners who are most valued among the local society and modern architects who have related design experience in residential buildings. To be precise, the targeted *Feng Shui* experts shall be someone who has more than 10 years of working experience and being active and popular in TV interviews and invited public talks. Besides, the targeted architects shall be with good experience and have been working for more than 10 years in design projects for residential building. Alternatively, the architects with good experience in building interior, handling more than 10 projects for interior design in residential buildings will be considered. This is supported by O'Keefe and O'Leary (1993) as they claimed that the simplest method to establishing a criterion for validation is to define the output level of expertise at which they should perform. It may be required that a system performs at the level of an expert, better than an expert, or at the level of a good trainee. Besides, Guimarães, Pena, Lopes, Lopes & Leite de Barros (2016) categorised experts for validation into Junior, Senior and Master level, which they can't be only represented by years of working experience but on deep knowledge on a subject.

Only the experts who passed the above identified criteria were selected as validation respondents. Validation survey requests were sent to potential respondents who are qualified as before described, to nineteen (19) local *Feng Shui* practitioners and thirty-five (35) architects. After months of efforts, ten (10) architects and five (5) *Feng Shui* practitioners agreed to participate in the face-to-face validation survey. According to Hardesty & Bearden (2004) and Hammersley & Atkinson (1983) the number of expert judges should be collected from at least three sources in order to increase the validity of the information collected. Hence, the number of responses sounds ideal for the validation in this study. The demographic information of the respondents is shown in Table 7.11.

Table 7.11: Demographic information of experts participated in validation survey.

Experts		Gender	Race	Religion	Years of practice	Adoption of Design Guideline/ Protocol in job routine	Experience in Develop Design Guideline/ Protocol
T1	Architect	Male	Chinese	Buddhism	15y	No	No
T2	Architect	Male	Chinese	Buddhism	22y	No	No
T3	Architect	Female	Malay	Islam	8y	No	No
T4	Architect	Female	Malay	Islam	10y	No	No
T5	Architect	Male	Chinese	Christian	16y	No	No
T6	Architect	Male	Chinese	Christian	12y	No	No
T7	Architect	Female	Chinese	Daoism	10y	No	No
T8	Architect	Male	Chinese	Christian	15y	No	No
T9	Architect	Male	Malay	Islam	2y	No	No
T10	Architect	Female	Indian	Hinduism	6y	No	No
P1	Feng Shui Master	Male	Chinese	Buddhism	23y	No	No
P2	Feng Shui Master	Male	Chinese	Buddhism	26y	No	No
P3	Feng Shui Master	Male	Chinese	Buddhism	18y	No	No
P4	Feng Shui Master	Female	American	Irreligion	10y	No	No
P5	Feng Shui Master	Male	Chinese	Buddhism	13y	No	No

In the validation stage of this study, ten architects (T1 to T10) and five *Feng Shui* practitioners (P1 to P5) participated in the validation of developed model. Among the fifteen (15) respondents, there were six (6) male architects and four (4) male *Feng Shui* Masters. Majority (80%) of the respondents were having more than 10 years of working experience in their practicing field except T3, T9 and T10. These respondents claimed that they had handled minimum 15 projects for interior design in residential buildings. Therefore their responses for the validation have high level of reliability. The experts' designations and years of working experience in related field suggest that they are able to contribute significant response to the model validation, probably with high reliability. The demographic profile of these respondents shows that they are of multiple races and

religions as shown in Table 7.11. All respondents claimed that they have not adopted any published or unpublished design protocol for bedroom interior to assist them in their design job routine/ design advice by *Feng Shui*. None of them have developed design protocol for bedroom interior like the author did.

7.4.2 Validation Survey

During the face-to-face session with the experts, each of them was given a validation survey as shown in Appendix XII. This validation survey was prepared to seek for the experts' comments on the practicality and comprehensiveness of the 'design protocol for bedroom interior'. The survey has covered several measures of agreement to the items of assessment which involves six (6) major focused inquiries purposely designed for the experts. *Feng Shui* terminologies and jargons were not used along the survey although it involved validation from *Feng Shui* practitioners. All questions must be responded based on the developed model as displayed in Attachment Y in Appendix XII. Before the respondents started to comment on the questions, briefing was provided to emphasise the concept of design in the developed model was merely based on the bed location in relation to wall, door, window and other potential threatening elements for sleep disruptions.

The validation survey was initiated by seeking the personal information in *Section A*, such as name, gender, religion, job title, years of working experience, and adoption of design protocol in assisting design job routine or design advice to clients. *Section B* of the survey was designed to seek for measures of agreement from the experts for the following six (6) major focus:

(1) *Do you think the* ***elements of concern in bed arrangement*** *(with statistical supports) in the given design protocol are sufficient to reflect the completeness of the model?*

(2) *Do you think the **types of bedroom form and shapes** in the given design protocol are sufficient to reflect the variety available in the housing market?*

(3) *By observing the **flow of stages in seeking an ideal bed arrangement** in the given bedroom scenario, the significant order of these stages is considered reasonable and impartial for bedroom interior arrangement. Do you agree with this conclusion?*

(4) *Do you think the given design protocol can be appropriately **applied to smaller bedrooms** as compared to the ones that have been outline in Attachment Y?*

(5) *Do you think the given design protocol can be appropriately **applied to people of all ages and with different health conditions**?*

(6) *Would you **recommend** this kind of 'design protocol for bedroom interior' **to any of your colleagues or peers** to ease the future design work/ design consultation?*

The following sub-sections disclose the measures of agreement from the experts to the six (6) items of assessment. The experts' comments on the practicality and comprehensiveness of the 'design protocol for bedroom interior' were discussed and conclusions were made for the final model.

7.4.2.1 Elements of Concern in Bed Arrangement

The fifteen (15) subject matter experts (T1 – T10 and P1 – P5) agreed with the elements of concern in bed arrangement for the developed model, which consisted of the bedroom form and shape, window directions, bed head supports, door direction from the bed, sharp angle threats to the bed, visual command from the bed, sense of balance and arrangement of other supplementary elements.

Majority of the experts (except T9 and T10) opined that these elements of concern are so relevant in considering an ideal spot for bed arrangement in any sleep environment of

different scenarios. Nine (9) experts namely T2, T3, T4, T8, T9, P1, P2, P4 and P5 have mutual agreement that seeking an ideal spot for bed head support along the wall lines is the most fundamental in bed arrangement. Three (3) of the subject matter experts (T2, T5 and T6) commented that the common practice of allocating bed in a sleep environment is by expertise and intuition. They claimed that there are chances that an inexperienced architect will refer to the past design records for better design inspiration. T2 emphasized that based on the modern and innovative design ideas available in the housing market, there are many unexpected factors arise during or after construction that could potentially impact on the given bedroom scenario. Hence revision to interior arrangement in the sleep environment will somehow happen. T2, T5 and T6 were generally satisfied with the design protocol and added that it is undeniably an amazing reference as each element of concern in bed arrangement was detailed, carefully verified and supported by trustworthy statistics from multiple dimensions.

7.4.2.2 Types of Bedroom Form and Shapes

The fifteen (15) experts agreed with the five drafted bedroom forms and shapes, i.e. square, rectangle, L-shaped, T-shaped and Z-shaped. They claimed that these are the basic forms that they have seen in the past projects. One expert (T4) highlighted that:

> *Despite the drafted bedroom forms and shapes are commonly seen in the residential projects, T-shaped and Z-shaped bedroom consist of eight edges which could have varying scale that may restrict an ideal bed arrangement in a sleep environment. This design protocol is just in place to find out a better place to sleep in an odd scale and odd shaped room.*

On top of that, another expert (T8) opined that:

> *Bed arrangement does not matter so much with the room shapes. It should be concerned with the room size. A spacious bedroom is highly important for interior arrangement.*
>
> *I can observe that the drafted bedrooms in the design protocol are quite spacious and easy for arrangement. When the bedroom size is shrunk, the identifiable final spot(s) for bed arrangement (F1, F2…) will be reduced with options. This is also to be concerned with the balance bed arrangement inside the bedroom.*
>
> *It is great that the design protocol demonstrated such a detailed procedure in interior arrangement. The provided stages also reveal analysis that can be done step-by-step in seeking the most ideal sleeping spot. It is understood that when the bedroom size is shrunk, the bedroom analysis can cease at a stage where it permits, with only one final option for bed arrangement.*

7.4.2.3 Flow of Stages for Ideal bed Arrangement

The fifteen (15) experts' views supported the findings that the flow of stages in seeking an ideal bed arrangement in the given bedroom scenario is reasonably significant and impartial. In particular, all the experts emphasized the logics of having such flow of stages by prioritising the bed location in relation to room openings. They drew a conclusion from the summary of the model, declaring the proposed flow of stages in the design protocol shall be made published.

In addition, the mutual perspectives of all five (5) Feng Shui Masters (P1 to P5) were recorded. They discussed that without assessment to the bedroom external Feng Shui, the bedroom indoor assessment is rational and designed in a right sequence. It is similar to the arrangement of *Yin* and *Yang* elements inside the bedroom. P1, P3, P4 and P5 added

that brick wall is referred as the mandatory solid back support for better sleep quality. It is a *Yin* element which can calm a sleeper's state of mind at bedtime. Conversely, the major *Yang* elements inside the bedroom are door and window. It should be avoided from direct contact to the bed, especially in a short distance. Both must be visible from the bed location in a diagonally far distance. In addition, P2 opined that:

> *The design protocol is forming an important strategy to improve human sleep quality by Feng Shui approaches. It is a valuable development where the concept of bedroom Feng Shui is blended with scientific analysis.*

7.4.2.4 Application to smaller bedroom

Six (6) of the experts (T2, T5, T6, P1, P3 and P4) agreed that the design protocol can be appropriately applied to smaller bedrooms such as a massive number of non-spacious bedrooms available in Hong Kong and Singapore with some terms and conditions.

The nine (9) remainder experts disagreed that the design protocol can be appropriately applied to smaller bedrooms, based on their working experienced in the past projects. They insisted that there will be some unexpected circumstances when applying the design protocol in smaller bedroom.

The other two different perspectives conversed the following:

> *T2: When the bedroom size is shrunk, the design protocol can be applied up to a stage where it permits. In another word, the application will stop in the middle of the available stages by identifying one restricted final option for bed arrangement.*

> *T5: In summary, the practicality of this design protocol in smaller bedroom will be incomplete. This could be the only restriction that makes the contribution imperfect. Such limitation shall be highlighted in the model.*

7.4.2.5 Application to people of all ages and different health conditions

All of the experts shared the same opinion that the design protocol can be appropriately applied to people of all ages, including physically and mentally fit person and even patients in the hospital. It is a reciprocal understanding among all experts notwithstanding they are partially practitioners with or without modern mentalities. Therefore, *Feng Shui* approaches in bed arrangement are probably modern art and science knowledge.

One of the experts (T7) has distinctive perception as the following:

> *I truly expect the application of design protocol will be more beneficial to sleep deprived category, on top of sleeping medication and other relevant therapies. People in this category shall inspect their current bed arrangement and make appropriate adjustment based on the developed model for more ideal sleep environment.*

7.4.2.6 Recommendation to Peers for Future Design Work

The validation ended with full agreements from all experts for the recommendation of such design protocol to their peers and colleagues. They claimed that they are very likely to notify their peers and colleagues about the existence of such expedient design model as it is easy to use for future design work or consultation work.

One expert (T2) said that:

> *The model impressed me because of its concise and precise. It is not about the restrictions in innovative design in a sleeping environment. A place to sleep shall be calmed by its nature of arrangement. We can't change our building / bedroom structure most of the time but bed arrangement is the only way to make us better.*

Innovative in bedroom design can be done from many other perspectives such as unique furniture design, colour themes, paintings and décor without threatening the user's sleep quality.

Two (2) experts have given suggestions for the model improvement. The suggestion from each of the expert is listed below:

Suggestion 1: The developed model shall highlight its application is limited for smaller bedroom. (T5)

Suggestion 2: The developed model shall highlight its application is subject to a hidden contingency plan and such contingency plan could be varying from time to time. (T2)

7.5 Confirmation of Final Model

In summary, the model has been successfully validated by all experts with full agreement for majority of the assessed item, except the part with "application to smaller bedrooms". 60% of the experts claimed that there will be unexpected circumstances when applying the design protocol in smaller bedroom. It seems that the developed model can be more appropriately applied into bedrooms with bigger size at 14.0 m2 or above as shown in Table 7.3. Hence, it is not ideal for smaller bedrooms which is more frequently happened in the countries such as Hong Kong and Singapore. This disagreement is to be discussed with the first suggestion by expert T5.

In response to the first suggestion, it is an undeniable fact that the application of such design protocol in smaller bedroom is quite limited. This has been emphasized in section 7.4.2.2 by expert T8, section 7.4.2.4 and 7.4.2.6 by expert T5. In fact, a bedroom of

limited space hardly identify a piece of continuous brick wall that can fit the bed head width. If that is likely to happen, the bed might be forced to be in line with the bedroom door or positioned with only one side access, without a sense of balance. In this case, the protocol can only be utilised up to a certain stage and terminated in the middle due to the unmatched bedroom scenarios. As a result, the previous developed model will be improved with this expert's suggestion by adding a statement of limitation in the final model.

Concerning the second suggestion, expert T2 expected further improvement for the model with another highlight. He accentuated the application of this bedroom design protocol is subject to a contingency plan. This suggestion is somehow making sense because of the pre-setting of bedroom openings in the model. The bedroom doors in the model were fixed at the south east area, and the window sizes were fixed to be a double panes window in the model as in Attachment Y in Appendix XII. In this case, the protocol is only able to show limited interior arrangement combination. Perhaps in the structure can be further enhanced with more bedroom scenarios in order to develop a more comprehensive design protocol. Thus, the expert's suggestion has its own rationality. The author may agree with this suggestion provided the contingency plan is determined and customised based on the provided bedroom conditions, or the user's experiences. Consequently, design protocol will be improved with this highlight by adding a related statement in the final model.

There is nothing in this world perfect, as well as this developed model. In view of the validation survey did not arouse major amendments in the design protocol; the minor changes as per the experts' suggestions were believed to enhance the existing model towards a better one. The modified design protocol for bedroom interior is shown in Appendix IX.

7.6 Summary of Chapter

This chapter firstly detailed the method and procedures to develop design protocol for bedroom interior and the hierarchical framework (stage one to eight) in the protocol clearly outlined the roles of an architect in setting up an effective sleep environment in a systematic manner. By combining both dimensional results (perceptual and experimental), a clear, accessible and standardised design protocol for bedroom interior was developed. Subsequently, the chapter discoursed about the model validation process with six (6) major assessment items, seeking the experts' comments on the practicality and comprehensiveness of the developed design protocol for bedroom interior. At last, a final model was confirmed with enhancement from the previous model. The previous model was modified with additional statements of limitation based on the experts' suggestion in the validation. The following chapter covers the discussion about the conclusions of the entire research.

CHAPTER 8 – CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

The chapter begins with a general review of current research and followed by a description of major findings and the results implications. Next, the challenges in verifying the *Feng Shui* theories in a sleep environment are presented. The strength and limitations of the study are discussed in subsequent sections. Lastly, the chapter closes with recommendations for future research. The outline of the chapter is displayed in Figure 8.1.

Figure 8.1: The framework of Chapter 8.

8.2 Conclusions

This research focused on bedroom *Feng Shui* theories, considering its basic concepts with the architects' design practices and the human desirable paradigm in a sleep environment. The research was then reinforced by sleep experimental results to young female adults, showing *Feng Shui* implications to human sleep efficiency. Lastly, a set of design protocol for bedroom interior was developed based on the blending ideas of *Feng Shui*, sleep-wake ratio, architectural insights and human perceptions.

Based on the results presentation and discussion in the previous chapters, the overall findings of the research supported the research hypotheses in which the survey, interview and experimental results revealed mutual thoughts, showing corresponding relationships to the ideal *Feng Shui* conceptions applied for a bedroom interior. As a result, bedroom *Feng Shui* conception indeed has its scientific origin which is not purely superstitious.

The research depicted several conclusions based on the remarkable findings achieved for each objective in the following sub-sections.

8.2.1 Research Objective (i)

Based on the first research objective, "To identify whether the human most preferable arrangement in a sleep environment is corresponding to the bedroom Feng Shui conception and concurrently evaluates the sleep quality and psychological impacts attributed to their choices of arrangements in subjective manner.", the first research question was formulated as "Is the Feng Shui concept applied for bed arrangement a pragmatic approach that is broadly accepted by majority bed users?"

The current research has successfully achieved objective (i) and the first formulated research question through the questionnaire survey. From the results discussion in Chapter 4, several conclusions are made for objective (i) as the following:-

- The human most desired paradigm in a sleep environment was found as corresponding to the ideal bedroom *Feng Shui* model in different prearranged bedroom scenarios. An ideal sleep environment is logically befit with the four emblems protection in Form School *Feng Shui*.
- The bed arrangements that tied with recommended *Feng Shui* rules were broadly accepted and supported by complacent psychological impacts while the one that tied with restricted *Feng Shui* rules were claimed with adverse psychological impacts.

- The most ideal *Feng Shui* model applied for a sleep environment may potentially reduce the respondents' time to fall asleep.

8.2.2 Research Objective (ii)

Based on the second research objective, "To examine the modern architects' perceptions in design procedures for a bedroom interior and assess whether the bedroom layouts produced by these architects are corresponding to the bedroom Feng Shui conception", the second research question was formulated as "Is the recommended Feng Shui rules applied for bed arrangement parallel with the architectural design criteria for a bedroom interior?"

The current research has successfully achieved objective (ii) and the second formulated research question through the interviews to modern architects. From the results discussion in Chapter 5, several conclusions are drawn for objective (ii) as below:-

- The common design criteria in bed arrangement shared by majority of the modern architects are in compliance with the recommended bedroom *Feng Shui* rules, particularly on the relationship between the bed, wall, door and window. To highlight the relationship: the bed head shall be placed with brick wall as back support and away from the draughts created between door and window.
- The mutual perspectives of majority architects in the design procedures of a bedroom interior forming a foundation for the development of bedroom design protocol. They have reciprocal thoughts that the bed is the focal point inside a bedroom as it serves the main purpose of "sleeping" rather than other dressing or storage functions. Hence it shall be the primary concern in bedroom interior arrangement to create a sleeping place with more sense of stability, comfort, and peace of mind.

8.2.3 Research Objective (iii)

Based on the third research objective, “To evaluate whether an ideal Feng Shui bed arrangement is supportive to better sleep quality using sleep experiments by wrist actigraphs and Pittsburgh Sleep Quality Index (PSQI)”, the third research question was formulated as “Is the Feng Shui concept applied for bed arrangement able to enhance human sleep quality?”

The current research has successfully achieved objective (iii) and the third formulated research question through the case study by sleep experiments to young female adults in Malaysia. From the group and individual sleep assessment results discussed in Chapter 6, several conclusions are drawn for objective (iii):-

- The ideal *Feng Shui* bed arrangement is supportive to better sleep efficiency among the young female adults in Malaysia.
- The individual sleep assessment showed even more robust evident on the sleep efficiency results towards the recommended *Feng Shui* bed arrangement.
- The statistical significance of the empirical results demonstrated that sleeping with solid bed head support rather than an opened window has the most implications in ensuring better sleep quality.

8.2.4 Research Objective (iv)

Based on the last research objective, “To develop a set of design protocol for bedroom interior based on the verified *Feng Shui* conception in objectives i, ii and iii”, a set of clear and accessible design protocol for bedroom interior was developed based on both perceptual and experimental results that were claimed as scientific in academic research.

The developed protocol was completed with logical flow of stages with the aid of diagrams, in seeking the ideal bed arrangement in multiple bedroom scenarios. The finalised design protocol will serve as a useful benchmark to ease the design works for

the design team and common bed users. It is also intended to provide valuable reference to the researchers and even the sleep deprived category specifically for young female adults in Malaysia. It would be an alternative approach to improve human desirable comforts, psychological well-being and nocturnal sleep quality in long-term basis.

8.3 Challenges of Verification in *Feng Shui* Theories

The current study created a niche research area which is not common in the built environment research but somehow a remarkable and valuable one. The research aims to investigate whether the ideal bedroom *Feng Shui* conception is a pragmatic approach that is widely accepted by the modern architects and majority bed users. In order to provide a recognised platform to this ancient knowledge by scientific approach in the built environment, several challenges were faced by the author along the journey to complete the research. The confronted challenges are itemised as below:-

- More efforts were required in the design of empirical approach in order to verify the *Feng Shui* theories in bed arrangement. This is due to *Feng Shui* theories are treated as superstition until the present day and the *Feng Shui* practitioners' insights are rather subjective as it was lack of systematic documentation in the past.
- The current research was complicated as it involves broad and multidisciplinary knowledge which comprise of architectural design, sleep psychology and human well-being.
- The research was time consuming for literature review of multiple disciplines and planning of research design and process. The volume of data also makes analysis and interpretation time consuming.
- The research could be bias if the respondents involve Chinese communities which are probably familiar with bedroom *Feng Shui* theories.

8.4 Strength of the Study

Although there were challenges faced by the existing research, the strengths of such multidisciplinary study cannot be overlooked. The following strengths undeniably upsurge the values of current research outputs:-

- The adoption of multiple-dimensional verification in triangulation approach has contributed precise understanding on the relationships between bedroom *Feng Shui* conception and the perceptual and experimental results.
- The appropriate sample sizes of the questionnaire survey, interview and experiments have reinforced the reliability of results.
- The research instruments that were not applied with *Feng Shui* terminologies or jargons throughout the data collection period have secured the research is conducted in an unbiased manner.

8.5 Research Contributions

This research is mainly contributing a design protocol with clear and logical flow of stages in bedroom interior arrangement based on *Feng Shui* conception, with the intention to create a more harmonious and healthier sleep environment for sleep quality improvement. The finalised design protocol is used for the purpose of seeking an ideal bed arrangement in different bedroom scenarios, anticipated to improve sleep efficiency specifically for young female adults in Malaysia. Besides, this study has successfully brought the concepts of bedroom *Feng Shui* beyond the shadow of superstition in the built environment via scientific methods, so that this ancient Chinese wisdom is well recognised by the nation and universal level.

The research output developed from the architect's insights and human desired paradigm in a sleep environment comprises all criteria which are beneficial to human physical comfort, sleep and healthier state of mind at bedtime. The final and validated

design protocol for bedroom interior is expected to serve as an important reference for the design team and researchers, intended to support better sleep quality and healthier well-being of young female adults in Malaysia. However, the protocol has no intention to restrict the freedom of arts and creativity in bedroom interior arrangement.

8.6 Limitations of the Study

This study encountered several limitations that may control the extensity of this research, when considering its overall contributions. The author believes the upcoming research may overcome the following limitations:

- The study restricted in scope to the local respondents in Malaysia.
- The research required the respondents to select for their most preferable choice of bed arrangement in the questionnaire survey rather than providing them with an actual experience in the provided bedroom scenarios, due to time and money constraints to invite hundreds of participants to the experiment bedrooms.
- The experimental results were accurate for the specific group of young female participants. It is undefined whether the findings will generalise to other categories of participants. Besides, the experiment results can be enhanced with the consideration of one month sleep for each type of *Feng Shui* bed arrangement. The current research employed one week test due to ethical reasons, time constraints and difficulties in finding volunteered participants.
- The developed design protocol for bedroom interior is somehow not ideal for smaller bedrooms which are more frequently happened Hong Kong and Singapore. The protocol can only be complied up to a certain level due to the unmatched bedroom scenarios. Besides, the protocol is only able to show limited interior arrangement combination. This is why the finalised design protocol is written with the statements of limitation, regarding its application to smaller bedroom and

subject to contingency plan. Perhaps in the structure can be further enhanced with more bedroom scenarios in order to develop a more comprehensive design protocol.

8.7 Recommendations for Future Research

This research has successfully formed an important reference for the architects and general bed users, as well as serving a foundation for future research. A few recommendations are suggested for the upcoming researches to expand the same body of knowledge, before the bedroom *Feng Shui* theories can be widely spread and applied. It is expected to open room for interesting findings in further experimental research. The recommendations are:-

- To expand the study by inviting non-local survey respondents and interviewees.
- To provide the respondents with actual experience in the predetermined bedroom scenarios for the selection of most preferable bed arrangement, if there is sufficient funding.
- To enhance the sleep experiment results by considering one month sleep for each type of bed arrangement, through ethical research planning and methods.
- To conduct the experiments for different groups of bedroom users, for instance old age adults or children. The sleep quality results are expected to be varying from one group to another.
- To enhance the design protocol by incorporating more bedroom scenarios in order to develop a more comprehensive design protocol.

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