

# Expertise Development in Commercial Property Valuation Practice

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*Abdul-Rasheed Amidu*

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Birmingham City University

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## **ABSTRACT**

Ever since the issue of inaccuracy and variance in commercial property valuation was first documented in the mid-80s by Brown (1985) and Hager and Lord (1985), many researchers have investigated the complex factors involved in effective problem solving in the valuation domain, focusing on the valuer and the valuation process. Several behavioural issues, including heuristics, have been noted to affect valuation outcomes. There is a growing literature on understanding the concept of expertise, especially using the field of cognitive psychology, and the present research explores valuer's cognitions in a commercial valuation context. The study aimed to determine how the role of valuers' cognitions and cognitive structures are crucial in furthering our understanding of effective valuation problem solving, as well as improving valuer training efforts.

The research was undertaken from a 'Critical Realist' perspective, and used a knowledge elicitation method called 'Cognitive Task Analysis'. Data were collected through a 'Verbal Protocol Analysis' (VPA) of a simulated commercial valuation exercise based on a real building, using semi-structured interviews. Six subjects (comprising two expert valuers, two intermediate valuers and two novice valuers) participated in the simulated valuation and in the follow-up interviews. Two further experts were interviewed to validate the findings.

Content and event-sequence analysis were performed on the data collected from the simulated valuation to yield the knowledge states, problem-solving techniques ('operators') and strategies used by valuers. Mapping of thought processes revealed that expert and intermediate valuers had better and well-structured patterns of thought which demonstrate greater degrees of cohesiveness and interrelatedness between problem-solving operators. Centred on data interpretation and meta-reasoning activities, expert and intermediate valuers used the problem-solving operators initially to schedule valuation analysis or establish valuation strategies, and to re-interpret and diagnose previously acquired information to update the outcome of their past valuations. Novice valuers' structured processes of solving the valuation

problem show fewer linkages between problem-solving operators, which may suggest underdeveloped cognitive structure or quick disengagement from task.

The results also show that where available data is inadequate, valuers solve an overall valuation problem by dividing the problem into a number of sub-problems that are solved by engaging in two main types of thinking: analytical and creative. These two levels of thinking enable the valuer to integrate available data with his/her existing knowledge through forward and retrospective ('backwards') reasoning. However, there were effects associated with level of expertise in the way these cognitive processes are used, with the expert and intermediate valuers being more fluid, thorough and comprehensive than the novice valuers. This enabled the expert and intermediate valuers to develop a greater number of more-sophisticated solutions to challenging valuation problems, and these were more likely to be immediately followed by meta-reasoning related activities or further exploration of data to justify the solutions generated. Novice valuers could not generate such well-developed solutions indicating that they were much more superficial in their valuation problem solving.

These processes are discussed and synthesised into a descriptive model of expert-valuer cognitive structure for undertaking valuation of a commercial property, in order to show an understanding of how valuers integrate the various cognitive processes to determine the value of a property based on available information. The research concludes with an assessment of the implications for valuation training and education.

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# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 BACKGROUND**

This study focuses on the development of expertise in a fundamental area of professional practice, the commercial property valuation domain. The study is conducted from a cognitive perspective. A particular focus of the study is the problem of how to develop the cognitive expertise of valuers within the context of complex commercial property valuation, so that the problem-solving methods are adaptable for improving professional development and training.

The central role of commercial property valuations for the efficient functioning of the property market is well established in the literature (see for example Baum et al., 2000). The input of a valuer is frequently required for a variety of decisions concerning issues as transfer of ownership, mortgage underwriting, insurance risk assessment and monitoring the performance of property investment. Seldom do people make a critically important decision in these without first consulting a valuer. This, therefore, creates opportunities for valuers to provide valuation services on a commercial basis. These opportunities enable valuers ability to develop competitive advantages in the area of information gathering, market analysis and interpretation and application of valuation methods and, are further strengthened by knowledge of the complexities of the property market and the uniqueness of a particular property that makes it difficult for transaction prices to be observed in the market (Wyatt, 2007).

Around the world, property professional bodies, including the Royal Institution of Chartered Surveyors (RICS) in the UK, have been very active in developing and maintaining professional standards to ensure greater credibility, reliability and clarity of valuation, and public confidence in the process. The RICS "Red Book", for instance, provides the most extensive and well-laid out rules and guidance that valuers must comply with when undertaking valuation for different purposes.

Furthermore, clients have the ability to pursue court actions against a valuer if they feel that the valuation advice received was so inadequate that it could be considered to be negligent.

Despite the existence of such codes of conduct, there is a growing scepticism among academia, media and in the legal system about the ability of professional valuers to make effective estimations of value because valuations are commonly believed to contain random errors and lag behind true market values. The perception of valuers' inability to provide accurate commercial property valuations was documented in several studies from the mid-80s to the late-90s (Brown, 1985; 1991; Hager and Lord, 1985; Adair et al., 1996; Brown et al., 1998; Crosby et al., 1998; Hutchison et al., 1995). In Brown et al. (1998), for instance, it was demonstrated that there is only a one in five chance of valuers recording value estimates that lie within 10% margin of the eventual sale price of a property. Crosby et al. (1998) also concluded that there is a two in three possibility that different valuers would report value estimates that vary within 10% of each other. What these and other researchers have shown is that valuations exhibit a relatively high degree of variance (a more in-depth discussion of valuation accuracy and variance is provided in section 2.5.1.1).

Initially, valuers did not offer any convincing explanations for inaccurate or widely differing valuations beyond the argument that valuation is an inexact art. However, as valuers started to feel increasingly vulnerable to claims of negligence from lay people and corporate clients, many, especially in the academic community, started to explore how valuations are performed. The focus of that line of research was to examine the role of valuers and their behaviour within the valuation process in order to have a greater understanding of what causes valuations to be inaccurate or unreliable. Some investigated, for example, the crucial and biasing effect of valuers' departure from normative models on valuation (Diaz, 1990a; 1990b; Gallimore and Wolverton, 1997; Diaz et al., 2002). Others focused on the role of judgment heuristics in commercial property valuations and the various reference points used by valuers in valuation decision making (Gallimore, 1994; 1996; Diaz and Hansz, 1997; 2001; Diaz and Wolverton, 1999; Gallimore and Gray, 2002; Northcraft and Neale, 1987; Gallimore et al, 2000). Finally, researchers such as Scott and Gronow (1990)

have highlighted the various components of valuation expertise which could be used in the production of an expert system. This research perspective assumes that valuers are neither entirely objective nor completely rational and, therefore, may utilise cognitive efficiency if they are to overcome natural processing limitations (Diaz, 2002)

Understanding the work of valuers thus seems a critical focus for researchers and this is necessary because an important component of the valuation problem solving, particularly in a commercial context, is the ability of the valuers to clearly rely and effectively utilise their valuation knowledge and experience in a manner appropriate to the client requirements. This not only impacts on valuers' training and development directly, but also contributes to high-quality valuation and client welfare indirectly. However, a shortcoming of the literature highlighted above is its failure to recognise sufficiently how valuers develop their expertise with regards to cognitive ability, especially with reference to the roles played by cognitive processes and structures in valuation problem solving. Thus, an investigation of expert valuers' cognitions seem crucial for advancing our understanding of commercial valuation practices as well as improving valuers' training and development efforts. This present research, therefore, intends to identify and describe expert valuers' cognitive processes and structures used in valuation problem solving in a commercial context. Expert valuers' cognitions, in this study, are considered to include the thinking and processes that occur during valuation problem solving. Detailed coverage of these processes is provided in section 2.3.2.1.

## **1.2 STATEMENT OF THE PROBLEM**

As noted above, although a large body of empirical investigations of valuers' problem solving behaviour exists in literature, very few researchers specifically have sought to describe expert valuers' cognitive development. In the early 90s, Scott and Gronow (1990) produced a conceptual paper which identified the various components of valuation expertise as applied to the domain of valuation of a residential property for the purpose of setting up a mortgage. The authors' adopted the cognitivists' perspective of expertise (as comprehensively discussed in section 2.3.2 of Chapter 2

of this study) and, with reference to existing cognitive psychology literature, identified and described five areas of valuation expertise based on an explication of the knowledge involved. Although Scott and Gronow (1990) also identified some of the cognitive processes (such as comparison, evaluation etc.) which may be applied in valuation problem solving, they did not provide any empirical evidence to support the use of those processes as is the case in many other domains of expertise (see section 2.5.2).

Since Scott and Gronow's study, the only known empirical study that is similar in some respect to this present study is that of Havard (2001b) which investigated a range of issues including valuers' decision making strategies in a commercial context. Although Havard's research focused mainly on anchoring and adjustment heuristics, the author also examined, superficially, incidence of use of some cognitive processes. One of the shortcomings of Havard's research is that it did not provide a deeper understanding of the processes identified and how they inform valuation expertise in commercial valuation problem solving. Moreover, the interaction between complex cognitive processes in expert valuers' commercial valuation problem solving is still poorly understood. It is important to understand how expert valuers make use of cognitive processes in their problem solving and how these processes integrate. Hence, the present research bridges this gap by providing a deeper understanding to the issue of how valuers develop and utilise their cognitive expertise in commercial valuation problem solving. To address this research objective, two key research questions were required, which were: 1) What are the knowledge states and cognitive processes used in valuation problem solving? and; 2) How might we understand the use of these knowledge states and cognitive processes in valuation problem solving? These research questions were explored using Cognitive Task Analysis (CTA) (as discussed in section 3.5).

### **1.3 AIM AND OBJECTIVES**

The main aim of this study is to identify and describe how valuers of different levels of expertise differ in terms of their cognitive structures and processes in commercial valuation problem solving and, in particular, provide a deeper understanding of how



to develop cognitive expertise that could inform any problem solving task in commercial property valuation. In order to accomplish this aim and, therefore, provide answers to the overall research problem and questions highlighted in section 1.2 above, a number of detailed research objectives were identified, which are encapsulated in the phenomenon of a valuer's cognitive development of expertise. These are set out below:

- i. To identify the knowledge states valuers concentrate on in the valuation task.
- ii. To identify the problem-solving operators valuers used to represent the knowledge states.
- iii. To investigate the problem-solving strategies valuers used to generate the knowledge states.
- iv. To map the thought processes represented by valuers in the valuation task.
- v. To develop a descriptive model of expert valuer cognitive structures for development of expertise.

#### **1.4 CONTRIBUTIONS**

As highlighted in previous sections, this research contributes to the literature on expertise by developing cognitive structures of expert valuers' in solving commercial valuation problems. This is particularly significant in the sense that it may provide opportunities for further application in other areas of study. Additionally, this study bridges the gap that presently exists within the behavioural valuation literature by providing empirical evidence of valuers' use of cognitive processes in commercial valuation. The past empirical research of Havard (2001b) employed a quantitative approach and did not account for the complex nature of the cognitive processes used in a commercial valuation. This present study gives deeper understanding by specifically describing expert valuers' use of cognitions and contrasting them with those possessing intermediate abilities and novices in the same field.

By providing a comprehensive understanding of expert valuers' cognitive processes and structures, this study could inform current valuation practices as well as valuation training programmes. Specifically, experienced valuers' cognitions could provide further understanding and insights of valuation knowledge and practices for valuation practitioners. Understanding and documenting what goes into expert valuers' cognitions, and how they are utilised and applied, could also provide means for valuers to reflect and improve their own valuation practices. Moreover, the results of this research could be useful for valuers in the experiential components of their training to achieve a higher level of cognitive functioning.

Similarly, what is involved in expert valuers' cognitive processes and structures in commercial property valuation problem solving is important for valuation educators and practitioners in order to effectively train more valuers. For instance, what specific valuation information is prioritised by the expert valuer and how is this information used in valuation problem solving? Furthermore, what are the cognitions of expert valuers and how are they utilised in valuation decision making, and how can they be categorised? Better understanding of these approaches to such questions are crucial and may inform current valuation education as curriculums are revised, and more goal-specific practices are offered to trainee valuers. In summary, the empirical evidence presented in this research could improve the current understanding and knowledge of valuation experts that will facilitate continual progress in valuation practices and education.

## **1.5 CONTEXT**

Specifying the context in which the phenomenon of valuers' cognitions manifest in valuation problem solving is important and is in alignment with the Critical Realist stance (Layder, 1993; Danermark et al., 2002), the philosophical perspective guiding this research (see section 3.3.1 herein). Doing so allows easy identification of the features of the entities involved in the phenomenon being investigated; which is valuers' cognitions in the present context of this research. The identification of the context can be done using different criteria (Miles and Huberman, 1994) such as participants, space and time (Creswell, 1998; 2003), activity (Stake, 1995) or process

(Yin, 2013). In this study, both activity and participant criteria were adopted; the latter is discussed in-depth in section 3.6 of Chapter 3. Accordingly, this research is set within the context of valuers who have acquired certain knowledge and skills in commercial valuation, a type of valuation focused on property mostly intended for income generation (i.e. office, retail, industrial etc.). The terms 'commercial valuation' and 'valuation' are used interchangeably in this research.

Valuation is a branch of the real-estate profession. The basic aim is to provide a single quantitative measure of value that is derived through one's access to, and control of, property. In other words, valuation is simply an estimate of value derived from the ownership of property. A more functional and all-embracing definition of valuation is provided in Millington (2014, p. 8) as

*"the art or science of estimating the value for a specific purpose of a particular interest in property at a particular moment in time, taking into account all the features of the property and also considers all the underlying economic factors of the market, including the range of alternative investments"*.

One of the key features of this definition is that it emphasises the concept of value as the basic aim of any valuation assignments. However, the word 'value' can be more difficult to define precisely as it could mean either usefulness (value-in-use) in one sense, or purchasing power (value-in-exchange) in another. Therefore a property can either have a value-in-use or value-in-exchange with the latter being the frequently sought in most valuation instructions (Wyatt, 2007).

From the professional valuers' perspective, the concept of value-in-exchange is synonymous to the market value basis of valuation which is *"the amount for which a property will transact on a particular date"* (Pagourtzi et al. 2003: p. 383). Due to the ambiguity surrounding the word 'value' the International Valuation Standards Council (IVSC) has prescribed a 'standard' to provide a common definition of market value for valuers to follow (Pagourtzi et al. 2003). Within the framework set by the IVSC, the RICS (2012, p. 30) defines market value as

*"The estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion"*

To estimate market value, the valuer needs to examine a range of features that are likely to impact on the value of the subject property. These features are broadly categorised into two groups: property specific, and market related features (Wyatt, 2007). The property-specific features relate directly to the subject property itself and include, for example, physical features (size, age, repair condition, external appearance etc.), legal considerations (interest-freehold or leasehold, users' restrictions, rent, review clause etc.) and location (accessibility, agglomeration economies etc.). The market-specific features, on the other hand, relate to the property market as a whole and include, for instance, national output (measured by Gross Domestic Product (GDP)), household disposable income, consumers' spending, retail sales and the tastes of consumers and clients. Wyatt (2007: p. 71) further argued that

*"the wider market factors have less to do with the valuation itself and more to do with context and form part of the cognitive background that valuers bring to a valuation, including market knowledge and an awareness of legislative framework, environmental policy and economic activity".*

With regards to the property-specific features, the valuer must be able to quantify their effects on value (Wyatt, 2007) and reflect that in the chosen valuation method (Pagourtzi et al. 2003). This is usually accomplished through the application of the concept of comparison, which is explained later in this section. However, this does not mean that valuation is simply a mathematical process. Rather, significant parts of the valuation process require valuers to exercise professional judgment on a wide range of issues, including the choice of valuation methods and data input into processing the methods (Maes, 1976; Millington, 2014; Ratcliff, 1972a; 1972b; 1975). In support of this argument, Kahn et al. (1963) also pointed out that the value of a report rests on the degree to which the valuer has good judgment in applying basic theory in an organised manner to the observations he has made, the data he has collected, and the problem he has considered.

Valuation is therefore an opinion-based exercise that relies heavily on mental processes (Rams, 1976; Scott and Gronow, 1990). These processes as

conceptualised by Kinnard (1971) and Dasso et al. (1977) involve four major tasks: (a) preparation of an outline; a plan or blueprint for action by the valuer; (b) assembling materials for analysis of market and property data; (c) applying appropriate tools of analysis: analytical techniques and approaches; and (d) applying judgement to reach a conclusion in terms of decision standards. Rams (1976) identified these tasks as genesis, diagnosis, analysis and synthesis. Levy and Schuck (1999) argued that valuation process is like a signal processing system that involves the filtration and interpretation of property- and market-information to produce an estimate of market value.

Some authors also maintained that valuation is a problem-solving process involving three functions: analysis and interpretation of both the problem (definition of value of an interest) and property (physical, legal, locational and environmental attributes) and prediction of market value (Lusht, 1981; 1997; Whipple, 1990; 1995) through the application of valuation methods. These processes are all conceptual ideas that form part of the general cognitive processes that have been identified from the cognitive psychology literature described in Chapter 2) but need to be evidenced in terms of their actual usage in valuation problem solving; this is investigated in this research.

In estimating a property's market value, valuers often need to apply valuation methods and procedures that are appropriate to the characteristics and nature of the property, and the conditions under which it is most likely to be sold. Also, differences in culture and experience in a country will determine the methods adopted for any particular valuation (Pagourtzi et al. 2003). Therefore, the method (or approach) to valuation in one case may not be appropriate in other circumstances. The introductory property-valuation texts in the UK (for example, Enever, 1989; Millington, 2014) generally make reference to the five traditional methods of valuation, that is (1) sales comparison; (2) income capitalisation; (3) replacement cost; (4) residual; and (5) profit. Of these five traditional methods, the first three have been noted as internationally recognised (Wyatt, 2007) and the most commonly used methods in the majority of valuations around the world (see, for example, Peto, 1997; Baum and MacGregor, 1992; Baum et al., 1996; Peto et al.,

1996). Vernor and Rabianski (1993) also reaffirmed these methods (sales comparison, income capitalisation, and replacement cost) as the US norm.

Although the five traditional methods mentioned above have attracted considerable interest, the 'comparison' approach has been the most influential especially among professionals within the property valuation disciplines. Pagourtzi et al. (2003) argued that the majority of all methods of valuation rely upon some form of comparison to assess market value. Comparison is, therefore, perceived as the cornerstone of all value judgements and one that often poses is particularly challenging in its application to professional practices (Enever 1989; Enever et al., 2014). Thus, the focus of discussion of valuation methods in this section is the comparison approach. This treatment also minimises any confusion that global comparisons may cause.

The comparison approach (or method of valuation) is based on the economic principle of substitution which states that "a purchaser would pay no more for real property than the cost of acquiring an equally desirable substitute" (Lusht, 1997; Boyce et al., 1984). Kummerow (2002, p. 2) provides a chronological process that describes the valuers' task in the application of sales comparison. This includes

*"(a) identifying the market in which the property is traded, (b) Choosing which sales are best to use to infer price, (c) Identifying price-affecting characteristics that differ between sales and the subject property, (d) Estimating the dollar value of the differences for each pair-wise comparison of the subject sale, and (e) "Reconciling" to give a single price estimate, where indicated values of the subject from different adjusted comparable sales are not identical"*

The main objective of this process is to gather recent comparable pieces of evidence that can be substituted for the subject property but sufficiently different to enable prices to be separated into component elements to reflect the market response to a variation in the features. Thus, the process is heavily dependent on the availability of data. Also, it requires the valuer to make adjustment to account for differences in features such as size, age, quality of construction etc. (Pagourtzi et al., 2003). The nature of such adjustment and how other problems are dealt with within the

valuation process will reflect the professional knowledge and problem-solving ability of the valuer which is further examined in the present study.

As indicated earlier, the valuation professions are, to some extent, regulated by professional bodies, such as the RICS in the UK. The main goal of these professional bodies is that it *"ensures accountability, establishes education and training requirements, sets standards and imposes disciplinary procedures on its members"* (Wyatt, 2007, p. 101). With regards to education and training, the RICS requires that valuers who practice in the UK are registered chartered surveyors who must have relevant academic qualifications and *"sufficient current local, national and international (as appropriate) knowledge of the particular market, and the skills and understanding necessary, to undertake the valuation competently"* (RICS, 2012, p.17). Additionally, it is argued, based on the foregoing discussion, that the ability of valuation professionals to reason through the valuation process and solve problems requires effective use of cognitions, which is investigated in this study to further guide valuation education and training.

## **1.6 SCOPE AND LIMITATIONS**

There are several areas of delimitation which seek to determine the boundaries of this present research. First, and as mentioned in the previous section, this study is set within the context of valuers in commercial valuation practice. The focus on commercial valuation area, therefore, resulted in deliberate exclusion of valuers working in other areas (for example, rural and residential properties). As widely acknowledged in the literature, valuers' cognitions are likely to be different in these other contexts of valuation practice.

Second, the model of cognitive structures developed in the present research is based upon the experiences of six research participants who are familiar with the property market in Birmingham, UK. The explanation of the findings can be generalised only to the extent that they may be useful to other researchers who want to apply them to similar situations. This is not so much a limitation – but rather a characteristic –

of the philosophical position of Critical Realism's ontological methods selected to guide this research.

Third, the task for the analysis was limited to only one valuation case, which provided property and market data to determine the market value of a warehouse. Due to this, the valuation case could not be considered an exhaustive one.

Fourth, this research was based on a comparison between the valuation approaches adopted by experts and novices. This approach helped to identify and describe gaps in the cognitive structures of the novice valuers. Although an in-depth investigation of how expert valuers developed their cognitive ability from novice to expert would be illuminating, this was beyond the scope of this research.

Fifth, cognition is a complex multidimensional and context-dependent human phenomenon, in which the journey towards its development is shaped by many other complex and intrinsic factors, including intuition and tacit knowledge. This present study did not seek to interpret the role played by these factors in the cognitive development of expert valuers.

Finally, it is argued in literature that experts are more accurate than novices when solving problems in their specific domains (e.g., Chi et al., 1982). This aspect of expert-novice differences was excluded from this research, in which emphasis was on identification of valuers' cognitive processes and not on their valuation outcomes.

## **1.7 SUMMARY**

The present chapter introduced the problem investigated in this study, which is that there is lack of comprehensive understanding of cognitive processes and structure in commercial valuation disciplines. One research question in particular helps to refine this research problem. The question essentially asks: How do valuers develop and



utilise their cognitive expertise in commercial valuation problem solving? This question is important as valuers' cognitions appear not to have sufficiently addressed in previous valuation literature. This chapter also presented the context in which valuers' cognitions manifest themselves in commercial valuations. The chapter argued that although valuers operate within a set of guidelines, they are largely independent and are required to solve problems, make judgement and justify them using their professional knowledge and cognitive skill. Thus cognitions can be considered as a central tenet for valuation expertise and problem solving. It is hoped that the research findings help to further the understanding of the complex research problem of how valuers develop and utilise their cognitive expertise in commercial valuation problem solving.

## **1.8 OVERVIEW OF CHAPTERS**

The present study is presented in six chapters. Chapter 1 introduced the study, identifying the research aim, objectives and areas for investigation. Chapter 2 presents a review of the literature on the theoretical framework informing the development of expertise and the empirical studies that have been conducted to provide an understanding of the subject from different domains. Chapter 3 presents the philosophical framework underpinning the research approach alongside a detailed outline of the method adopted in collecting and analysing the data for the study. Chapters 4 and 5 present the research findings; with the latter presenting the discussion of results in the view of current expertise literature and development of the research model. Finally, Chapter 6 presents the conclusions of the study and provides recommendations for future research.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

This chapter provides a detailed review of relevant literature on expertise to set the context for the empirical investigation engaged in the present study. The key issues of the nature of professional expertise and its development are explored first. The various cognitive and experiential theories of expertise that have been developed through both theoretical and empirical researches are identified and contrasted in order to draw a distinction between these two perspectives of how individuals may develop professional expertise. Although this study is based primarily on cognitive psychology, which associates expertise to personal knowledge, the experiential perspective – learning from experience – is equally important in the development of expertise, especially in providing an understanding of how individuals transform their knowledge in professional practice. Additionally, the theories of problem solving have the potential to contribute to the development of a more holistic understanding of knowledge and how it is utilised. Thus, this chapter also endeavours to identify the problem-solving theories and strategies that could explain how practical commercial valuations may be dealt with, especially when they are complex and ill-defined in nature.

Following on this, the chapter considers the mainstreams or frameworks under which empirical understanding of expertise have been conducted from the cognitive perspective. This is significant not only in terms of clarifying the basic assumptions and goals prevalent to each stream, but also in highlighting the different methodological approaches used to study expertise.

#### **2.2 THE NATURE OF PROFESSIONAL EXPERTISE**

The literature concerning the concept of expertise is extensive and continues to increase (Gobet, 2016; van Winkelen and McDemott, 2010). Yet there is still no consensus as to what constitutes expertise or how it may be measured. Hoffman et

al (1995) maintained that there are almost as many definitions of experts as there are researchers who have attempted to study them. Farrington-Darby and Wilson (2006) argued that because of the many different approaches adopted in understanding expertise and many needs for its application, defining the concept of expertise is no easy matter. Ericsson (2006, p. 3) cites Wikipedia definition of an expert:

*"An expert is someone widely recognised as reliable source of knowledge, technique or skill whose judgment is accorded authority and status by the public or his or her peers. Experts have prolonged or intense experience through practice and education in a particular field"*

Key features of this definition significant to this present study are that (a) experts possess a unique body of knowledge not generally available to the general public and, (b) both training and experience are critical to developing expertise. These features emphasise the central role of knowledge (as advanced in cognitive psychology) and practice (based on experiential models) in the development of expertise. These two perspectives are further examined in the following section.

### **2.3 THEORETICAL FRAMEWORK FOR DEVELOPING EXPERTISE**

Understanding how experts develop in their subject domain is a traditional field of cognitive psychology. As shown in section 2.5, this field has produced many empirical researches on expertise, and several cognitive theoretical explanations have been proposed (Gobet, 1998), attributing expertise to particular types and bodies of knowledge acquired through cognitive processes (Faulkner et al., 1998). Experiential theories as derived primarily from the medical professions provide alternative explanations for the development of expertise. Rather than viewing expertise as knowledge in human memory, shaped by intrinsic qualities, experiential theories emphasise the external context of experts with specific reference to the significance of learning from experience of 'doing', that is, practical knowledge. Eraut (1994) argued that the rationale for this paradigm shift is the need to recognise how theories are used in practice. The contention here is that knowledge is rarely used without having to go through some form of transformation.

Although, these two broad categories of theories reflect a spectrum of views on the development of expertise, they are considered appropriate in defining the conceptual framework for this study. Hence this section compares some of the main contenders within both categories. According to Gobet (1998, p. 2), there are two main approaches for undertaking such a theoretical comparison:

*“to compare theories across several domains, emphasizing the general principles stressed by each theory, or to focus on a particular domain, analysing in detail the explanations offered by each theory”.*

The former approach is adopted in this section, in an attempt to provide general explanatory frameworks of expertise as opposed to the narrow view of a particular domain.

### **2.3.1 Experiential models of expertise**

As indicated earlier, experiential theories emphasise the significance of practical knowledge. Researchers in this line of thinking focused primarily on skill acquisition and several models have been proposed with each attempting to outline representative patterns and qualitative distinct stages of learning along a developmental continuum. The five stage progression of skill acquisition in adults proposed by Dreyfus and Dreyfus (1986; 1988; hereafter, Dreyfus model) and further explicated by Benner (1984) and Bloom’s (1985) three-phase model of learning for children and young adults are some of the main contenders within an experiential orientation.

Although the skill acquisition models mentioned above have attracted considerable interest, particularly in the health profession, the most influential has been that of Dreyfus brothers. Yelder (2004; 2009) also maintains that while there is much literature available that has focused on practical knowledge, the majority of papers relied on the Dreyfus’ model either to further advance the notion of expertise or as a foundation for its critique. Thus, the focus in this section is on the Dreyfus’ model of skill acquisition, although other alternative models proposed within the experiential contention are also considered in the subsequent discussion.

### ***2.3.1.1 Dreyfus and Dreyfus' model of skill acquisition***

The five-stage Dreyfus' model of skill acquisition was developed as part of research on computer expert systems, artificial intelligence and the nature of human expertise. In the 1980s, when many people were celebrating the dawn of the era of computers and artificial intelligence, the Dreyfus brothers were concerned about the claims made by experts in artificial intelligence on the ability of computers to simulate human judgment and reasoning. Following this concern, they started researching into the processes of human skill acquisition in three domains (automobile drivers, chess players and airline pilots) and subsequently produced a five-stage novice to expert skill acquisition model, which has now become a more broadly based model of expertise (Eraut, 1994). The model states that as practitioners acquire a skill, they go through five developmental stages. These are (1) novice; (2) advanced beginner; (3) competent; (4) proficient; and (5) expert. Each stage has unique and qualitative distinctions along the developmental progression. A brief summary is given in Table 2.0.1 below as provided in Eraut (1994, p. 124).

Although the Dreyfus model is presented as five stages of skill acquisition, it emphasises perception and decision making as opposed to routinised action. Eraut (1994) states that although the Dreyfus brothers referred to skilled behaviour as connoting semi-automatic – rather than deliberate – processes, they define skill as an integrated all-inclusive approach to professional action and this will encapsulate both routines and the decisions to use them. The Dreyfus brothers further argued that skill acquisition, in some cases, can remain at the competent stage, notwithstanding years of professional experience. Thus, the transition to higher stages, i.e. proficient and expert stages, does not automatically happen with the passage of time in professional practice (Dreyfus, 2008; Benner et al. 1996). This will require, among other things, a learners' emotional ability to accept risk and responsibility associated with their performance outcomes (Dreyfus and Dreyfus, 1996); although the model acknowledges that this transition does not necessarily need to happen for all learners.

Table 2.0.1 Dreyfus and Dreyfus' (1986; 1988) stage model of expertise

Stage 1 – Novice	<ul style="list-style-type: none"> <li>➤ Rigid adherence to taught rules or plans</li> <li>➤ Little situational perception</li> <li>➤ No discretionary judgment</li> </ul>
Stage 2 - Advanced Beginner	<ul style="list-style-type: none"> <li>➤ Guidelines for action based on attributes or aspects (aspects are global characteristics of situations recognisable only after some prior experience).</li> <li>➤ Situational perception still limited.</li> <li>➤ All attributes and aspects are treated separately and given equal importance</li> </ul>
Stage 3 – Competent	<ul style="list-style-type: none"> <li>➤ Coping with crowdedness</li> <li>➤ Now sees actions at least partially in terms of long-term goals</li> <li>➤ Conscious deliberate planning</li> <li>➤ Standardised and routinised procedures</li> </ul>
Stage 4 – Proficient	<ul style="list-style-type: none"> <li>➤ Sees situations holistically rather than in terms of aspects</li> <li>➤ Sees what is most important in a situation</li> <li>➤ Perceives deviations from the normal pattern</li> <li>➤ Decision-making less laboured</li> <li>➤ Uses maxims for guidance, whose meaning varies according to the situation</li> </ul>
Stage 5 – Expert	<ul style="list-style-type: none"> <li>➤ No longer relies on rules, guidelines or maxims</li> <li>➤ Intuitive grasp of situations based on deep tacit understanding</li> <li>➤ Analysis approaches used only in novel situation or when problems occur</li> <li>➤ Vision of what is possible</li> </ul>

### ***2.3.1.2 Benner's revised model of skill acquisition***

While the domains of focus of the Dreyfus brothers' model was limited to the areas of chess, car-driving and plane-flying, Benner (1984) demonstrated that the model can be readily applied to professional work. In her work on skill acquisition along a novice to expert continuum (Benner, 1984; Benner et al., 1996) she combined learning and development to develop a research-based framework which is now widely used to understand and promote learning within the domain of nursing. Benner's developmental timeline mimics that of the Dreyfus, with a minimum of five years being the time required to attain expert stage.

It is also worth mentioning that two additional theoretical stages have been added to the five-stages originally proposed in the Dreyfus' model of skill acquisition, namely, Stage 6 – Mastery (developing one's own style) and Stage 7 – Practical Knowledge (ability to do things appropriately) (Dreyfus, 2008).

### **2.3.1.3 Other experiential models of expertise**

Within the experiential orientation, other models (such as Raiola (1990) and Rolfe (1996)) have been proposed as alternative views to the novice to expert skill-development models. Using the domain of outdoor education, for instance, Raiola (1990, p.237) posited a four-stage cycle in the development of outdoor leadership expertise as given in Table 2.0.2 below.

Table 2.0.2 Raiola' (1990) cyclical model of expertise

Stage 1 - Unconscious Incompetence	Student is unaware of skills, knowledge and experiences associated with effective leadership
Stage 2 - Conscious Incompetence	Student becomes aware of his/her level of incompetence at specific skills and knowledge associated with effective leadership
Stage 3 - Conscious Competence	Learning skills and information, leader is very aware of skills and knowledge, and is immersed in that awareness to the point of awkwardness
Stage 4 - Unconscious Competence	Leader is able to operate at a high level of skill and abilities without conscious effort

Raiola (1990) developed his framework for the development of expertise in a cyclical model. Each stage of the model requires new learning. Thus, every time a leader attains a new stage the cycle starts again.

### **2.3.1.4 Evaluation of experiential models of expertise**

As demonstrated above, the approaches adopted by experiential theorists emphasise perception and understanding based on ability for 'picking up' of flexible style of professional behaviours and not rules (Eraut, 1994). This view is also corroborated by English (1993) who maintains that the experiential models place emphasis on learning in context which stands in marked contrast to habitual focus on theoretical

instruction. In particular, the Dreyfus' model highlights the significance of knowing how, rather than knowing absolutely, and supports the existentialist opinion that the skill required to knowing how is not knowing a lot of facts and rules, but human understanding of their relationship (Dreyfus and Dreyfus, cited in Eraut, 1994).

Authors (see for example Gobet and Chassy, 2008) writing about experiential models also argued that the progressive development from slow and hesitant to fast and fluid problem-solving behaviour provided in Benner's model captures certain aspects of the development of expertise very well, particularly in terms of the complexity of professional works and the timeframe needed to develop expertise. They also recognised the important contribution her work has made to the domain of nursing, emphasising the fact that her model provides significant insights on the complex interaction between nursing theory and practice (Gobet and Chassy, 2008).

Also worth mentioning is the fact that in the experiential approaches to expertise the role of emotions and implicit knowledge is emphasised, which is rarely the case in most researches on expertise (Gobet and Chassy, 2008). This point is further echoed by Eraut (1994, p.127) who opined that "*The strength of the Dreyfus model lies in the case it makes for tacit knowledge and intuition as critical features of professional expertise in 'unstructured problem areas'*". Finally, Kinchin and Cabot (2010) argue that a practitioner can, at least, identify the characteristics that indicate developing expertise is the experiential models' greatest strength, as this is a potential guide to becoming an expert.

In spite of the above and, indeed, their popularity, experiential models have been criticised by authors (see for example English, 1993; Eraut, 1994; Gobet and Chassy, 2008 and Kinchin and Cabot, 2010) on various grounds. A discussion of these follows.

First is the presence of stages in the development of expertise without adequate definitions and the criteria for attaining them. As argued earlier, each of the stages



has unique and qualitative characteristics along the developmental trajectory, which has the potential to provide a clear path to progression (Kinchin and Cabot, 2010). However, there are no explicit definitions of what they mean (English, 1993; Gobet and Chassy, 2008). Thus, it is extremely difficult to identify at what stage a practitioner might be on in the models that have been advanced. Similarly, the evidence presented in literature to justify the existence of stages appears very weak. Gobet and Chassy maintained that the use of years of supervision experience and judgements as criteria for assigning nurses to stages in Benner's comprehensive study of nursing practice is not reliable and also uncorrelated with expertise. Gobet and Chassy (2008, p.13) also state that the other concern with the stages presented by experiential theorists is that "*...it is well known from research in developmental psychology that empirically establishing the reality of stages is a difficult matter, requiring complex mathematics ... and a wealth of quantitative data, which are lacking in this case*". Arguably, while this may be true, at least in establishing criteria for expert attainment, it is interesting to note that most professional practices such as real estate have well-established criteria for assessing a lower level 'competence' for the purpose of professional registration (see for example, the guidance on assessment of professional competence, RICS, 2015).

Second is that developing expertise requires a shift in knowledge from abstract principles to concrete past experiences and from explicit to implicit knowledge. At the centre of experiential models is an emphasis almost entirely on learning from experience (learning in context). However, as pointed out by Eraut (1994), in reference to the Dreyfus' model, there is lack of explanation as to how this occurs. Rather, there was occasional reference to theoretical learning or the development of fluency on domain tasks (Kinchin and Cabot, 2010). The presumption here is that the expert no longer relies on rules or guidelines (explicit knowledge); they are in fact forgotten. Instead, an intuitive grasp of situations is developed based on a deep implicit underpinning knowledge (Kinchin and Cabot, 2010). In relation to this, Gobet and Chassy (2008, p.132) observed that "*The list of competencies identified by Benner (1984) contains items that clearly require access to explicit knowledge*". In support of their view, Gobet and Chassy (2008, p.132) cited example of three competencies, namely, "providing an interpretation of the patient's condition and giving a rationale for procedures", "Getting appropriate and timely responses from

physicians” and “Contingency management: Rapid matching of demand and resources in emergency situations” which relate to explanation, communication and organisation skills respectively, and all go beyond intuition and recognition ability. Although Dreyfus and Dreyfus (1996) seem to acknowledge this by arguing that “...*practice without theory, cannot alone produce fully skilled behaviour in complex domains such as nursing*”, this was not accounted for in neither their model nor that of Benner.

Third is the fact that the experiential approaches turn to emphasise implicit (tacit) knowledge and intuition as core attributes of the development of professional expertise, especially in ill-structured problem solving (Chi et al., 1988). In relation to their model for instance, Dreyfus and Dreyfus (1986, p. 30) stated that: “*The proficient performer, while intuitively organising and understanding his task, will still find himself thinking analytically about what to do*”. However, “*An expert’s skill has become so much a part of him that he need be no more aware of it than he is of his own body*”. Eraut (1994) also maintains that the model posited by the Dreyfus brothers presumed that most expert performance is automatic and non-reflective. This by implication not only precludes the use of reflection but also underestimates the role played by analytic and conscious problems at the expert level (Gobet and Chassy, 2008). To support their view, Gobet and Chassy (2008) cited two cases in the domain of chess where information search and analytical thinking need to be combined to achieve expert performance.

Interestingly, while Benner (1984) seems to have acknowledged this omission by agreeing that critical thinking may be necessary in two circumstances (when there was no prior experience on the task or when the initial intuition was wrong), she did not consider this as complementary to their theory (Benner et al. 1996), despite the fact that there are much theoretical and empirical evidence sources in the literature (see for example Hammond, 1988; Cader et al. 2005; and Offredy et al. 2008), establishing that expert problem solving and decision making requires both intuition and analytical processes in the domain of clinical judgment.

A related point is the claim by some experiential theorists that intuition and tacit knowledge cannot be explained or modelled for teaching (Kinchin and Cabot, 2010). Clearly, if practitioners are to advance the practice of others, then they must be able to verbalise the knowledge underpinning their own practice in order to share with colleagues (Rolfe and Fulbrook, cited in Yelder, 2004). Authors (such as Jarvis, 1996; Gobet and Chassy, 2008) have also argued that professionals' inability to articulate their actions may be due to the fact that they lack the appropriate tools to clearly reveal what it is that they are doing, and/or the vocabulary or self-awareness to articulate it. For instance, Gobet and Chassy (2008, p.132) observed that: *"...some of the methodology used by Benner and her colleagues (in particular narrative interviews in small groups of nurses) does not seem the most appropriate, as it uses a channel of communication that is essentially limited to the verbal modality"*. Finally authors within the field of cognitive science (see for example, André and Gobet, 2008; Hoffman and Lintern, 2006; Basque et al, 2008) have demonstrated that with the use of appropriate tools (such as concept mapping), tacit knowledge can be made explicit.

In summary, the experiential models presented in this section define distinct learning stages of skill development and identify unique and qualitatively distinct learning experiences at each stage. This is significant not just in terms of the simplicity with which they explain learning in the context of professional practice, but also in the extent to which their use can potentially provide a guide to practitioners who strive to become an expert. It is also widely acknowledged by key authors that the central feature of their model is learning from experience but that experience alone does not transform into expertise. If experience on task is not enough, then what are the other factors influencing the development of professional expertise and, how do they interact with practice learning to ensure the realisation of full expertise? The field of cognitive psychology has attempted to address these questions empirically as well as conceptually, and has also arrived at conclusions (see for example Hammond's (1988) Cognitive Continuum Theory) that could be complementary to the experiential models described in this section. The next section presents an overview of theories within the cognitive psychology.

### **2.3.2 Cognitive psychological models of expertise**

As stated earlier, understanding the development of expertise is a traditional field of psychology. However, unlike in the experiential orientation, there are few actual models of expertise that have emerged from cognitive psychology. Instead, a vast majority of authors have written about the subject of expertise based on their theories, which have generally provided a focus for research on the acquisition of expertise as a cognitive process (for instance, the phenomenon of cognition, such as memory limitations and reasoning biases) and for discussion on cognitive theory issues such as that involving knowledge representation (Hoffman, 1998). Hoffman (1998) further maintains that some judgment and decision-making research may also be considered, on reflection, as studies of expertise.

To limit the details proposed by these theories, this section focused on Hoffman's (1998) development progression model (which is clearly described, conceptually organised and provides a detailed coverage of cognitive processes) and Schmidt et al. (1990) four-stage model (which has been very instrumental in studies of clinical expertise within the domain of medicine).

#### ***2.3.2.1 Hoffman's development progression model of expertise***

Focusing on the developmental progression of expertise, Hoffman describes the process as evolving from a superficial and literal understanding of problems to an, articulated, conceptual and principled understanding; both levels representing the qualitative marks of novices' and experts' cognition respectively. The distinction in developmental level between 'novice' and 'expert' involves qualitative shifts and stabilisation in knowledge and performance. In the continuum of development model posited, Hoffman also included a shift from expert stage to 'master' stage whereby an expert is viewed by others as being the consummate, elite, expert and who is able to explicitly communicate his/her knowledge through teaching. Table 2.0.3 below presents the seven distinctions proposed for his continuum of development.

Table 2.0.3 Hoffman's (1998) development progression model

Naivette	One who is totally ignorant of a domain
Novice	Someone who is new, a probationary member, and has only had limited exposure to the domain
Initiate	A novice who has begun introductory instruction
Apprentice	One who is learning and able to undergo a program of instruction by following someone at a higher level
Journeyman	An experienced and reliable person who can perform unsupervised, but through orders
Expert	A person who is highly regarded by peers for his/her uncommonly accurate and reliable judgments, consummate skill and economy of effort in performance, dealing with rare cases effectively and possessing special skills or knowledge
Master	A person who belong to an elite group of experts whose judgments set the regulations, standards, or ideals and qualified to teach others at a lower level

The distinctions were expressed using the original terminology of the 'craft guilds' of the Middle Ages. As posited by Hoffman (1998), the shifts in developmental milestones are underpinned by the cognitive functionality of experts as derived from research on the expert's knowledge and reasoning processes. These shifts are investigated in terms of knowledge structure and organisation, perceptual skill, case-based reasoning, reasoning flexibility and the declarative-to-procedural shift. A summary of the main features of experts' knowledge and problem solving operators synthesised from studies within cognitive psychology is provided in Table 2.0.4 below.

It is also arguable whether the concept of 'intuition', as advocated in the experiential models could, in some cases, be as well portrayed as rapid pattern-recognition and perceptual awareness. English (1993) supported this view by saying that "...intuition as described by Dreyfus and Dreyfus (1980) refers principally to decision making, but the main use of intuition as described by Benner's (1984) subjects refers to a perceptual process, and reference to cognitive psychology models of memory offer clear explanations more capable of accounting for 'intuitive' responses" (p.393), although he maintains that "the example of nurses' intuition given by Benner (1984) tend to be ones of recognition (that there was something wrong) rather than identification (which would allow them to say what it was that was wrong)" (p.392).

Table 2.0.4 Hoffman's (1998) Experts' knowledge and problem solving operators

Knowledge structure and organisation	<ul style="list-style-type: none"> <li>➤ Knowledge is extensive and domain specific, draw more complex conceptual distinctions (more abstract) and highly differentiated</li> <li>➤ Concepts are interrelated in meaningful ways and memories are concept-context and context-addressable</li> <li>➤ Remember not the verbatim cases, but rather their meanings and inferences made</li> <li>➤ Represent knowledge in the form of 'mental models' which are dynamics, concept-based imaginal representations and largely abstract</li> </ul>
Reasoning processes	<ul style="list-style-type: none"> <li>➤ Generate representations which are conceptually richer and more organised</li> <li>➤ Use 'abstract' representation that rely on 'deep knowledge'</li> <li>➤ Better able to gauge the difficulty of problems and know the conditions for the use of specific knowledge and procedures</li> </ul>
Perceptual skill	<ul style="list-style-type: none"> <li>➤ Allocate attention more efficiently, focusing on abnormal features that differentiate the images</li> <li>➤ Rapid perceptual process without explicit evaluation of different cues</li> </ul>
Case-based reasoning	<ul style="list-style-type: none"> <li>➤ Often refer to illustrative or prototypical examples to justify or explain decisions or actions</li> </ul>
Reasoning flexibility	<ul style="list-style-type: none"> <li>➤ Increased ability to form multiple alternative interpretations and representations of problems, to revise old strategies and create new ones as problem solving proceeds and to generate frameworks for reinterpreting novel difficult decisions</li> </ul>
Declarative-to-procedural shifts	<ul style="list-style-type: none"> <li>➤ Knowledge often becomes less verbalisable</li> </ul>

In developing his model, Hoffman was quite emphatic at the outset that the development of expertise is underpinned by differences in individual behavioural and psychological attributes. This is a key factor which seems to have been neglected in the experiential models of expertise where intuition is the exclusive province of expertise. He was also clear that years of experience alone cannot deliver expertise. Finally, his last stage (master) emphasises the significance of explicit knowledge for the purpose of communicating an expert knowledge and skills to other professionals; although he also cites other works (such as that of Lesgold et al. (1988)) which maintain that "whenever a skill (e.g., reading, bicycle riding) is highly practiced, knowledge that is initially taught explicitly becomes tacit or 'automatic'" (Hoffman,

1998, p.91). Hoffman further argues that this leads to a potential paradox given that “the knowledge they need to show in order to prove that they are experts is the very knowledge the expert is least able to describe or talk about” (p.91). As a critique, it can be argued that the skills presented (reading and bicycle riding) as becoming tacit and automatic with practice are not really as complex as those that the professionals use in practice, particularly in dynamic real estate markets where automatic behaviour could present serious consequences, as the present study demonstrates later in the review of literature on valuation expertise

It is also interesting to note that while Hoffman (1998) claimed to have advanced a general model of expertise which explicates the relationship between and general intellectual functions, he does not make any reference to memory storage, despite acknowledging the fact that some earlier studies have related this to expertise. This gap was addressed by Etringer et al. (1995) who adopted similar approach to that of Hoffman by reviewing previous studies which have examined the acquisition of cognitive process by counsellors as they progress from novices to experts. Etringer et al. (1995) did not elucidate developmental progression stages from novice to expert, but instead highlighted the conceptual issues (as shown in Table 2.0.4 above) that differentiate experts from novices in terms of memory and knowledge structure, procedural and declarative knowledge, problem-solving operators and goals, pattern recognition and problem structure. Also, they did not explain how experience relates to decision-making aspects of cognitive functions of expertise.

### ***2.3.2.2 Schmidt et al.'s stage model of clinical expertise***

Schmidt et al. (1990) premised their four-stage model of clinical expertise on the assumptions that diagnostic performance difference between medical students and experts with varied amount of experience is primarily the result of memory changes and that the functioning of memory is dependent on knowledge structure (also known as the ‘illness scripts’) used to represent the information stored about a disease. They then argued that the gradual progression from novice to expert can be described by four developmental stages. Each stage is characterised by the emergence of a distinctively different knowledge structure which Schmidt et al. (1990, p.613) maintain “do not decay or become inert in the course of developing

expertise but rather remain available for future use when the situation requires their activation". An overview of the knowledge structures as presented in Yelder (2009, p. 89) is provided in Table 2.0.5 below.

Table 2.0.5 Schmidt et al.'s (1990) four stages of clinical expertise

Stage 1	Development of richly elaborated, causal networks which medical students can use to explain causes or consequences of diseases in terms of pathophysiological processes. Limited understanding of how disease manifests
Stage 2	Transformation of these elaborated networks into abridged networks using high level causal models. Information about signs and symptoms is subsumed under diagnostic labels (i.e. summarised, less detail). This change involves a transition from academic to clinical environment for medical students. Only knowledge pertinent to understanding a case is activated
Stage 3	Dependent on accumulated experience of working with patients and takes longer to reach. The emergence of an 'illness script', i.e. the organisation of knowledge about an illness to conform to a pattern which uses temporal rather than causal relations to order information. For example, enabling conditions, fault, and consequences. This serial structure is an important feature. Problem solving is a matter of script searching, selection and verification. These illness scripts are highly idiosyncratic and bear only superficial relation to prototypical cases as they occur in textbooks
Stage 4	Experienced physicians use memories of previous patients. These case memories are retained as individual entities rather than merged into prototypical form (although illness scripts are not 'lost'). These memories play a significant part in diagnosis by experts. The availability of a vast store of previous patients is a central feature of expertise in medicine.

The model of clinical expertise posited by Schmidt et al. (1990) emphasises the essential complementary nature of four modes of knowledge representation (Table 2.0.5), although the earlier modes get used less frequently as more advanced modes become accessible. In their words, they maintain that

*"the different representations we have described coexist in the mind of the physician. In other word, the way in which a disease expresses itself in human beings are represented both as a 'generalised experience' in the form of illness script for the disease, pathology descriptions, and so forth, and as an elaborate set of lively recollections of specific patients who suffered from that disease"* (Schmidt et al., 1990, p. 617).



Schmidt et al.'s (1990) stance completely opposed that of the experiential models, which suggest that the use, for instance, of illness scripts, by an experienced physician, is in some way a return to a less-developed stage. Rather, they view it as experts making effective utilisation of the knowledge representations available to them. This point is further emphasised in their conclusion (p. 619-20) where they maintain that "(1) there are at least two separate levels or stages – a rapid, non-analytical dimension, which is used in the majority of problems, and a slower, analytic approach, applied to a minority of problems that present difficulties; (2) neither is to be preferred, since both may lead to a solution; (3) it is not now possible to predict which kinds of problem will cause difficulty for an individual, since difficulties arise from individual experience..."

An important feature of Schmidt et al.'s (1990) model, as observed in Eraut (1994), is that it successfully explains the frequently confirmed research findings that expertise is domain specific. That is to say, for example, a physician with acknowledged expertise in one domain will perform at no better than average level in a different one. Within a particular domain, the model also acknowledges individual differences in the accumulated store of illness scripts and cases. Schmidt et al. (1990, p.617) state that "...based on his or her unique experience with a certain disease, each physician develops rich, idiosyncratic scripts for that disease, which may or may not resemble the scripts of other physicians or the textbook". This acknowledgement, quite clearly, marks a contrasted difference compared to the position of the experiential models, which assumes general intuitive approaches, regardless of individual attributes.

Although Schmidt et al.'s model explains the development of clinical reasoning skills in stages, it focuses, entirely, on the process of diagnosis. The model does not examine the reasoning used when the treatment or management of a disease is under review, and "only briefly discussed...the interactive and progressive nature of decision-making" (Eraut, 1994, p. 136), an aspect that is also neglected in the experiential models. Perhaps also of great concern is the neglect of many cognitive studies that have informed studies of experts' problem solving, as discussed in the next section.

## **2.4 PROBLEM SOLVING AND EXPERTISE**

The previous section has reviewed few relevant models that explain the development of expertise in terms of cognitive structures. This section focuses on expert problem solving, covering some theories that explain the conceptualisation of cognitive activity involved in problem solving, problem-solving strategies and mental models.

Problem solving is a high-level cognitive activity within a problem space (a problem solver's view and operators (rules, techniques and strategies) to solve the problem (Ernst and Newell, 1969; Hunt, 1994). A problem space is synonymous with problem representation, which is described as "a cognitive structure corresponding to a problem constructed by a solver on the basis of domain related knowledge and its organisation" (Chi et al., 1981, p. 121-122). Also, an effective problem representation has been documented as significant for problem solving in several domains (e.g. Anderson, 1993; Simon, 1973; Kaplan and Simon, 1990; Voss et al., 1991).

### **2.4.1 Cognitive theories of problem solving**

Problem-solving theory originated from human information processing-theory which, according to Ericsson and Hastie (1994, p. 48), assumes that "*thinking can be described as a sequence of identifiable knowledge states or thoughts separated by more processing activity that determines the transition from one state to its successor...these assumptions lead to an image of the thought process as movement from location to location, tracing a unique path through a problem space*". The key idea is that a problem solver can actively and progressively expand his or her knowledge of a problem situation within a problem solving task and repeat the process several times until a solution is reached. Depending on the problem and its complexity, as well as the failure or success of one's representations of the problem, a problem solver may, as suggested by Gick (1986, p. 101), "jump back and forth between different steps of the process".

#### ***2.4.1.1 Newell and Simon's problem-space theory***

In Newell and Simon's (1972) problem-space theory, problems are assumed to exist in both external (the task environment) and internal (in individual's mind) contexts. The external problem space is an objective analysis of the task environment (or from the viewpoint of the experimenter) where all the possible states are provided. For instance, the valuer's task environment includes all market information such as comparable sales information, yields, pending sale prices, opinion from other experts, and other market information. Often this data is incomplete and/or inaccurate contributing to the complexity of the environment. The internal problem space, on the other hand, consists of the space that an individual problem solver's has constructed (i.e. an initial representation of the problem), which typically includes the available operators and the goal state. Thus, Newell and Simon theorise that the problem solver, when confronted by a problem within the task environment, solves the problem by identifying a path through the problem space from an initial state to a goal state. This process is operationalised as a problem search (Mayer, 1983) and, it involves finding operators (or solution strategies) which can transform a problem from the initial problem state to the goal state (Anderson, 1993).

The problem-space theory as originally conceived by Newell and Simon (1972) was based on a research that involved well-defined problems. The problem solvers were presented with a full description of the problem alongside relevant constraints and operators and the goal that needed to be achieved. Emphasis appears to be on the structure and process of problem search as opposed to problem generation (Mayer, 1983) in which the problem solver may have to find the problem, its constituent elements and their relationship by activating a schema-based knowledge (Dillon, 1982).

The process of problem generation is particularly significant in the case of complex ill-defined problems where there may be multiple, or no, solution path, or uncertainty about which concepts, rules and principles are relevant for the solution (Jonassen et al., 1999) and, this appears to be the main perspective on which the limitations of Newell and Simon's problem-space theory are discussed in academic literature. For instance, Simon (1973) argued that while abstracted problems are likely to well-

defined in all respects, real-world problems are almost always ill-defined (or ill-structured) in some respects. This makes the vision of Newell and Simon's problem-space theory not compatible with reality in some domains of expertise, especially where the task is complex and ill-defined such that it (1) embodies an incomplete or ambiguous specification of goals, (2) had no predetermined solution path and (3) required the integration of information from multiple knowledge domains (Ball et al., 1997; Simon, 1973). Simon (1973) proposed that disaggregation theory seeks to modify Newell and Simon's problem-space theory and is discussed in the next section.

#### ***2.4.1.2 Simon's disaggregation theory of problem solving***

Contrary to well-defined problems which assume the presence of a problem space with an initial state, a goal state, and a set of operators that can be applied to move the problem solver from one state to another (Dunbar, 1998), no problem space exists for ill-defined problems (VanLehn, 1989). Thus, Simon (1973) argued that when faced with a complex ill-structured problem where one or more of the initial and goal states and operators are not well-defined, the problem solver finds a solution to the problem by breaking it down into small units which are manageable and can be processed serially.

Simon's (1973) vision is that a single problem space is incapable of holding all the necessary problem information that one needs to search to find a solution to a large complex ill-defined problem. In other words, individual problem solvers are not presumed to have the entire problem space represented when solving a problem. Often, they will only have a small section of the problem space at any one point in time to process consciously, especially in the context of a complex ill-defined problem (Anderson, 1990; Dunbar, 1998; Simon, 1973). So with these assumptions, individuals will attempt to solve a large complex ill-structured problem by breaking into a series of small well-defined problems capable of being solved in a conventional problem space. This process of problem disaggregation requires application of schema-based knowledge aimed at providing structure and organisation to particular types of problems that have been previously encountered by the problem solver. Simon's theory has been observed in several domains of expertise such as in design

(Chan, 1990; Eckersley; 1988) and could provide one of the strategies that individual valuers use when they are faced with a complex ill-structured commercial valuation problem.

#### **2.4.2 Problem solving strategies**

In any problem solving (whether in relation to a well-defined or ill-defined problem), there are two core processes that the problem solver will have to go through in regards to the problem space; the process of generating the problem space itself and the process of searching the problem space to find the solution (Mayer, 1983). Both processes require the use of different problem-solving strategies. Problem-solving strategies are heuristics (Lindsay and Norman, 1972; Myers, 1993; Finke et al., 1992) or 'rules of thumb' which allow a problem solver to search or generate problem spaces. Heuristics can be contrasted with algorithms (or mathematical formulas in some contexts), which always guarantee the correct answer (Dunbar, 1998; Lindsay and Norman, 1972). Problem solving strategies have general- or domain-specific applications, are often quick ways to get to the goal state but do not guarantee the correct solution (Dunbar, 1998; Mayer, 1983). For example, an experienced valuer valuing a property in a familiar geographical location may skip steps in the normative valuation process, such as the market analysis, and proceed directly to the comparison approach. If any unusual market indications are found in applying the method, the valuer might return to prior steps in the valuation process to consider further investigation into the market area.

Several problem-solving strategies have been identified within the literature on cognition which might be used to solve practical commercial valuation problems, especially when they are complex and ill-defined in nature. This sub-section discusses three of those strategies that subjects in this study are more likely to use: pattern recognition, problem decomposition and, means-ends-analysis.

#### **2.4.2.1 Pattern recognition**

Chase and Simon (1973), in advancing their 'chunking theory', argued that a critical feature of experts is their ability to rapidly recognise significant problem attributes. These attributes are stored internally as chunks and act as a lens through which semantic long-term memory can be accessed (Gobet, 1997). Thus, pattern recognition allows strong problem solvers to be highly selective in their generation and search of problem space for solutions (Gobet, 1997). Indeed, one of the key findings from de Groot (1965) is that expert chess players often homed in quickly onto promising moves. In other domains of expertise such as medicine (Kundel and Nodine, 1975; Reingold and Sheridan, 2011; Taylor, 2007), it has also been established that experts can rapidly solve routine problems with little deliberation. In Kundel and Nodine' study of radiologists, for instance, experts could identify about 70% of abnormalities in chest X-ray film when presented for only for 200 msec and about 97% when there was no time limit.

As shown above, pattern recognition depends on a number of factors such as problems sharing similar attributes (Holyoak, 1985) and the way individuals represent the problem (Chi et al., 1982). With regards to the later, research in the domain of physics, for instance, has demonstrated that there is a greater chance of recognition where problems are represented invoking the underlying laws of physics than on the problem's surface attributes (Chi et al., 1982). This would appear to suggest that pattern recognition is a schema-driven problem-solving strategy that is more likely to be used by experts than novices.

From a cognitive perspective, a schema is a structure of preconceived domain specific or general knowledge which can be activated during problem solving. As stated by Sweller (1990, p. 120), a schema is "*a cognitive construct that allows problem solvers to recognise problems and problem states as belonging to a particular category requiring particular moves for solution*". The availability of many schemas will allow a problem solver to recognise many problem states and work forward when solving a familiar problem (Sweller, 1990), disaggregate ill-defined problem into a series of well-defined problems (Simon, 1973) and reduce the time and effort in problem solving (Gick, 1986). Activating a schema in problem solving is

an automatic process that is usually triggered by aspects of the problem at the early stage of generating the problem space (Patel and Groen, 1991; Chi et al., 1981; Lesgold et al., 1988).

#### ***2.4.2.2 Problem decomposition***

Apart from pattern recognition, problem decomposition is another general strategy often used in problem solving. As theorised by Simon (1973), this strategy is particularly used for solving complex ill-defined problems and, involves breaking down a problem into smaller units with each unit having well-defined initial and goal states. This process is already discussed in detail in section 2.4.1.2 under Simon's disaggregated theory of problem solving. It is also important to emphasise that this strategy is also driven in part by a schema-based knowledge system (Simon, 1973).

#### ***2.4.2.3 Means-ends analysis***

The final problem strategy that this study considered likely to be used in practical commercial valuation problem solving is means-ends analysis. Means-ends analysis, according to Gick (1986), is the process of reducing the discrepancy between the current state and the goal state of a problem through the application problem-solving operators. It was first articulated in the General Problem Solver Model (Ernst & Newell, 1969) "*where the problem solver isolates the goals to be achieved and then systematically selects the methods (means) to achieve each of those goals*" (Jonassen, 1997, p. 72).

The use of means-end analysis is common in problem solving, especially where the initial and goal states are well-defined (Anderson, 1993; Gick, 1986; Gick and Holyoak, 1980; Larkin et al., 1980a; Newell and Simon, 1972). The strategy involves either working forward from the initial state (forward reasoning) or backward from the goal state (backward reasoning). In several domains of expertise, experts tend to search forward, especially when the problem is simple in nature. Novices, on the other hand tend to search backward, particularly when they do not possess extensive stocks of schemas (Sweller, 1990). However, in the domain of physics (e.g. Larkin

et al., 1980a; Larkin et al., 1980b), medicine (Patel and Groen, 1986) and geometry (Koedinger and Anderson, 1990) for instance, it has been established that experts revert to searching backward when the problem is complex in nature. This suggests that backward searching is about non-routine situations rather than of novices *per se*. Detailed empirical evidence on these search behaviours are provided in section 2.5.2.2

### **2.4.3 Mental models and problem solving**

As noted in sections 2.4.1.1 and 2.4.1.2 under cognitive theories of problem solving, the standard cognitive problem-solving process of searching through problem space is vitally depended on an individual problem solver's internal representation of the problem. Dunbar (1998) argued that one of the key elements of solving a problem is constructing a good way of representing the problem. This internal representation of a problem is synonymous to a mental model (Johnson-Laird; 1983; Newell and Simon, 1972) which, in the literature, is also referred to as cognitive structure, knowledge structure or a cognitive map.

A mental model, according to Winn (2004, p. 90) is a "*...putative structure that contains knowledge of the world*". In other words, it provides a working mental model to enrich our understanding of the subjects' knowledge of the world (Johnson-Laird, 1983; Qin and Simon, 1995). Rouse and Morris (1986, p. 7) provided a functional, and more elaborate, definition of the concept of mental models as "*the mechanisms whereby humans are able to generate descriptions of system purpose and form, explanations of system functioning and observed system states, and predictions of future system states*". This definition presumes that individuals undertake processes such as to describe, explain and predict events within their task environment (Mathieu et al., 2000). It also aligns closely to Ryder and Redding's (1993) view of a mental model as a task's functional abstraction which provides a deductive framework for problem solving.



From the view point of a professional practice, a mental model provides the most critical characteristics of how professionals perform their routine job. In Mathieu et al. (2000), for instance, the similarity of the mental models of individuals working in a team was observed to be impacted by the team processes and performance. Thus a mental model can be considered as an important tool for enhancing training and learning within a particular domain of expertise at both individual and organisational levels. This view is also well supported by studies that have been conducted on the relationship between mental models and learning (e.g. Kieras and Bovair, 1984; Ifenthaler et al., 2011; Ross et al., 2006).

In research on a mental model, the Cognitive Task Analysis (CTA) is often used as a method of data collection. This method, according to Chipman et al (2000), and as indicated in section 3.6, is capable of yielding information about the cognitive structures and processes underpinning observable task performance. Within the framework of CTA, researchers have resorted to different techniques including verbal protocol analysis (e.g. Boshuizen and Schmidt, 1992; Ericsson and Charness, 1994) and interviews (e.g. Nelson, 1989; Payne, 1991; Hmelo-Silver and Pfeffer, 2004; Means and Voss, 1985), techniques adopted in this study.

It is clear from the foregoing that expertise and problem solving are integrated concepts and that mental models are critical to reveal the knowledge (cognition) underlying experts' performance in problem solving. The following sections provide a comprehensive review of studies that have been conducted based on the cognitive psychology and problem-solving theoretical perspectives of expertise outlined above.

## **2.5 COGNITIVE FRAMEWORK FOR UNDERSTANDING EXPERTISE**

Within the literature, the characteristics of expertise are described, rather than trying to define what exactly 'expertise' actually is. Similar to Wikipedia's definition cited in section 2.2, some authors refer to the concept of domain-specific knowledge and the mental processes required to utilise that knowledge in problem solving (e.g. Chi, 2006; Bereiter and Scardamalia, 1993, as cited in van Winkelen and McDemott,

2010) as attributes of expertise. This view connects expertise to cognitive psychology literature, which is concerned with understanding the nature of human knowledge and how it is structured and utilised (Anderson, 2000). The contention here is that knowledge enables people develop expertise that helps in performance (Pliske et al., 2001). As argued by Anderson (2000, p. 4), "*if we really understand how people acquire knowledge, then we will be able to improve the intellectual training and performance accordingly*". Thus, the focus of the cognitive view is on the knowledge base and the cognitive processes underpinning the behaviour of different levels of expertise.

Others, such as Ericsson et al. (2007), suggest that expertise involves not just knowing, but also the ability to act; thus linking expertise to decision-making (behavioural) literature. From this perspective, research on expertise is premised on the need to understand how people make the choices they do, with the view that understanding the way people make decisions on what they do will ultimately provide decision making guidance (Farrington-Darby and Wilson, 2006).

In the following sections, the empirical works that form the frameworks of expertise in different domains will be reviewed from both behavioural and cognitive perspectives to provide the context for empirical investigation in this research.

### **2.5.1 Behavioural (decision making) literature**

From the decision making perspective, expertise is observed from two main perspectives: (a) outcomes of decision making and, (b) decision-making strategies. The following sub-sections provide details about expertise from these two perspectives.

#### ***2.5.1.1 Outcomes of decision making***

From this perspective of expertise, the belief is that optimal decisions can be made. As a consequence, the decisions of experts are often compared with those of optimal

decision output using statistical models (Farrington-Darby and Wilson, 2006). This is based on Einhorn's (1974) paradigm, a pioneering attempt to identify an expert through a psychological analysis of three medical pathologists who were asked to make judgment on the amount of histological characteristics they considered to be important on a six-point rating scale. Based on the Brunswick' (1956) lens model of judgment and decision making, Einhorn concludes that internal consistency is a pre-condition for identifying expertise. That is, judgments of an expert should be consistent over time. If not, a person's behaviour could be prima facie evidence of a novice. Einhorn's (1974) other necessary condition for expertise is consensus. That is, experts should agree with each other and that failure to do so would imply that some are not truly experts.

Such consistency and consensus findings were also reported in studies of auditors (Ashton, 1974; Ashton and Kramer, 1980) and judges (Weiss and Shanteau, 2001). In Weiss and Shanteau (2001), for instance, the aim was to develop an empirical measure of expertise. Through a critical evaluation of Einhorn's (1997) criteria, the authors proposed that, in addition to being consistent, an expert should be able to discriminate between the stimuli within the domain; that is recognising the distinctions that novices may miss. Weiss and Shanteau (2001) further combine both consistency and discrimination to form a single ratio, Cochran-Weiss-Shanteau (CWS), which has been empirically found to offer a new insight on how to distinguish expertise purely from data (e.g. Shanteau et al., 2003).

In property valuation, a large body of research has also been conducted based on Einhorn's paradigm. Property valuation is an opinion-based profession and all valuers are required to possess particular qualifications (such as be a member of RICS) and undergo similar training in the field. Accordingly, valuers, in an ideal world, are expected to demonstrate consistency and consensus in judgments as advocated by Einhorn (1974). In valuation parlance, these two variables are measured by valuation accuracy and valuation variance respectively. Boyd and Irons (2002, p. 108) succinctly define valuation accuracy as "*a measure of the difference between a value determination or a group of value determinations, in relation to a subsequently realised sale price*" and, valuation variance a "*a measure of the*

*difference between value determinations provided by different valuers*". Thus, while valuation accuracy seems to be restricted to the question of valuation outcome versus market price, the focus of valuation variance is valuation outcome one valuer versus another.

The valuation accuracy and variance research was pioneered by Hager and Lord (1985). In this study, ten valuers were invited to value two properties – a rack-rented office property and a reversionary retail unit. All valuers were given similar instructions and, their resultant valuations were expected to lie within +/-5% of the control value determined by an expert valuer who had knowledge of the local property market. The analysis of the valuation opinions of the sampled ten valuers indicated a range of +/- 10.6% for one property and +/- 18.5% in the other. On the basis of this result and given the +/-5% benchmark, Hager and Lord (1985) argued that there was a relatively low level of accuracy in the valuation produced by expert valuers. Comparable findings were reported in studies by Brown (1992), Hutchison et al. (1995), Adair et al (1996), Brown et al (1998) and Crosby et al. (1998). In all of these studies, variability of judgment seems to differ thus limiting the prospects of any meaningful generalisation. However, given that majority of the valuations reported in these studies seem to be falling outside the set targets, namely +/-5% or +/-10%, it can be reasonably inferred that some expert valuers, like their counterparts in other domains, are making inadequate decisions.

Other studies not based on valuation variance are Brown (1985), Parker (1999), Blundell and Ward (1997), Matysiak and Wang (1995), Newell and Kishore (1998), and Cole et al. (1986). In these studies, expert valuers' opinions were analysed in relation to the subsequently realised transaction prices. Unlike in valuation variance literature, where authors seem to have unanimously indicated a high variance in expert valuer's decisions, a considerable disparity exists in the findings reported in the studies on valuation accuracy. While some turn to suggest the proposition that valuations serve as a good proxy for market prices (see for example Brown, 1985; Parker, 1999; Newell and Kishore, 1998), others suggest otherwise. However, based on the presence of a large amount of valuations greater than a range of +/-10% of

market/sale prices in each case, the general ability of expert valuers to accurately predict market prices remains elusive (Boyd and Irons, 2002).

In general, the results of valuation accuracy and variance seem to be consistent with similar research of other domains presented earlier; suggesting that experts are inaccurate and unreliable decision makers (Shanteau, 1992). While Einhorn (1974) and Shanteau and Hall (2001) outcome measures are no doubt a more objective criteria in identifying who an expert is, they may not necessarily reflect the underlying degree of expertise. Weiss and Shanteau (2001) maintain that whereas a low level of consistency, consensus and discrimination may suggest that there is a problem, it would not suggest where the problem is, leaving the question of who is truly an expert unanswered. Weiss and Shanteau (2001) further argued that it is possible for experts to agree through 'artificial consensus' and be consistent by following a simple but incorrect rule and may still be wrong or achieved an inappropriate outcome. Finally, the outcome measures failed to offer any insight on the processes involved in expert decision making.

#### ***2.5.1.2 Decision making strategies***

Another approach to characterising expertise, based on the behavioural paradigm, is to examine the strategies used in making decisions (Shanteau, 1992). This psychological body of research into expert decision making centres on the mechanisms that people have developed to cope with their environment – the heuristics that are employed to speed up decision making but also have potential risks associated with them (Tetlock, 1991; as cited in van Winkelen and McDermott, 2010). The contention here is that the predictive thinking patterns that premise heuristics risk introducing biases into the decision-making processes (van Winkelen and McDermott, 2010). Shanteau (1992) argued that experts use a variety of formal and informal decision strategies that clearly separate them from non-experts.

Following this line of reasoning, the nature of expertise has been widely researched in different settings, including property valuation, using a variety of techniques. Xiao et al (1997, as cited in Farrington-Darby and Wilson, 2005), for instance,

reports a study involving observation of 40 planning experts in anaesthesiology. The aim of the study was to investigate how practitioners plan for future tasks and how such plans influence other activities. Using verbal protocol analysis, the study revealed that anaesthesiologists rely on cues or warning signs when actively anticipating problems and searching for information on constraints to potential preventive measures. Bedard and Mock (1992) studied the decision-making behaviour of auditors, looking at how they search and acquire information in audit planning task. Fifty-two expert and novice auditors participated in the study and, data were collected through the process-tracing method. The results indicate that experts exhibit a more-global search-strategy pattern guided by an overall planning strategy. They also acquire substantially less information and spend significantly less time on the task than did novices.

In property valuation, behavioural research into expert valuers' decision-making is classified as follows: valuation processes (Diaz, 1990a; Diaz et al., 2002), comparable sales selection (Diaz, 1990b; Wolverton and Gallimore, 1997) and bias in value estimates (e.g., Diaz, 1997; Havard, 1999; 2001a; 2001b; Diaz and Hansz, 1997; 2001; Diaz and Wolverton, 1998; Gallimore and Wolverton, 1997; Hansz and Diaz, 2001). Table 2.0.6 provides an overview of this behavioural property valuation literature.

Diaz (1990a) pioneered the most well-known research program on the valuation process. Inspired by the earlier work of Kahneman and Tversky (1974), Diaz studied and evaluated the decision-making behaviour of 12 expert appraisers/valuers in the USA in relation to the normative valuation process prescribed by the Appraiser Institute (1996). The results indicate that experts' actual valuation processes differ significantly from the normative process, but are described better in terms of heuristics behaviours that can lead to systematic bias in judgment (Kahneman and Tversky, 1974; 1981; 2000).

Table 2.0.6 Overview of behavioural literature in property valuation

<b>Subject</b>	<b>Author (s)</b>	<b>Methodology</b>	<b>Sample</b>	<b>Results</b>
Valuation process (departure from normative models)	Diaz (1990a)	Process tracing of residential appraisal in the US	12 appraisers and 12 novices	Residential appraisers depart from the normative appraisal normative models process
Valuation process (departure from normative models)	Diaz et al. (2002)	Process tracing of residential valuation in the US, UK and NZ	12 US appraiser, 12 UK valuers and 10 NZ valuers	The descriptive model of US appraisers' behaviour was found to be different from descriptive modes of the process of UK and New Zealand valuers
Comparable sale selection	Diaz (1990b)	Controlled experiment on residential appraisal in the US	12 appraisers and 12 novices	Experts use a less cognitively demanding search strategy and examine less data as compared to novices.
Comparable sale selection/Bias in valuations (anchoring to asking price)	Gallimore & Wolverton (1997)	Controlled experiment on residential valuation in the US and UK	16 US appraisers and 16 UK valuers	UK valuers are highly susceptible to sale price knowledge, but exhibit sales selection bias to a lesser degree than US appraisers in a residential valuation problem
Bias in valuations (anchoring to anonymous experts estimates)	Diaz (1997)	Controlled experiment on appraisal of land in the US	30 expert commercial appraisers and 28 apprentices	No evidence that expert appraisers operating in areas of geographic familiarity were influenced by the previous value judgments of anonymous experts
Bias in valuations (anchoring to anonymous experts estimates)	Diaz and Hansz (1997)	Controlled experiment on appraisal of land in the US	44 expert commercial appraisers	In contrast with Diaz (1997), expert commercial appraisers operating in areas of geographic familiarity do rely on previous judgments of anonymous experts
Bias in valuations (anchoring to anonymous experts estimates)	Diaz and Hansz (2001)	Controlled experiment on appraisal of land in the US	87 expert commercial appraisers	Confirmed the findings in Diaz (1997) and Diaz and Hansz (1997)
Bias in valuations	Diaz and	Controlled experiment	31 expert	Expert commercial appraisers make

(anchoring to own estimates)	Wolverton (1998)	on appraisal of residential apartment complex in the US	commercial appraisers	insufficient temporal adjustments when re-appraising or updating a prior value judgment
Bias in valuations (anchoring to market feedback)	Hansz and Diaz (2001)	Experimental study on the effects of market feedback on appraisal prices	40 expert commercial appraisers	Expert receiving transaction feedback indicated that they had been low in previous valuations seem to adjust upwards, their subsequent, unreeled value judgements
Bias in valuations (anchoring/recency)	Gallimore (1994)	Questionnaire survey of expert valuers in the UK	276 respondents	Evidence of anchoring and recency effects in valuation judgement
Bias in valuations (anchoring to transaction price)	Havard (2001a)	Controlled experiment on valuation of commercial property in the UK	45 University students	In the first stage, the group with knowledge of the transaction price produced valuations that were biased towards this price. No apparent bias detected to knowledge of the transaction price in the second stage.
Bias in valuations (anchoring)	Havard (2001b)	Structured interviews and Verbal Protocol Analysis of a simulated commercial valuation task	Interviews: 40 senior commercial valuers VPA: 20 practicing commercial valuers	Subjects produced valuations that were biased toward a number of potential sources of value anchors, including external sources (for example, knowledge of the transaction price of a subject in a loan security valuation) and internal sources (derived from the valuer's own experience)



Comparable findings have also been obtained in the study of United Kingdom (UK) and New Zealand (NZ) valuers (Diaz et al., 2002). In this study, expert valuers in the UK and NZ were subjected to the same experimental design utilized in Diaz's (1990) study of US appraisers. The study revealed that neither NZ nor UK expert valuers, like their US counterparts, follow the normative valuation models. Also, the descriptive model of US appraisers' behaviour was found to be different from descriptive modes of the process of UK and NZ valuers. From these findings, it is concluded that expert valuers' behaviour can be influenced by differences in training, reporting requirements and business cultures. While the small sample size is an obvious criticism in these two studies, they do provide good evidence in support of the view that experts develop their own decision-making strategy (Shanteau, 1992).

Acquisition and adjustment of comparable sales information is a key element in property valuation decision-making, particularly where the sales comparison approach to valuation is adopted. The decision on the amount of sales information obtained and the choice strategy depend on the task familiarity and level of experience (Diaz, 1990b). Diaz (1990b) used a controlled experimental methodology to investigate how novice and expert residential appraisers select comparable sales. Diaz found that experts examined fewer comparables properties as compared to novices. Experts used a less cognitively demanding selection-strategy (for example, they search for one or two of the best sales and compare them to other sales) and focus on key attributes (such as location). Novices, on the other hand, used cognitively demanding search strategies (for example, considering a larger number of comparable sales) and deferred final selection of 'best' sales until all the comparable sales had been examined. The use of less information by experts is attributable to their complete knowledge of decision-making which gives them an advantage in recognising the important cues without any detailed comparative analysis of all available information (both relevant and irrelevant). It is, therefore, not surprising that experts' judgments are often inconsistent and inaccurate as widely reported in property behavioural studies on expertise, and in other domains.

Considering bias in valuations, the contention is that human judgments are often governed by approximate guideline rules rather than strict rational analysis. This

form of behaviour was central to Newell and Simon's (1972) theory of problem solving, and, when properly applied, can reduce the search time as well as the time required to perform a task. In fact, Newell and Simon (1981) argued that intelligence or expertise can be defined by ability to use simplifying heuristics. On the basis of Newell and Simon's theory, Tversky and Kahneman (1974) identified three main types of judgment heuristics that have been the focus of studies in expertise. These include judgment by representation, judgment by availability, and judgment by anchoring and adjustment. Of the three, only anchoring and adjustment have been studied by behavioural researchers into property valuation; with the exception of Gallimore (1994). Tversky and Kahneman (1974) describe the 'anchoring phenomenon' as when people make an estimate by starting from an initial value (known as the 'anchor') that is then adjusted to yield the final answer. The authors further argued that adjustments are frequently insufficient and could bias the final estimate towards the initial reference point.

In valuation behavioural research, an expert valuer's judgments have been found to rely on the valuation estimate made by an anonymous expert (e.g., Diaz, 1997; Diaz and Hansz, 1997; 2001), their own previous valuation opinion (e.g., Havard, 1999; 2001a; 2001b; Diaz and Wolverton, 1998), and other available information such as the asking price (e.g., Gallimore and Wolverton, 1997; Diaz et al., 1999) and the uncompleted contract price on the subject and on comparable properties (Hansz, 2004), particularly when engaged in unfamiliar geographical locations. A discussion of these studies follows.

In Diaz's (1997) study, a two-factor experimental design was employed to address the questions of whether expert appraisers anchor on an anonymous expert opinion in areas of geographic familiarity. The experimental task involved the valuation of a vacant parcel of industrial land located in the northern suburbs of Atlanta and was designed to reflect real-world appraisal problems. Diaz found no evidence that expert appraisers operating in areas of geographic familiarity were influenced by the previous value judgments of anonymous experts.

Diaz and Hansz (1997) replicated Diaz's (1997) study but used expert appraisers unfamiliar with the market. Contrary to the earlier findings, experts' valuers operating in areas of geographic unfamiliarity were influenced by previous value judgments of anonymous experts. These findings from these two studies suggest that geographic unfamiliarity increases the complexity of the valuation problem and this is more likely to trigger heuristic behaviour.

Diaz (1997) and Diaz and Hansz (1997) has been criticised on the grounds that they were both based on a cue unsanctioned by the normative appraisal process. However, other studies (e.g. Diaz and Wolverton, 1998) based on sanctioned reference points have also provided evidence in support of the use of anchoring as means of dealing with greater uncertainty in valuations. Diaz and Wolverton (1998) recruited 31 expert commercial appraisers to provide a value estimate in a case involving a residential apartment complex in a geographically unfamiliar area (Phoenix, Arizona, USA). Six months later, the appraisers were asked to re-appraise the property. The second valuation case had some updated information reflecting changing economic conditions in the market. Diaz and Wolverton (1998) found that expert appraisers were significantly influenced by their own appraisal when working in a geographically unfamiliar area.

Diaz and Hansz (2001) set up a series of experiments to evaluate the relative importance of an expert opinion (an unsanctioned cue), a pending sales contract, and a pending sales agreement (sanctioned by cues) on valuation judgment. The methodology employed in this study was the same as that employed in Diaz (1997) and Diaz and Hansz (1997). Each subject was given an identical task (see the valuation case used in Diaz, 1997) but different reference points. The results indicate that all the three reference points significantly influence the valuations of experts operating in areas of geographic unfamiliarity. The study also showed that sanctioned reference points exert a stronger influence on valuation judgment under geographic unfamiliarity than unsanctioned reference points.

Gallimore (1994) carried out the first large-scale behavioural study in the UK and found evidence of anchoring and recency effects in valuation judgment. However, both Levy (1997) and Hardin (1998) have noted the limitations of the survey design employed by Gallimore: a simple, but extensive, postal survey method, obtaining a sample of 276 responses. The authors argued that anchoring and adjustment is a complex heuristic, which can only be realistically observed under real-world settings.

Other studies that have investigated the impact of anchoring on value judgments in the UK, but based on real-world simulated valuation exercises, include Gallimore and Wolverton (1997) and Havard (1999; 2001a; 2001b). Gallimore and Wolverton's (1997) study was designed to investigate cultural differences in comparable sales selection strategies of US appraisers and UK valuers. Consequently, Gallimore and Wolverton (1997) replicated Wolverton's (1996) study of US appraisers using UK valuers. The study found that, similarly to US appraisers, UK valuers are highly susceptible to sale price knowledge in their choice of comparable sales, but exhibit sales-selection bias to a lesser degree in a residential valuation problem. Also the valuers examined far fewer sales than the appraisers.

The Havard (2001a) study recognised the fact that almost all the studies conducted to investigate bias in valuations were based on residential property. The author noted that studies that have explored the same field in the commercial market are rare because of the complexity of research in this area. Consequently, Havard's (2001a) study was conducted in a commercial valuation setting in the UK. Havard recruited a cohort of 45 students from UK universities to participate in an experimental study, which comprised two stages. In the first, 23 of the students were assigned randomly to two groups to carry out a valuation task, one with knowledge of the transaction price of the property to be valued, one without. Both groups received the same information including information on ten transactions representing the market evidence. The group with knowledge of the transaction price produced valuations that were biased towards this price. In the second stage of the experiment, 22 students repeated the task. In this case, the information on the transactions was supplemented with a tabulated presentation of the market evidence. But, there was no apparent bias detected to knowledge of the transaction price.

Havard's (2001a) study has been criticised on the grounds that the use of students as the subjects implies that findings from this research have less practical relevance. Furthermore, there a growing body of literature have documented expert-novice differences in terms of their actual valuation behaviour (see for example, Diaz, 1990; and Diaz et al., 2002 discussed earlier in this section).

Havard's (2001b) study, on the other hand, was conducted to investigate how valuer behaviour, and the valuation process itself, influences the outcome of a valuation. In particular, the decision-making behaviour of commercial valuers was examined to test the proposition that valuers adopt heuristics in carrying out valuation tasks. Based on analysis of structured interviews with senior valuation professionals and verbal protocol analysis of a simulated valuation task, Havard found that anchoring is commonly adopted by commercial valuers as a tactic for dealing with complex task environment. Subjects produced valuations that were biased toward a number of potential sources of value anchors, including external sources (for example, knowledge of the transaction price of a subject in a loan security valuation) and internal sources (derived from the valuer's own experience).

Havard's (2001b) study is particularly important to this present study in the sense that it is the only study that has examined, albeit superficially, incidence of use of cognitive processes in a commercial valuation task. In contrast, this present study identifies the cognitive processes used in commercial valuation and how provides and provides an understanding of how they inform valuation expertise in commercial valuation problem solving. This present study utilised a Verbal Protocol Analysis (VPA) of a simulated valuation exercise. This approach is similar to the one used by Havard, although Havard's ruse of VPA was to collect data for quantitative analysis.

The results of the behavioural studies presented above are testimony to the fact that experts often make use of both formal and informal decision aids (Shanteau, 1992) in an attempt to minimise the biasing effect of heuristics.

In summary, one tenet of the behavioural paradigm of expertise is that expertise may positively affect the decision-outcome measures such as consistency and reliability. This hypothesis, though desirable, may not be a valid explanation of the true picture of expertise. The other tenet of behavioural model views expertise in terms of decision making, and attempts to study and provide explanation of the way people make decisions on what they do by comparing how a rational person should choose (normative behaviour) with the choices people actually make (prescriptive behaviour). In this line of research, expert prescriptive behaviour was found to differ from the normative behaviour. However, as observed by Simon (1979, p. 42):

*"We must expect to find different systems using quite different strategies to perform the same task. I am not aware that any theorems have been proved about the uniqueness of good, or even best, strategies. Thus, we must expect to find strategy differences not only between systems at different skill levels, but even between experts".*

Expert valuers may then use different valuation processes or methods to arrive at their opinion of value, weigh comparable information differently, and may not necessarily achieve accuracy and reliability as evidenced in the literature on behaviour in property valuation. Valuations, as argued in the Mallinson Report (RICS, 1994), are the expression of an expert valuer's opinion and, valuers may rightly and appropriately differ in their assessment of value even when the same property is being considered. As such, their value- or decision-making-differences cannot be what truly identifies them as experts. It is argued in this research that the differences observed in valuation expertise are due to varied amount of experience and knowledge base underpinning the behaviour of an expert valuer. This view of expertise has its root in cognitive psychology (Anderson, 1981) and, is the focus of this research. It is thus examined in greater details in the next section.

### **2.5.2 Cognitive psychology literature**

As previously stated, the present study is in alignment with the cognitivists' perspective of expertise which considers expertise as the natural results of the process of mastering specified bodies of knowledge. The rationale for this is in twofold. First, as noted in the previous section, an examination of literature has not revealed any empirical studies of expertise that explore the knowledge and

cognitions within property-valuation practice. The literature written within real-estate professions focuses on the behavioural or decision-making perspective of expertise, with no regard to knowledge utilisation and application. Second, the cognitivist emphasis on knowledge and cognitions, for many years has been the most dominant perspective on expertise and also the most common approach used to research it (Bou et al., 2006).

As noted previously, the cognitive perspective of expertise shifts the focus away from observable behaviours towards the study of knowledge and cognition. Within this framework, different authors have approached the phenomenon of expertise in different ways. In particular, the contribution of different authors can be grouped on the basis of whether the focus is on the specific characteristics of inputs of cognition, or on the characteristics of the processes or outputs of cognition (Bou et al., 2006). These groupings form the basis on which the empirical researchers within the cognitive framework are discussed in the following sub-sections.

#### ***2.5.2.1 Characteristics of inputs of cognitive processes***

Within the body of research into the specific characteristics of inputs, authors focus on the relationship between expertise and the accumulation of knowledge (Anderson, 1982; Bedard, 1989; Black et al, 2004; Frensch and Sternberg, 1989; Prietula and Simon, 1989; Shanteau, 1992); the expert is, therefore, considered as someone who has stockpiled more knowledge. Feldon (2007) maintained that a fundamental component of expertise is the quantity of knowledge that is readily made available for application in practice. With this premise, two processes are perceived as important: storage and retrieval of knowledge. This view is further supported by a wealth of theoretical and empirical researches, although it was first documented by de Groot (1965) and Simon and Chase (1973) in the domain of chess playing.

In de-Groot's earlier study, which was further developed in Simon and Chase's study, a basic experimental task was used to compare the recall of chess positions by chess masters and novices. Specifically, subjects were asked to reproduce a chess position

of play after they have been shown the 20<sup>th</sup> move of a hypothetical chess game for five seconds. An expert, in both studies, was able to recall much more of the pattern than a novice. The original explanation offered by these authors is that retaining/encoding information in meaningful ways is the crucial aspect of expertise; experts organised their knowledge in 'chunks' which are stored in memory. A chunk is a storage structure which bonds a number of more elementary units into a larger organisation (Feltovich et al. 2006). According to Gobet et al. (2001, p. 236), it is as "*a collection of elements having strong associations with one another, but weak associations with elements within other chunks*". Thus, in the recall task developed de Groot (1965) and Simon and Chase (1973), experts appear to use their experience to structure the materials in groups of elements rather than individual elements. Thus, as professionals acquire more expertise, their chunks are expected to be more complex and larger. This is in no way suggesting that experts have larger memory; rather they were better at storing meaningful information. For instance, while the chess novices were able to recognise a number of independent chess pieces, their expert counterparts saw almost the same number of larger units (Feltovich et al. 2006). Cowan et al. (2004) also noted that although both the expert and the novice are restricted by the same constraints of working (or short-term) memory, expert chunks are larger.

Following de-Groot's and Simon and Chase's (1973) study, several empirical studies have been inspired in other domains of expertise, such as electronics (Egan and Schwartz, 1979), the game of bridge (Charness, 1979; Engle and Bukstel, 1978), process control systems (Vicente, 1992) and professional writing (Kellogg, 2006). These studies have all confirmed that the ability to encode meaningful information in a domain depends on the expertise level. Chase and Simon (1973) further argued that the ability to demonstrate effective usage of working memory through memorisation of domain-specific knowledge materials is a product of experience-based knowledge and pattern-based memory derived from several years of practice experience (see also, Ericsson, 1985, Hughson and Boakes, 2009; Alberdi et al., 2001, Beilock et al., 2002). Simon and Gilmartin (1973) also demonstrated that between 10,000 and 100,000 chunks need to be learnt to become a chess master. This chunk size, according to Simon and Chase (1973), is equivalent to 10 years or



10,000 hours of practice experience in the field of chess playing, and is applicable to any other domains of expertise.

Apart from storage of knowledge, accessing the stockpiled knowledge is equally significant in the development and attainment of expertise. In this regard, authors who emphasised the outstanding role of memory turn to focus on recall as a measure of expertise (e.g. de Groot, 1966; Ericsson and Chase, 1982; Ericsson and Polson, 1988; McKeithen et al., 1981). These studies have demonstrated that experts not only recall more, but also do so in meaningful ways. For instance, McKeithen et al. (1981) investigated the recalling performance of programmers across different levels of expertise in their usage of programming language. They found that both experts and intermediate programmers focused on functional significance of the words and were able to recall more using their general programming language knowledge. In other terms, recalled words of these two groups of programmers were grouped as chunks and uses general programming language formats, compared to the beginners whose recall was more verbatim and in the specific format of the programming language as described in the study. Experts' superior power of memory recall, according to this group of authors, is not innate but rather based on repetition (e.g. Ericsson and Chase, 1982) or gained through at least ten years of deliberate practice (Ericsson et al., 1993). Ericsson et al., (1993) describe deliberate practice as an individualised training regimen that involves extensive coached practice, supported with feedback aimed at improving current level of skill (Ericsson and Charness; 1994; Starkes et al., 1996; all cited in Feldon, 2007). Its role on expert performance in real-life settings has also been confirmed in empirical studies (e.g. Stefanidis et al., 2007).

Two themes seem to have emerged from the foregoing. First, even though accumulation and storage of more knowledge is crucial in regards to evolution towards expertise, good knowledge structures are what make the difference. Second, experts have superior memory recall ability, particularly when recalling episodic information such as problem states, events and descriptors. However, it is worth noting that this linear relationship between expertise level and memory recall has been rejected in the domain of medicine. In this domain, results suggest an

inverted U-shaped relationship (referred to as the “intermediate effect”) between levels of expertise and clinical case recall (see for example Boshuizen and Schmidt, 1992; Rikers et al., 2000; 2002; Gobet and Borg, 2011). Participants with an intermediate level of expertise recalled clinical case information better than novices and participants with considerable expertise. This phenomenon has motivated Schmidt and Boshuizen (1993) theory of knowledge encapsulation, an alternative explanation of how experts organise and restructure their knowledge.

Still on the specific characteristics of inputs of mental processes, other streams of research have focused on expert–novice differences based on their use of different knowledge types during problem-solving (Johnson et al., 1981; Norman et al., 2006; Mitchell and Unsworth, 2005). In the domain of medicine and surgery, for instance, the combination of experiential and analytical knowledge has been documented as crucial for effective medical diagnosis. Also, in Mitchell and Unsworth (2005), the reasoning processes of expert and novice therapists were compared and constricted during their home visits. The study found fundamental differences in terms of the cognitive dimensions used by both subject groups in their reasoning process. In particular, expert therapists appeared to use the combination of conditional, procedural, and other types of reasoning processes while novice therapists could only reason procedurally. The study also revealed that experts appear more confident and clear in their reasoning process; in contrast, novices were more awkward and self-conscious.

#### ***2.5.2.2 Characteristics of outputs of cognitive processes***

A related but different body of research within the cognitivist view of expertise involves the understanding of the output of cognitive processes. The approach taken in this line of inquiry is based on the cognitivists’ common perception of experts’ superior performance above novices (Bou et al., 2006). In particular, Bou et al. focused their study of expertise on analysing ‘top performance’ and identifying the characteristics associated with it or its process. Authors such as Simon and Simon (1978) and Chi et al. (1981) have also argued that differences in the way mental processes are used when solving problem is crucial to understanding expert-novice differences.

One area of expert–novice differences that has been examined within this body of research centres on the quality of problem representations. For example, Chi et al. (1982) examined the structural knowledge of expert physicists and novices by asking them to elaborate on an inclined-plane problem. The study revealed that experts were able to immediately utilise their knowledge of complex physics principles that provide procedures for achieving a solution. In contrast, novices provided, accurately and in detail, a rich amount of concepts that represent superficial components and entities of such a problem. Thus, whereas experts knew immediately the information and knowledge to recall and use, novices were dealing with a large amount of information in a confusing manner. Chi et al.'s study and the earlier ones (de Groot, 1996 and Chase and Simon, 1973) produced robust results on several expert-novice differences which Glaser and Chi (1988) summarised into seven key attributes of experts.

First, experts excel mainly in their own domain. Glaser and Chi (1988) argued that experts' excellence in task performance was due to their domain-specific knowledge, which can be quickly and consistently recalled and deployed to solve problems (see also Ericsson and Lehmann, 1996 and Feltovich et al., 2006). However, experts' knowledge in one domain cannot be transferred to other domains (Bedard and Chi, 1992; Feltovich et al., 2006). Feltovich et al. (2006, p.47) maintain that "there is little transfer from high-level proficiency in one domain to proficiency in others domains – even when the domains seem, intuitively, very similar". For example, in Patel et al. (1989, as cited in Bedard and Chi, 1992) where experts from three subspecialties (cardiology, surgery and psychiatry) within the domain of medicine were presented with a problem in cardiology), the diagnosis of expert cardiologists were more accurate than that of experts from the domains of surgery and psychiatry (see also Voss and Post, 1988).

Second, experts perceive larger meaningful and interconnected patterns in their domains. As found in Chase and Simon (1973), expert chess players excel in memory recall of groups of chess pieces when recalling meaningful chess positions.

In other words, they were able to recognise sophisticated patterns, organised them in memory and automatically recall them for use. Zeitz (1997, as cited in Feldon, 2007) argued that this was not due to superior perceptual abilities of experts; rather, it is a reflection of the level of conceptual abstraction in experts' knowledge structures that embodies an efficient compromise between representations of concrete elements of a problem and the general concepts and principles developed through many years of experience (see also Patel et al. 2000). The memory-recall ability was operationalized in terms of the number of patterns subjects were able to recognise. For instance, in Chase and Simon (1973), the number of chunks that is required to be stored in memory to become a chess master was estimated at around 50,000 (Bedard and Chi, 1992). Evidence of approximately the same number of chunks of domain-related information has been reported in Ericsson et al. (1993) and Patel et al. (2000) for expertise in other domains, such as music, science and medicine. It has also been reported that 10 years of experience in a discipline is required to accumulate such large chunking.

Third, experts are faster and more accurate than novices when solving problems in their specific domains. Chi et al. (1982) maintain that experts were generally quick problem solvers, despite the fact that they tend to be slower than novices in the initial stages of problem solving. As demonstrated earlier, this is largely a function of experience-based knowledge and experts' ability to recognise larger patterns. Patel et al. (2000) also assert that as experts acquire more experience of a specific task in their domain, the nature of their cognitive operation changes in a way that it becomes increasingly smooth, efficient and automatic. This reduces the cognitive demands of the operations, thus releasing cognitive resources for other operations (Feltovich et al. 2006). In other words, with enough practice, experts could free up their resources to perform related tasks. For example, in Gentner (1988, as cited in Farrington-Darby and Wilson, 2006), the practical motor skills required in typing were investigated by comparing the differences between novices and expert typists in a series of different experiments. Video analysis of movements between letters requiring the same finger and typed one after another demonstrated expert typists did not move any more quickly between keys, neither were they found to move shorter distances, but rather, they commenced their move from the current key to the next more quickly. Also, expert typists' speed was found to be correlated with

hours of practice such that their skill became automatic and their memory capacity was available to process other aspects of the task at the same time (see also, the earlier work of Shaffer, 1975).

Fourth, experts have superior short-term and long-term memory compared to novices. As demonstrated earlier, the automaticity of performances implies that experts' memories are available for other aspects of a cognitive task. Feltovich et al. (2006) and Patel et al. (2000) maintain that, in attending to demanding complex tasks with many different cognitive components, some of the more basic ones (for example, fundamental decoding, encoding of input) become automatic, so that conscious processing can be devoted to the higher level ones, such as reasoning, comprehension, inference, monitoring and integration with minimal interferences in the overall performance. Thus, in the absence of any short- or long-term memory advantages, experts are presumed to have freed up memory space that can be made available for other cognitive processes needed to perform related tasks.

Fifth, experts see and represent a problem in their domain at a deeper (more principled) level than novices who tend to represent a problem at a superficial level. Glaser (1985) observed that although novices and experts usually generate identical conceptual categorisations, their information processing strategies differ qualitatively (see the earlier cited work of Chi et al., 1982). Lesgold et al. (1988, as cited in Farrington-Darby and Wilson, 2006) used a somewhat different method (naturalistic observation) to collect 'think-aloud' reasoning protocols on the initial and final diagnoses of novices and expert radiologists based on the x-rays, and the eventual clinical findings. Analyses of these think-aloud protocols revealed that experts reported more different diagnoses, had larger reasoning chains with a greater number of their diagnoses linked to at least one other diagnosis. In other words, experts were more inferential in their thinking and produced more coherent knowledge and explanations than novices who, in contrast, made more superficial, fragmented and piecemeal representations. Similarly, as found in Johnson's (1988) work with regards to reviewing job applicants' paperwork, experts knew which parts of the application paperwork were significant to focus on, in comparison to novices

who reviewed all of the materials. It thus means that when considering solutions to a problem, experts know the most critical components of the problem.

Sixth, experts spend a great deal of time analysing a problem qualitatively. Although Chi et al. (1988) maintain that experts are fast problem solvers; they think and process information diligently when faced with uncertainty. Jennings et al. (2005) also argued that when exposed to uncertainty, experts devote a large amount of time understanding the problem in terms of its detail, complexity, depth, and thoroughness. In the previously cited Johnson's (1988) work on reviewing job applications, experts actively searched for information, often returned to previously examined information, and frequently changed their attention from one part of the information to the other. Hence, they were more active and flexible in their information search and in understanding strategies.

Seventh, experts have effective self-monitoring skills. Glaser and Chi (1998) maintain that, apart from ability to perform effectively, another challenge which impacts significantly on cognitive capacity in the traditional information processing view concerns the experts' ability to be able to reflect on their thought processes. That is, individual's ability to know his or her own cognitive processes. Its significance to expertise is derived, in part, from the observation that experts are more aware of their errors, the reasons for their errors, and the need to monitor, modify and adjust their solutions (Glaser and Chi, 1988) (see also the recent study of Eells et al., 2005). In addition, Chi et al. (1982) have found that experts are more honest in acknowledging their limits and difficulty of tasks.

Clearly, these seven characteristics do suggest that experts, in many domains, turn to reason and process information differently from non-experts. However research is yet to establish the extent to which some of these skills might influence property valuation problem solving in a commercial context

### ***2.5.2.3 Characteristics of cognitive processes***

In another important area of research (mainly in the domain of the medical profession), authors have studied the characteristics of cognitive processes. This area of research focused on the directionality of the reasoning strategies of experts when solving problems in relation to that of novices. In this area, a distinction is often made between forward reasoning (in which the data is used to develop and substantiate hypotheses) and backward reasoning (in which data are sought to prove or disprove the hypothesis generated). The consensus in this line of inquiry is that experts engage in forward reasoning based on their domain knowledge while novices use backward reasoning (Simon and Simon, 1978; Larkin et al., 1980a; Patel et al., 1990; Buchanan et al., 2006; Feldon, 2007); although exceptions exist (Gobet, 2016).

In the early study of Simon and Simon (1978), for instance, the authors observed that experts resort mainly to forward reasoning, which involves working forward from data to hypotheses until a solution is reached. The problem solving of novices, on the other hand, was associated with backward reasoning, which involves the generation of problem solutions by formulating hypothesis and then seek data to support it. Simon and Simon (1978) further argued that the use of forward reasoning, when combined with a well-integrated representation of the problem in short memory and a vast knowledge base, can lead to more-efficient and accurate problem solutions.

Also, in the work of Larkin et al. (1980a), it was demonstrated that expert physicists initiate the problem-solving process by representing a situation on the basis of physics principles and relevant available data. In particular, experts begin their problem solving by constructing abstract relations (equations) that enabled immediate calculation of values from the information provided. This means that experts use theoretically-driven strategies and conceptual schemas capable of integrating both the relevant information provided and the abstract relationships between problem elements (Dhillon, 1998; Larkin, 1985). Physics novices, on the other hand, reason backwards by determining their strategy from the required solution. In other words, they tended to work backward using a means-ends

strategy. They classify problems in terms of surface-level details which are not significant to the operational principles of the task. In this case, novices solve problems inductively by trial-and-error tests of constantly changing hypotheses to identify solutions (Lambert and Newsome, 1989).

Similarly, in Patel et al. (1993), the reasoning strategies employed by expert physicians and novices for solving clinical problems were evaluated using the 'thinking aloud' method. Verbal protocol analyses revealed that as novices gain more clinical experience, they became more aware of the role of providing coherence to the problem solution by coordinating hypothesis and evidence (data). The results also revealed that subjects generate a major hypothesis and then reinterpret or ignore conflicting data, generate concurrent hypotheses to account for different sets of data or generate initial hypotheses and then narrow their focus using data. These strategies have also been observed in many other domains (Lovett and Anderson, 1996).

Another stream of research has examined expert–novice differences based on their relative use of backward and forward reasoning. This stream of research is reinforced by the findings in Elstein et al. (1978) who reported that experienced physicians used both forward and backward reasoning. In subsequent studies of Patel and Groen (1986), the authors found that expert physicians use more forward reasoning than backward reasoning in generating diagnosis or interpreting tests results. Recently, Eells et al. (2011) have also established that expert therapists formulating diagnostic and treatment planning use more forward than backward reasoning and that when compared with non-experts, use more forward and backward reasoning.

Groen and Patel (1991) also found that both expert and novices use backward reasoning, particularly in non-routine situations. The authors concluded that backward reasoning seems to be an attribute of new or non-routine problem solving rather than of novices *per se*. This conclusion is also corroborated by the findings in Kaufman et al. (2008) who reported that experts use more forward reasoning when



dealing with routine problems, but that both novices and medical experts problem solving in non-routine situations is characterised by the use of backward reasoning. Earlier studies have also found that the directionality of reasoning is related to the level of accuracy achieved during performance (Patel and Groen, 1986; Patel et al. 1990). These studies examined the factors that may disrupt the pattern of forward reasoning and concluded that accurate performance (usually from the experts) was associated with pure forward reasoning. In contrast, inaccurate performances (usually from the sub experts) were related to both forward and backwards reasoning

These differences between experts and novices strategies during task performance are significant and quite clearly emphasise the role of relevant prior knowledge in the development of appropriate problem-solving strategies. Therefore, in order to understand how expert valuers develop their cognitive expertise, the present research examines expert-novice differences in terms of the cognitive processes (in the form of problem-solving operators and strategies) they employed when formulating solutions and valuation plan in non-routine situations.

## **2.6 SUMMARY**

This chapter introduced and discussed the general concept of expertise. The diversity of the various models and theories that help to understand the development of expertise has shown that the journey towards professional expertise requires a continuum of development and refining of many complex factors, including intuition, knowledge, cognitions and problem solving. From a cognitive perspective, however, the nature of expertise was observed to be inextricably linked to the issue of knowledge which also depends on cognitive skill. Glaser and Chi (1988), for instance, argued that expertise is the possession of an organised body of both conceptual and procedural knowledge that can both be readily accessed and used with superior cognitive skills. Also, as illustrated in the conceptual framework presented in the next chapter, different forms of knowledge organisation (e.g. of chunks, schemas, encapsulation and scripts) are valuable for effective use of cognitive processes in commercial-valuation problem solving which this study aims to

describe. The review has also identified the paucity of academic research regarding valuer's cognitive development of expertise, thus further justifying the need for this present study. The majority of the studies on valuation expertise took the behavioural approach, which failed to recognise the role of knowledge and cognition in the development of valuation expertise. Thus, this present study is expected to provide comprehensive contributions to the understanding of valuers' cognitions and their cognitive structures.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1 INTRODUCTION**

The previous chapter presented a comprehensive review of relevant theoretical and empirical literature on expertise and problem solving that are central to understanding cognitions in commercial valuation, which is the context and focus of this study. Following on from this, this chapter presents the conceptual grounding for designing appropriate research methodology to address the research problems outlined in Chapter 1. The chapter also articulates the specific details of the research methodology employed in the study. This involves a systematic explanation of the assumptions and values underpinning the critical realism stance adopted for the study and the justification of the choice of Cognitive Task Analysis (CTA). It also includes the criteria and framework guiding the collection, analysis and interpretation of data collected for the study. This chapter is significant in the sense that it demonstrates an understanding of theory of research method and, in particular, adopts methodological approaches that are consistent not only with the research problems but also with the ontological positions taken by the researcher. The chapter is organised into nine broad themes including research conceptual framework, philosophy, design and participants, methods of data collection and analysis, research quality and ethical considerations.

#### **3.2 RESEARCH CONCEPTUAL FRAMEWORK**

Based on the review of both empirical and theoretical literature on expertise presented in Chapter 2, a conceptual framework for understanding the development of commercial valuation expertise and problem solving is attempted here. This framework is limited to cognitivists' conceptions of expertise, as reviewed in the literature. In line with these conceptions, and as indicated in Figure 3.0.1 below, this study considers the development of commercial valuation expertise as a process of accumulating knowledge for valuation problem solving. However, the effective usage of this knowledge requires cognitive processes. These cognitive processes, also referred to in literature as 'process knowledge', are key elements of experts'

knowledge base which enables them to develop their expertise and to be able to effectively deal with complexity and ambiguity in problem solving.

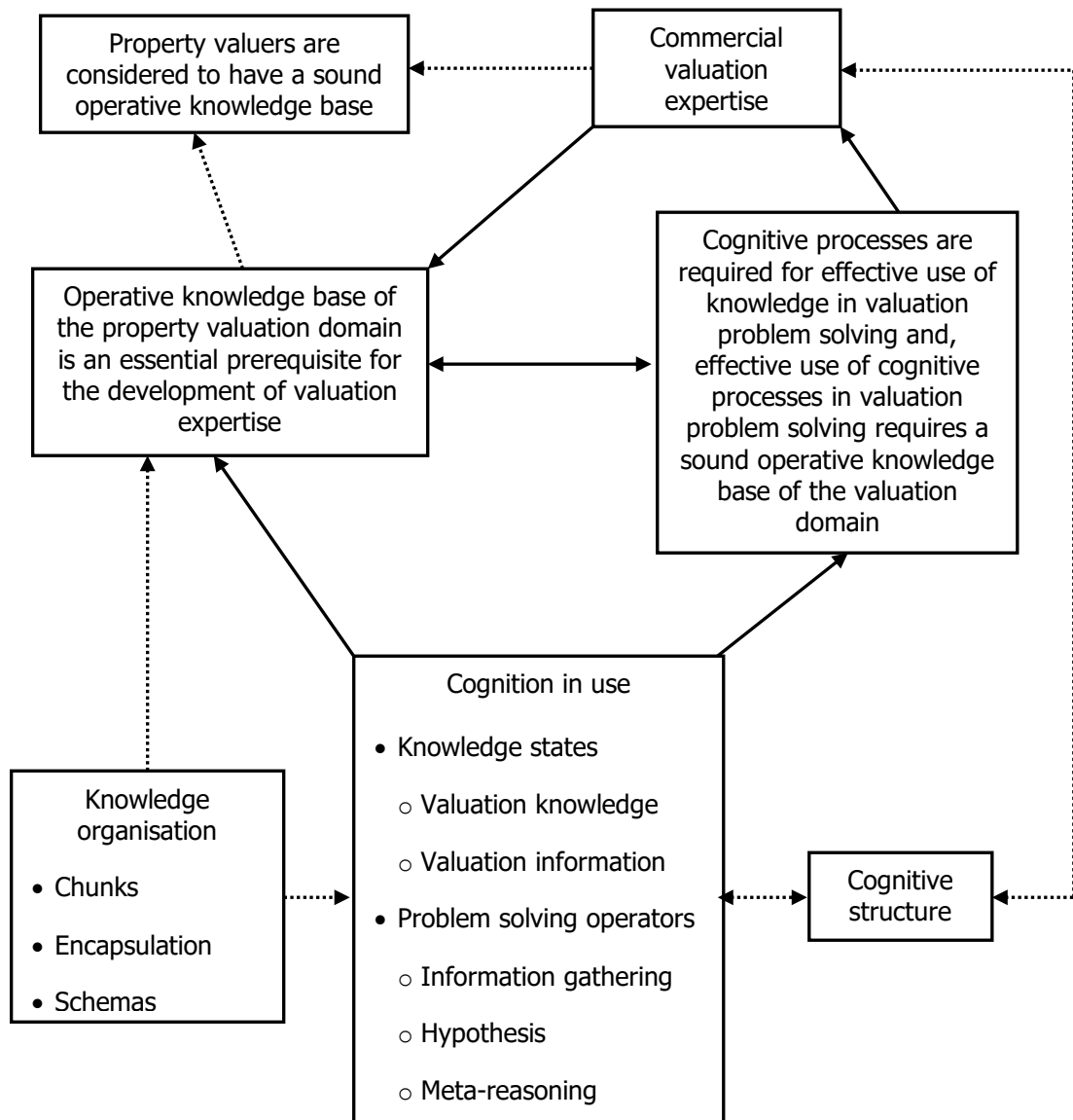


Figure 3.0.1 Conceptual framework for assessing cognitive processes and mental models in commercial valuation

The contention in literature is that cognitive processes cannot be acquired in an abstract fashion. Rather, they need a professional context and process in order to develop. Thus experts are expected to demonstrate different cognitive skills in different domains. This study, therefore, explores the cognitive processes of valuers within the domain of valuation expertise. The study relies on the cognitive literature

to identify the processes, in the nature of problem solving operators and strategies, which might be used to solve practical commercial valuation problems having regard to their complex ill-defined nature.

Experts, according to the literature, have demonstrated more-sophisticated and efficient methods of cognitive processing than novices in many domains of expertise. Thus, this study also examine whether there is expertise effects in the use of cognitive processing in commercial-valuation problem solving and if so what accounts for such differences. The present research presents the view that differences in problem-solving performance among people with different levels of expertise could be attributable not only to the types of knowledge that subjects bring to bear on the problem, but also to the ways they organise such knowledge. The types of knowledge organisation that have been identified in literature and are likely to influence commercial valuation problem solving are chunks, encapsulations, schemas and illness scripts.

Cognitive structures have significant impact on the development of a domain since they represent one of the most critical attributes of how experts do their routine job. Therefore, interpreting experts' methods of cognitive processing into a cognitive structure is one of the most reasonable approaches to reveal the underlying reasons for expert problem solving performance. This present study isolates the relevant cognitive features of participants and used those features to construct cognitive structures of their commercial-valuation problem solving. These structures contain and integrate the knowledge state, problem-solving operators, and strategies for solving problems in commercial-valuation practice. Additionally, this study utilises interviews to elicit the context of commercial-valuation problem solving from the perspective of expert valuers.

### **3.3 RESEARCH PHILOSOPHY**

The basic aim of researchers in every research project is to generate knowledge and, the two fundamental questions that researchers normally face in the process are to

understand: (a) what is acceptable knowledge? and, (b) how can this knowledge be generated and verified in order for it to be considered as acceptable public knowledge? (Bryman and Bell, 2007; Carson et al., 2001; Creswell, 2003; Easterby-Smith et al., 2002) The answers to these questions depend on the philosophical stance of the researcher(s). Hence, in addition to providing both theoretical and conceptual frameworks, a researcher equally requires a clear philosophical stance that will provide the basis for making ontological and epistemological selections (Wikgren, 2005). In simple terms, ontology refers to one's view of reality and being while epistemology refers to the view of how one can acquire knowledge (Mack, 2010). In other words, ontology represents the study of "*claims and assumptions that are made about the nature of social reality, claims about what exists, what it looks like, what units make it up and how these units interact with each other*" (Blaikie, 2000; as cited in Grix, 2004, p. 56). Epistemology, on the other hand, is concerned with "*the philosophical theory of knowledge, which seeks to define it, distinguish its principal varieties, identify its sources and establish its limits*" (Bullock and Trombley, 2000, p. 279).

Why does one's view of knowledge and social reality matter in real-estate research? A possible answer to this question is based on the view that a research endeavour is inextricably linked with an individual's philosophical assumptions and theoretical perspectives. Easterby-Smith et al. (2002) gave prominence to this by arguing that failure to think through both the ontological assumptions and epistemological undertakings can significantly compromise the quality of a research, which is, of course, a major factor in research design. Grix (2004) also warns that people undertaking research need to understand the underpinning philosophical assumptions informing their choice of research questions, approach and methods. Zolan and Lewis (2004) argued that, outlining ones philosophical position in a research study, provide justification for the choice of research approach and techniques to guide subsequent data analysis and interpretation. Therefore, one's view of social reality and knowledge influences the way one uncovers the knowledge of the social phenomenon under investigation.

For this research, Critical Realism, a philosophy widely thought to have originated from Bhaskar's (1978; 1986; 1989; 1994; 1997: 1998) transcendental realist theory of science, is considered an appropriate philosophical stance to investigate cognitions and its usage in the context of commercial-valuation practice. In other words, Critical Realism forms the basis of developing the analytical framework used to analyse the empirical data in this study. In the ensuing discussion, the Critical Realism approach is described followed by the justification for selecting it for this study.

### **3.3.1 A Critical Realism perspective**

Fundamentally, the realist assumption is that social and psychological phenomena exist, while the alternative, idealist assumption is that they do not: they are constructed in the minds of individuals. Therefore, as the name suggests, critical realism adopts a realist ontological stance. From a critical realist's perspective, objects of knowledge are acknowledged to exist at two levels: transitive and intransitive (Archer, 1998; Bhaskar, 1978; 1989). Transitive objects comprise an agent's fallible knowledge of the world that includes, for instance, the antecedently established facts and theories. On the other hand, intransitive objects of knowledge are independent of human agents and include mechanisms and processes which together generate the actual events that we experience (Lawson, 1997; Mingers, 2004). The existence of intransitive objects of knowledge is, therefore, a necessary condition for scientific experimentation from a critical realist's view and, such experimentation according to Benton and Craib (2011) would be unintelligible if the mechanisms and their tendencies under investigation did not exist independently of the activities and beliefs of the experimenters.

Ontologically, therefore, critical realists acknowledge "*that reality exists and that it is possible to conceptualise it and make theories in order to describe it*" (Jeppesen, 2005, p. 4). Ranyard (20014) argued that the ultimate goal of a critical realist is to explain and describe the occurrence of a phenomenon at a given level of reality in a specific context. Such reality, according to Critical Realism ontology, is divided into three different levels: empirical, actual and real (Bhaskar, 1978; Collier, 1994;

Easton, 2010; Jeppesen, 2005; Mingers, 2004; Sayer, 1992). 'Empirical' refers to individual's personal experiences which can be observed and experienced directly by the observer; 'actual' refers to the events themselves, some of which may not be observed at all or may be understood by different observers differently; 'real' refers to the mechanisms that operate to allow events to occur and can never be completely understood but rather theorised about (Collier, 1994; Easton, 2010). As indicated in Table 3.0.1 below, "*the real contains the whole of reality – mechanisms, events, and experiences; the actual consists of events that do (do not) occur and includes the empirical, those events that are observed and experienced*" (Minger, 2004, p. 93).

Table 3.0.1 The three domains of reality (Adapted from Mingers, 2004, p. 94)

	Real	Actual	Empirical	
Experiences	√	√	√	The part of the real and actual that is observed and experienced
Events	√	√		The domain of events that are generated by the mechanisms
Mechanisms	√			The domain of causal tendencies

In summary, understanding reality from a Critical Realism perspective involves examining the experiences of individuals and the underpinning structure and mechanisms that comprise the social world (Dobson et al., 2007). As further stated by Jeppesen (2005, p. 5), the goal of "*Critical Realism is to explain the relationship between experiences, events and mechanics*" and the emergent interaction between these, across the various domains of reality (Easton, 2010). For instance, while sociological analyses are usually interested in the interaction between social structures and individual agents, a cognitive-psychological analysis (as is the case in this investigation) would generally focus on the interaction between the conscious experience of individuals and sub-conscious mental processes (Ranyard, 2014). The empirical data obtained for this investigation were analysed (as illustrated in Table 3.0.2 below) based on the three domains of reality proposed by Bhaskar (1989).



In this philosophical stance, emphasis is placed on identifying specific attributes of a particular phenomenon and how and why it came into being. Hence, rather than making predictions (which is, of course, possible in controlled conditions), the ultimate goal is the explanation of the constitution of empirical phenomenon (Jeppesen, 2005; Ranyard, 2014). There is also the notion that “*general explanations are not possible, only specific ones, grounded in specific contexts*” (Ranyard, 2014, p. 4).

Table 3.0.2 Empirical data analysis based on critical realism ontological framework

Domain of reality	Analysis
Empirical (entities)	Interpretation of valuers’ cognitive processes using cognitive task analysis
Actual (events and actions)	Interpretation of pattern of cognitive processes within the empirical data
Real (mechanism and processes)	Interpretation of cognitive processes into a model of cognitive structures of commercial valuation problem solving

### 3.3.2 Rationale for selecting the Critical Realism paradigm

The research philosophy selected in any investigation should represent the best way of addressing the research question posed and/or understanding the phenomenon in that investigation (Guba and Lincoln, 1994; Morse, 1994a). The rationale for selecting Critical Realism is addressed in terms of its strengths in understanding the phenomenon considered in this investigation: cognitions in commercial valuation problem solving.

Cognition is a complex multidimensional and context-dependent human phenomenon. The social constructionism researchers believe that, ontologically, this phenomenon can only be understood from the shared knowledge and meanings that individuals develop from their experiences. However, from a critical realist perspective “*social reality is not limited to what people know*” (Lopez and Potter, 2005, p. 28). As stated by Reed (1997, p. 25), the critical realist’s approach broadly

seeks to avoid a “*myopic analytical focus on situated social interaction*” to the “*detriment of the explanatory power of structure*”. Thus, both individual subjective meanings and objective structures have causal capacity for a critical realist (Archer, 1995; Olsen, 2008). Choosing the pluralistic paradigmatic approach of critical realism, therefore, allows objective and subjective insights into the phenomenon of valuers use of cognitive processes explored in this study. In addition to describing in detail the cognitive processes that individual valuers use to solve practical valuation problems, the adoption of a critical realism approach also allows an exploration of how experienced and less-expert valuers differ in terms of their deep structure of cognition in commercial valuation.

It is evident from the available literature that there is a need for theoretical understanding of expert valuers’ cognition and cognitive structures of commercial-valuation problem solving. The Critical Realism stance of explaining social phenomenon through identification of causal mechanisms and processes promotes the theorisation of “*the nature of individuals, the nature of society*” and “*the nature of their causal interaction*” (Sayer, 2000, p. 140). In other words, Critical Realism supports a description of the entities involved in the phenomenon as well as an explanation of causal mechanisms that generate them (Lopez and Potter, 2005). Such causal mechanisms, according to Mutch, (1997), differ from the positivist notion of cause and effect. Instead, a critical realist acknowledges that “*causal mechanisms do not always generate a particular sort of event*”, but that there are “*tendencies to interact in certain ways*” (Lopez and Potter, 2005, p. 11). Ackroyd and Fleetwood (2000) maintained that causality, from a critical realist stance, is a means to understand and explain what happens, rather than being used for predictions. Therefore, critical realism emphasis on underpinning mechanisms and causal tendencies can advance the approach to investigation beyond description to include explanation of the phenomenon.

### **3.4 RESEARCH APPROACH**

The approach to the present study is one where the cognitions of a group of valuers in commercial-valuation practice are explored and compared to a group of less-

expert valuers in the light of the ideas developed in the review of substantive literature. The research is, therefore, conducted within a qualitative framework which, according to Denzin and Lincoln (1994, p 2) is a "*multi-method in its focus, involving an interpretative, naturalistic approach to its subject matter*". This approach is also compatible with several research paradigms, including the critical realism paradigm (Denzin and Lincoln, 2000; Higgs, 2001), with different philosophical underpinnings and theoretical perspectives. In other words, qualitative research intensively studies a phenomenon in its naturalistic environment and interprets the findings in terms of the meaning people bring to them. From this perspective, the researcher would be able to build "*a complex, holistic picture, formed with words*" (Creswell, 1994, p. 1). Merriam (1988) also argued that qualitative research is descriptive (words rather than numbers-based), exploratory, inductive and emphasises processes rather than ends.

Patton (1990) enumerates the key strategic themes of qualitative research, all of which have direct application to this present research, and hence justify its choice. These include naturalistic, inductive, holistic, context sensitive, dynamic, emphatic, unique case selection, and 'thick description' themes. For instance, this study is 'naturalistic' in the sense that it investigates the cognitive processes used to solve practical commercial valuation problems in a simulated naturalistic setting where the researcher has no direct control over the events and processes as they unfold. Holistically, the study sought to understand how various cognitive processes are used in commercial-valuation problem solving by valuers of different levels of expertise. Also, the researcher was open to theories, hypotheses and categories emerging from the data, thus demonstrating its inductive nature. The research was also dynamic; methods of data analysis were reviewed as the data unfolded, and emphatic – the researcher was non-judgmental in regards to the views of the research subjects. Finally, the research involves 'thick description' whereby each subject use of cognitive processes was described in a detailed and in-depth manner in order to develop an understanding of valuers' use of cognitions in valuation problem solving.

Although this research is primarily qualitative, this thesis also employs some quantitative analyses to gain an understanding of frequency of use of different

cognitive processes. Several authors have advocated the use of both qualitative and quantitative approach in a research, especially where doing so facilitates different levels of understanding on the phenomenon being investigated (Salomon, 1991; Qureshi; 1992; Hurmerinta-Peltomaki and Numela, 2006). In this present research, for example, qualitative analysis was used to provide an understanding of how valuers use different cognitive processes in valuation problem solving while quantitative analysis was used in the relative use of the cognitive processes.

### **3.5 RESEARCH STRATEGY**

The qualitative approach to research encompasses a number of research strategies, including grounded theory, ethnography, case study, and Cognitive Task Analysis. Given the nature of the research problem addressed in this study; how valuers develop and utilise their cognitive expertise in commercial valuation problem solving, the Cognitive Task Analysis (CTA) was selected as the most appropriate research strategy to guide the data collection. Over the past 25 years, CTA has been the standard and effective technique utilised in industrial/organizational psychology to capture the unobserved knowledge and cognitive processes underlying human performance within a particular domain (Chipman et al., 2000; Cooke, 1992).

The analytical framework presented in Figure 3.0.2 below provided a diagrammatic illustration of implementing the CTA for this research. The framework also incorporates aspects of data analysis and how that leads to theory development using the conceptual issues presented in section 3.2. This is consistent with Critical Realist approach which proposes that any analytical process of theory development must be grounded in the empirical data (Sayer, 2000).

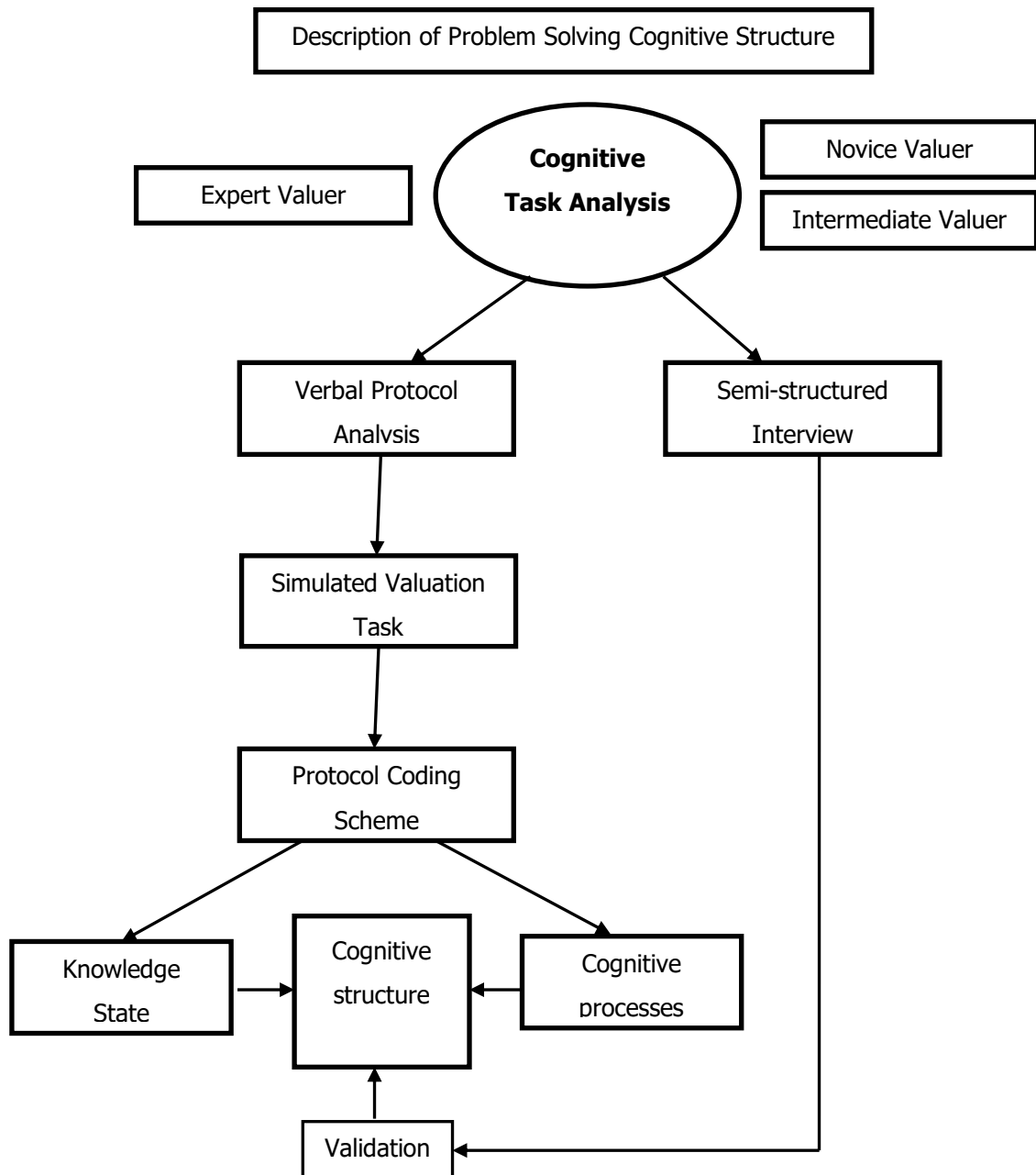


Figure 3.0.2 Research analytical framework

The following sub sections describe the CTA in a more detail and provide justifications for its use in this research.

### 3.5.1 Cognitive Task Analysis (CTA)

Cognitive Task Analysis is a qualitative analysis technique of knowledge elicitation which comprises the process of acquiring and explicating the knowledge underlying an expert performance within a particular problem domain (Cooke, 1999; McTear

and Anderson, 1990). Chipman et al. (2000, p. 3) define CTA as an *“extension of traditional task analysis techniques to yield information about the knowledge, thought processes, and goal structures that underlie observable task performance”*. This definition seeks to broaden knowledge elicitation focus of CTA to include application in other aspects of cognition such as perception, judgment and decision making processes.

From a practical application view point, CTA is simply a collection of methods and techniques that capture the knowledge and cognitive processes embodied in the performance of tasks (Cooke, 1992). Such methods and techniques are usually referred to as a “practitioner’s tool kit” (Cooke, 1999, p. 4) aimed to elicit knowledge, facilitate data analysis, and represent the content and structure of knowledge (Crandall et al., 2006). Thus, CTA encompasses three distinct aspects (Crandall et al., 2006): knowledge elicitation (“collecting information about what people know and how they know it: the judgments, strategies, knowledge, and skills that underlie performance”, p.10), data analysis (“structuring data, identifying findings, and discovering meaning”, p.21) and knowledge representation (“displaying data, presenting findings, and communicating meaning”, p.21). These aspects of CTA provide the analytical framework for this research and further elaborated in Figure 3.0.2 above in section 3.7.

### **3.5.2 Rationale for choosing CTA**

A key strength of CTA; which influenced its adoption for this study, is that it aids experts in articulating knowledge that is generally difficult to verbalize (Militello and Hutton, 1998). Clark and Estes (1996) argued that CTA is a valuable approach to determine the cognitive knowledge used by experts who have demonstrated high performance standard on a target task. Militello and Hoffman (2008) also maintained that CTA, through a variety of interviews, observation, experimental and modelling approaches, allows us to capture a complete and accurate description of the cognitive processes and decisions in the mind. It therefore helps to identify task-performance skills, determine cognitive structures and analyse mental models that would never have been discovered through the use of conventional techniques of data collection. According to Hoffman et al. (2009), CTA enables an explicit and in-

depth chronicle of significant decision-making strategies that are otherwise inaccessible through superficial methods such as survey and interview. Analysts also use CTA to identify information-processing strategies; usually by comparing experts to those with less experience. The outcomes in this and other cases outlined above are most often to improve teaching and learning processes, thereby facilitating the transition from being a novice to an expert.

## **3.6 RESEARCH PARTICIPANTS**

### **3.6.1 Category**

Due to the comparative nature of this study, it was necessary to consider participants with different levels of valuation expertise. As such, three categories of participants were distinguished for the purpose of this study. These included (i) participants who had no practice experience in commercial valuation (the novice valuers), (ii) participants who had only a little practice experience in commercial property valuation (the intermediate valuers) and, (iii) participants who had greater level of practice experience in commercial property valuation (the expert valuers). The research used years in commercial valuation practice and professional and peer recognition as the criteria for identifying expert valuers. Absence of professional recognition was used to identify the intermediate valuers who were real estate graduates but still undergoing practical training (that is, RICS Assessment of Professional Competence (APC) students). Finally, absence of experience was used to identify the novices who were real-estate students at the final year of their academic training.

The literature on expertise provides models of identifying expertise in several areas of performance such as in music, chess, physics and medicines. One of these models posits that as a practitioner acquires a skill, he/she goes through five developmental stages (Dreyfus and Dreyfus, 1980; 1986; Benner, 1984). These are (1) novice; (2) advanced beginner; (3) competent; (4) proficient; and (5) expert. Although each stage of this and other models has unique and qualitative distinctions along the developmental progression, they often relied on the individual's level of cognitive development as the criteria for characterising expertise. Thus, it was not

possible to use the criteria provided by these models to select research participants without undertaking extensive investigation of each potential participant's level of cognitive development. In addition, the developmental stages developed in these models were not significant to this research which rather focused on the knowledge transformation that takes place as a result of years of practice experience.

In valuation literature, researchers almost routinely use accreditation as a surrogate for expertise. The underlying assumption of these studies is that accreditation or title as a certification of valuation skill is a major determinant of expertise. The problem of this approach is that it is usually connected with the time on the job rather than on level of performance. Also professional accreditation is held for life even when one's skill level might have suffered a major decline (Weiss and Shanteau, 2003). Other criteria such as number of years of working experience, quality (accuracy) of decision, academic qualification, holding a senior position and peer identification have been used to measure expertise in other fields, but they have problems too. For instance, identifying expertise based on number of years of working experience is problematic in the sense that even though experience is an essential requirement for expertise, it does not necessarily equate to expertise; one can have considerable experience and not be an expert (Bedard, 1989). Also, in property valuation, the quality of decision is difficult to evaluate because there are few areas in which objective criteria can be employed to evaluate the quality of valuer decision making.

Expertise is therefore difficult to operationalise due in part to the fact that there is not universally acceptable definition of expertise and also because it is a complex concept that cannot be completely accounted for by one single measure (Feltovich et al., 2006; Sternberg and Horvath, 1995). As a consequence, this study adopts multiple criteria (years of property valuation experience and professional and peer recognition) for selecting research participants. In applying the years of practice experience criteria, this research took notice of Hayes' (1985) observation that an individual general practitioner requires 10 years of practice experience in order to gain recognition as an expert. Thus, the participants selected in the expert category for this research were chartered valuers with at least 10 years of experience in



commercial property valuation. This is consistent with the at-least five years of experience suggested for proficient and expert stages proposed in Dreyfus and Dreyfus's (1986) model of skill development. The participants selected in the intermediate category for this research were graduate real-estate students who had completed the academic requirements for professional membership but were still undergoing their APC training. The participants selected in the novice category for this research were undergraduate real-estate students in the final year of their bachelor degree programme.

### **3.6.2 Recruitment strategy**

Given the qualitative nature of this study, non-probability sampling technique was used in selecting research participants. This sampling technique, as noted by Ritchie et al. (2003, p. 78), is where "*units are deliberately selected to reflect features of or groups within the sampled population*". Thus, in a non-probability sample, the objective is to select participants who possess certain features that allow for detailed exploration and understanding of the central issues under study. The use of random sampling technique was not considered appropriate due to its unreliability as a method of gaining in-depth understanding about a particular phenomenon (Cohen et al., 2000).

There are specific non-probability sampling strategies for the selection of research participants when using the qualitative approach to research (Flyvbjerg, 2006). These sampling strategies include snowball (chain), stratified, purposive and convenient sampling. In the conduct of this study, and also in order to select information-rich cases for detailed investigation (Denzin and Lincoln, 2000; Patton, 2002), participants for the verbal-protocol analysis task and interviews were selected using purposive- or criterion-referenced sampling. This method is congruent with Critical Realism paradigm research (Mills et al., 2009) and is also a suitable approach for an exploratory study given that any patterns that emerge from the study may be of particular interest (Patton, 1990).

As noted in the previous sub-section, the research participants for this study comprise expert, intermediate and novice valuers who were differentiated by academic qualifications, work experience and professional recognition. These features make it possible to select participants who are well-suited to small-scale and in-depth investigation of the phenomenon of complex mental processing in the present context. In recruiting participants for the expert and intermediate groups, the present researcher sought to select surveyors working in the valuation department of private real-estate firms within metropolitan Birmingham because surveyors working in these settings were more likely to have commercial valuation experience to undertake the verbal protocol task and discuss their mental and reasoning strategy. Further advantages were the possibility of recruiting participants who have the knowledge of the local property market and live within the proximity of the subject property and the researcher's home and workplace.

In terms of the recruitment process, surveyors in charge of valuation departments of real-estate firms within Birmingham were contacted by email to explain the purpose and process of the research and seek their support. The heads of valuation departments were requested to inform their staff about the project and to direct those interested in participating to contact the researcher directly through the email address or telephone contact provided. Some surveyors personally known to the researcher and eligible to participate were also contacted. Surveyors who indicated willingness to participate in the project were provided with an information pack on the verbal-protocol analysis task following an agreement of the date and time of participation.

### **3.6.3 Sample size and profile**

In qualitative research, sample size is a function of the intensity of contact with participants and the depth of information required (Cohen et al., 2000; Patton, 2002). Thus, as the duration of contact with participants increases, the size of the sample will usually decrease. Also, the use of a small-sample size allows for and requires richer data to be collected, because more time is spent with individual participants. Given the demands of the use of verbal-protocol analysis employed in

this study, it was determined that six participants (two in each subgroups) would allow for collection of rich information relating to the complex mental processes used in commercial property valuation.

The use of a small sample size is consistent with the method and strategy employed in this study where statistical representation is not of primary concern. In choosing the sample size, notice was taken of Morse's (1994b) recommendation of at least six participants for qualitative research and Ritchie et al.'s (2003) observation that where vast amounts of information would be collected for each participant, the sample should be kept to a reasonably small size to allow in-depth analysis of the data.

As stated previously in section 3.6.1, the participants for this research were expert, intermediate and novice valuers. These groups provided a means of investigating the effects of expertise level on the cognitions used in solving valuation problems. Table 3.0.3 below presents the background information on each participant as at the time of data collection.

Table 3.0.3 Participants relevant background information at the time of data collection

Code	Gender	Academic Qualifications	Professional Membership	Years of Valuation Experience	Average Valuations Per Year
EV1	M	RICS examinations	FRICS	21 years	1,000
EV2	M	Bachelor of real estate degree	MRICS	22 years	350
IV1	M	Bachelor of real estate degree	APC candidate	3 years	28
IV2	M	Bachelor of real estate degree	APC candidate	2 year	156
NV1	F	Undergraduate real estate student	Nil	Nil	Nil
NV2	F	Undergraduate real estate student	Nil	Nil	Nil

Two experts and one intermediate valuer were recruited from large, private-equity partnership real-estate firms in metropolitan Birmingham, UK. Participants working

in private firms were chosen because they would have had many valuation encounters to bring to bear on the simulated valuation task. One intermediate valuer was recruited from the Birmingham City Council where he is currently undergoing APC training, but in a valuation pathway. All the novice valuers were final year undergraduate real-estate students at Birmingham City University.

The participants in this study had years of valuation experience ranging from 0 to 22 years. This demonstrates a wide level of experience and potentially provided subjects who were at different phases of development of cognitive and problem-solving ability. Also expert valuer 1 did not complete a university degree in real estate. Instead, he completed the RICS examinations to gain his professional membership. He thus has less formal education as compared to other participants. The advantages of this and the fact that subjects were in varying stages of cognitive development and problem solving abilities are that there is the potential for increased richness in the data collected and the a diversity of of perspectives for providing an understanding of how valuers develop and utilise their cognitive expertise.

### **3.7 METHODS OF DATA COLLECTION**

The methods of data collection employed in research need to be congruent with the philosophical assumptions of the working paradigm (Crotty, 1998) and need to provide relevant data about the participants' experiences of the phenomena under study, which in this context is valuers' use of cognitions in valuation problem-solving. As indicated in section 3.5, the widely accepted Cognitive Task Analysis (CTA) was adopted to elicit the cognitive processes that the subjects used to solve the practical commercial valuation task. According to Gordon (1994), cognitive science has a wide and varied pool of methods of Cognitive Task Analysis, including observations, Delphi survey, controlled experiments, Verbal Protocol Analysis and interviews.

Observation is a direct method of knowledge elicitation (Olson and Biolsi, 1991) which involves a purposeful, systematic and selective way of watching and listening

to a phenomenon as it takes place (Kumar, 2005). Observation, according to Collis and Hussey (2003), may be categorised as participant (where the researcher is fully involved with the participants and the phenomena under investigation) or non-participant (where the researcher is separated from the activities taking place). Although this method has been used to investigate clinical expertise in various contexts (for example, Kaufman and Patel, 1988), it was dismissed as being impractical on three grounds. First, there is the possibility that the problem of observer bias may arise and the observer may fail to observe some activities because of distractions. Second, the method is problematic and, in the context of this research, will require gaining access to observe the valuation process of many real estate firms in order to develop an understanding of the cognitive processes used in problem solving. This is further compounded by the fact that valuations are in practice rarely carried out as a single discrete process (Havard, 2001b). Third, even in Kaufman and Patel's research, the data obtained through observation was acknowledged to be unreliable in terms of revealing knowledge and cognitive processes being used by participants in a particular context. As a result, the method was considered impractical to use for data collection in this research.

Similarly, Delphi survey was ruled out as the primary data collection method for this research. Delphi survey is an interactive technique that allows the refinement of opinion over a number of iterative rounds with the ultimate goal of building consensus (Vosmer et al., 2009). It was originally designed to forecast, identify issues and validate a construct and has been applied as a tool for understanding experts' cognitive skills in a wide variety of disciplines, including software development (e.g., Surakka and Malmi, 2005). Delphi survey is very feasible where substantial information is sought (through the use of questionnaire) from a large sample for quantitative analysis. For this reason, it was not considered beneficial to gain a deeper understanding of the cognitive structures that identify and describe the cognitive processes valuers used in commercial valuation problem solving.

Controlled experiment has been the method of choice for most behavioural research in property valuation (see Table 2.0.6 above). An experiment has three basic features (a research instrument, a random sample, and a manipulation) and often

conducted to make causal statements. In an experimental study, information is carefully controlled between the controlled group and the treat group. With this, evaluative statistical methods can be used to establish strong causal relationship between manipulation and response. Given the qualitative nature of this present research, controlled experiment was ruled out as inappropriate for data collection.

Verbal Protocol Analysis (VPA) and interviews, on the other hand, are the most widely employed qualitative means of gathering rich data relating to knowledge and thought processes used in problem solving. Accordingly, both were considered as the primary methods of data collection for this research. The rationale for the selection of these methods and details of their instrumentation are discussed in the following sub-sections.

### **3.7.1 Verbal Protocol Analysis**

The first phase of this research was to provide a descriptive cognitive structure of expert valuers' valuation problem-solving, and the main data collected was through the verbal protocol analysis method. This method is derived from a cognitive psychological or information processing framework for studying human behaviour (Hassebrock and Prietula, 1992) and, has evolved as one of the most widely used to gather rich information relating to the knowledge and human thinking processes that are used to solve problems in the laboratory and quasi-naturalistic settings (Cooke, 1999; Crutcher, 1994; Ericsson and Simon, 1993; Newell and Simon, 1972). The method was originally developed for the study of short-term memory of participants when performing a task but now widely used in a variety of problem-solving, decision making and judgment contexts such as in chess (e.g., Charness, 1981; de Groot, 1965; Chase and Simon, 1973), sport (e.g., McPherson, 1999a, 1999b, 2000), writing (e.g., Flower and Hayes, 1981), music (e.g., Waters et al., 1998), software (e.g., Carroll et al., 1987), aviation (e.g., Wiggins & O'Hare, 1995), and valuation (e.g., Havard, 2001b).

Verbal protocol analysis is a research method in which verbalisation of participants' thoughts are elicited and transcribed for analysis (Ericsson and Simon, 1980). The method requires participants to "talk aloud" or "think aloud" when performing a task, for example solving a valuation problem, with the explicit instruction to verbalise everything that comes to their mind. These think aloud procedures, as argued by Ericsson and Simon (1980), do not change participants' thoughts because they are verbalised as information being processed. Rather the procedures help to minimise the potential hazards of inferences about behaviour.

Therefore, a unique advantage of using verbal report data is that it reflects the content of ongoing behaviours of a problem solver. This allows a researcher the opportunity to verify what subjects said with what they actually do. For this reason, the method was considered as the most appropriate for this research over and above the so-called direct research methods such as observation. Some have argued that the VPA is not an effective knowledge elicitation method in all contexts (see example of Rowe et al., 1996 in the study of troubleshooting in airborne electronics). One of the explanations offered by Rowe et al. is that subjects were not used to verbalising their thinking in troubleshooting and demonstrated reluctance in using the method. But it can be argued that verbalisation is a natural part of thinking about practical commercial valuation problem as real-estate students and practitioners need to be able to explain their thinking about problems to their colleagues and clients. The adoption of the VPA is, therefore, consistent with Ericsson and Simon's (1993) argument that thinking aloud activity is only appropriate for tasks where verbalisation is a natural part of thinking,

The verbal report data obtained through the think-aloud method can be particularly useful in gaining an understanding of how cognitive skills and strategies develop and change (Robinson, 2001) in a wide range of domains, including conducting commercial-property valuation where the approach would be able to provide more-complete and rich data on valuers' problem solving strategies. In addition, the think-aloud method provides an effective means to accurately record and describe the cognitive processes of an individual subject (Pugalee, 2004; Redding, 1995; Newell and Simon, 1972).

Verbal protocols can be generated either retrospectively or concurrently (Hoffman, 1987). The later was adopted in this study and entails asking subjects to think-aloud while performing commercial valuation task. This approach was preferred over retrospective protocol to ensure that subjects did not reconstruct event that did not actually happen during the valuation.

#### ***3.7.1.1 Task***

Collecting data through the verbal protocol analysis method involved presenting a problem task to participants, requesting them to think-aloud while performing the task and audio-taping the think-aloud sessions. The task for the think-aloud sessions of this research consisted of an observed, simulated valuation in a commercial practice context. The reason that the present researcher sought to investigate cognition in a commercial valuation practice was because the valuation of a commercial property is invariably complex, involving considerable judgment that requires the valuer to gather and integrate a large amount of information from multiple knowledge domains (Havard, 2001a; 2001b). Thus the context of the task could be characterised as fulfilling Simon (1973) highly ill-structured problem which make it an interesting focus for research on valuers' thinking and decision making processes. The task was designed in the form of a typical valuation case requiring the valuation of a warehouse property located in a city (Birmingham city) that was familiar to all the participants – a feature that makes the task an authentic valuation similar to that a valuer might encounter in practice. The practicality and authenticity of the task was further enhanced by using a task that was developed from a real valuation report produced by a chartered commercial valuer but obtained from the property owner, whose permission was sought for the information to be used for the purpose of this research.

The task was prepared by the researcher and evaluated in a pilot session with a colleague with over 20 years of valuation practice experience to ensure that it reflected a typical valuation task that a valuer might encounter in practice. Required revisions such as including additional information or clarifications were made after



the trial session to enhance the realism of the exercise. The task was set out in information pack, which consisted of narrative statements for valuation instructions, description of the subject property, comparable sales and lettings data, and other related information (see Appendix A for a complete description of the valuation task). Photographs were also provided to improve visual content. This simulated valuation task was comparable to a "fixed-order" problem where expertise differences in thinking can be revealed by having expert, intermediate and novice valuers respond to identical case data (Elstein et al., 1978 as cited in Hassebrock and Prietula, 1992).

### ***3.7.1.2 Procedure***

Prior to the commencement of the think-aloud task, participants were also given a set of verbal instructions in order to orientate them to the valuation task. These include the following:

- i. They were told that the goal of the research was to better understand the thinking and decision making processes used by valuers when carrying out commercial valuation in a naturalistic settings.
- ii. They were also told that they will be given information pack of the subject property to value and that the task was to determine the appropriate opinion of the market value of the property.
- iii. The participants were asked to "think-aloud" as they carried out the valuation analysis. The importance of verbalising their thought processes was also emphasised and they were told that they would be prompted to keep talking should they fall silent.
- iv. They were told that they could spend as long on the valuation analysis as they deemed fit. The essence of this was to allow them do their valuation analysis as they will normally do if they were instructed to carry out the valuation of a commercial property in practice. Thus, all sessions were therefore self-terminating.
- v. They were told that they could refer to any of the information at any time during the valuation and that if they had questions or desired additional information, they should feel free to ask the researcher.

- vi. Critically, participants were told that their think-aloud verbalisation would be audio-taped.

All of the valuation analysis sessions with expert valuers took place in their respective workplace while sessions with intermediate (APC students) and novices took place in an empty board room at the researcher's University. In all the sessions, participants were not allowed access to any decision aids or reference materials (apart from Parry's Valuation and Investment Tables by Davidson (2013)) but were required merely to analyse and perform the valuation, using their existing knowledge and experience. This way, the researcher was able to gain an insight into expert-novice valuer differences in terms of their mental cognitive processes.

In the early stage and before the actual verbalisation, participants were allowed a trial-run verbalisation period during which they could practice to familiarise themselves with this rather awkward process of thinking aloud. The idea was also for the researcher to provide feedback on appropriate ways think aloud in order to avoid generalisation, inferences and description of actions (Ericsson and Kirk, 2001; Ericsson and Simon, 1993). The trial-run session was terminated once a participant indicated he/she was comfortable with the process of thinking aloud and ready to start the actual verbalisation.

Throughout the actual verbalisation task, the researcher took an unobtrusive role and only gave a "keep talking" reminder to participants after long pauses. Prompting participants this way may eventually force reactivity as they may feel pressured to satisfy the expectations of the researcher and, hence report thoughts that otherwise would not represent their actual thought processes. Thus in order to reduce forced reactivity to verbalisation, the researcher took the advice of Ericsson and Kirk (2001) and informed the participants that the "keep talking" prompt was only a reminder to verbalise their thoughts and not an obligation to report extraneous thoughts. The data collection activity in this phase of the study was terminated when the participant reported he/she arrived at opinion of value and was immediately followed by interview sessions.

### **3.7.2 Interviews**

Although protocol analysis often allows a researcher to gain useful insight into problem solving, the protocol obtained may not entirely or truly reflect subject problem-solving processes. Thus, in order to have a deeper understanding of the subject matter and related themes, this research also involved interviews. This practice is consistent with Cooke's (1994) recommendation of the use of multiple methods and which has also been echoed throughout the CTA literature (Ericsson and Simon, 1993; Russo et al., 1989).

The style of interviewing used in this study took the form of a semi-structured conversation between the present researcher and the participants; focusing on the latter's perceptions and experiences. Interviews, according to Yin (1994), are particularly useful in generating evidence to support the case studies and, in the context of this research, provided an opportunity for the subjects to construct the reality around them and provide important insights into how they interpreted and reasoned through the commercial property valuation. Merriam and Tisdell (2015) also noted that the use of interviews is necessary when data about belief, perceptions, opinion and feelings cannot be observed as in the case of this research. Although case-study interviewers normally use an unstructured interview techniques, most commonly, to adapt and explore interesting areas of discussion in greater depth (Burns, 1994), in this study, a more-focused format with broad questions forming an interview outline guide was used as a general focus, but altered when necessary to allow for flexibility of both questioning and response. In essence, the questions were only prompts to facilitate access to personal experiences and to keep the conversation flowing, but were not used rigidly. The general question outlines are included in Appendix B.

In this study, the interviews were conducted in two stages. The first stage related to the verbal-protocol analysis task. After participants had completed the task, they were asked to provide a free recall of the information provided and their thought processes. This free recall helped to capture participants' understanding of their own

general problem solving strategy during the performance of the valuation task. The second stage of the interview sessions consisted of more specific questions relating to the development of cognitive skills in commercial-property valuation practice. For each participant, both interview sessions were carried out on the same day and audio-taped.

### **3.8 METHODS OF DATA ANALYSIS**

As noted in the previous section, the analytical framework presented in Figure 3.0.2 guided the data collection and analysis. This sub-section, therefore, discusses the procedures involved in the analysis of the two sets of data utilised in the study: the verbal-protocol report obtained through verbalisation of the valuation task by participating valuers, and the verbal responses taken from the interviews of four expert valuers.

#### **3.8.1 Verbal protocol data analysis**

The participants' verbal protocols were analysed using content analysis (LeCompte et al., 1993; Patton, 1990) and the method for protocol analysis developed by Ericsson and Simon (1993) and which includes three phases of analysis: (a) recording and transcribing of verbalisations, (b) encoding the transcribed verbalisations into codes and, (c) analysis of the codes for sequential patterns. The procedures involved in these phases are further discussed in the following sub-sections.

##### ***3.8.1.1 Transcribing and segmenting the verbal protocols***

The audiotapes of the subjects' verbal reports were transcribed by the researcher. The transcription included the exact utterances of the subjects and the format was in accordance with the conventions used by Bracewell and Breuleux (1994) and Jefferson (1978) in order to ensure that syntactic structures are preserved as much as possible. In particular, syntactic breaks within the transcribed verbalisation were designated by commas, semicolons or periods as appropriate. Short pauses were designated by an ellipsis (...) while long pauses, say for duration longer than 5 seconds, were designated with the word "pause" within parentheses, in addition,

features that indicate pause, hesitation, emphasis, different tones or intonations were excluded. This is in line with Fonteyn et al.'s (1993) suggestion that portions that do not reflect verbal thoughts, such as filler words like "ah", "um", and "uh", be eliminated from the verbal protocol transcripts. Once transcribed, the resulting protocols were then broken down into small units or segments. Ericsson and Simon (1993) referred to these segments as 'statements' each representing a single thought or process. They further argued that "*in normal speech, statements are often abbreviated phrases—even single words*" (Ericsson and Simon, 1993, p. 266). Several cues such as paralanguage (pauses, intonation, contours etc.) on the one hand and syntactical markers on the other hand were suggested for identifying statements and for complete sentences and phrases respectively for segmentation in ordinary discourse (Ericsson and Simon, 1984, p. 205).

There are two alternative ways to segment verbal protocols: segmenting based on complete ideas or segmenting based on a set of time interval (Ericsson and Simon, 1984). Both approaches require the researcher to consider the context of the verbalisation with a view to determine what constitute a complete idea first and foremost and, second, to make sense of the segments. Eckersley (1988) also demonstrated how other cues such as verbal pauses, hesitations and syntactically complete thoughts can be used to segment verbal protocols relatively simply.

In this present study, the transcripts of participating valuers were segmented in accordance to a complete thought or to clear changes in topic. This way, each segment could address a particular instance of problem-solving behaviour on the task or relate to a "single production activity" (Ericsson and Simon, 1984, p. 207). It also allows the usual convention of assigning each segment a single code (Ericsson and Simon, 1984; Yang, 2003). The option of segmenting based on a set of time intervals was used in several studies of the problem-solving strategies in engineering design (e.g. Ball et al., 1997; Motte et al., 2004) but was not considered appropriate for this research as some segments might contain more than one categories of cognitive activity.

After transcription and segmentation, the resultant protocols were then loaded onto an Excel spreadsheets for coding and subsequent interpretation. A particular advantage of the use of an Excel spreadsheets is that they facilitate the counting of cognitive processes and a further analysis of sequence of thought across different subject groups. In addition, the spreadsheet also enabled easy interrogation of data in order to check on coding and also retrieve phrases with similar codes for comparison. Each segment was coded, using a scheme defined *a priori*, to reveal the cognitive processes underlying each segment. The coding scheme adapted for this study was based on the results of previous studies in others domains as discussed in sub-section 3.8.1.2 below.

### **3.8.1.2 Coding scheme**

Typically, verbal protocols are usually analysed using a coding scheme developed or adopted from previous studies. Such a coding scheme provides both a framework to identify cognitive behaviour and a guide to structure the analysis and interpretation. Bracewell (1994) and Greene and Higgins (1994) argued that for a verbal protocol analysis to be effective, it needs to be analysed in accordance with an appropriate coding scheme. The development and application of a coding scheme, according to Hassebrock and Prietula (1992), depends on two significant factors: (1) the nature of the task and, (2) the theoretical construct underpinning the research. In other words, a coding scheme is expected to be a theoretically based model of the cognitive processes that reflect the types of activity involved in the task under study.

The coding scheme used in this present study (as shown in Figure 3.0.3 below) was based on a preliminary analysis of the protocol content as well as previous schemes developed by Hassebrock and Prietula (1992) in their analysis of medical problem solving. It was also similar to other schemes for coding human problem solving activity found in literature (Ericsson and Simon, 1984; 1993; Greeno and Simon, 1988; Newell and Simon, 1972) but differed in the extent to which it contains valuation-specific terminology. The scheme was adapted in this present study because it has been applied in several other domains such as in mammographic interpretation (Azevedo et al. 2007). This, therefore, allows a direct comparison of task analysis with other domains of expertise. The coding scheme is based on three

types of protocol representation: (a) knowledge states, (b) problem solving operators and, (c) problem solving strategies (Hassebrock and Prietula, 1992; Newell and Simon, 1972). These three major categories and their subcategories are presented in Figure 3.0.3 below

A knowledge state, as conceptualised in this study, is a type of protocol representation (Newell and Simon, 1972) which identifies units of valuation information that a participating valuer recognised as potentially relevant in the problem solving of the commercial-valuation task (i.e. information from written instruction, comparable evidence and property attributes of the subject, including physical, legal, location and environmental factors). It also includes solutions or self-generated ideas that are developed in response to challenging or problematic valuation situations. Participant self-generated ideas or solutions could differ depending on whether they pertain to the valuation-problem statement, the analysis, or valuation opinion. A generic category scheme (as shown in Figure 3.0.3 below) was developed by the researcher to categorise solutions or self-generated ideas. In the process of coding the protocols (as described in the next sub-section), operational definition along with example were also formulated for each category (see Table 3.0.4 below).

Problem-solving operators are the cognitive acts undertaken during the commercial-valuation task. In other words, they are inferred cognitive processes that modify, add, and/or eliminate existing or currently active knowledge states and produce new, active knowledge states (Azevedo et al., 2007; Hassebrock and Prietula, 1992; Newell and Simon, 1992). In this study, the eight types of conceptual operators suggested by Hassebrock and Prietula were re-categorised into seven generic categories of valuation behaviour (e.g. "Data examination"). These problem-solving operators help to identify the knowledge and problem-solving behaviours that characterise solving a commercial-valuation task.

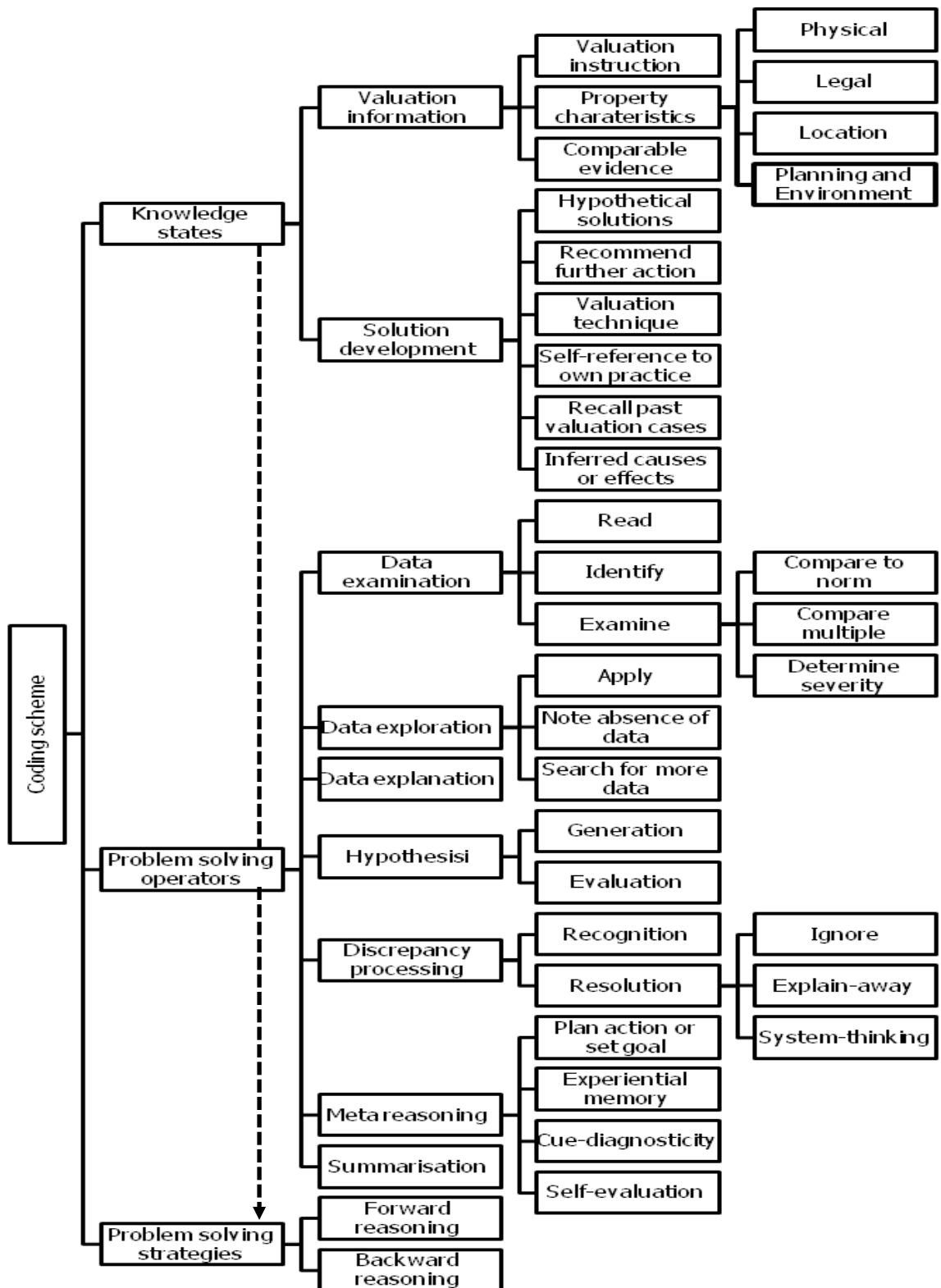


Figure 3.0.3 The coding scheme for analysing valuation cognition (adapted from Hassebrock and Prietula, 1992, p. 662)



There were instances (as shown in Figure 3.0.3 above), where a generic problem-solving operator could embody a one- or two-tiered categorisation of specific instantiations of valuation problem-solving behaviours. For example, the generic code termed "Data examination" subsumed activities such as "Examine" or "interpret valuation data" which also subsumed different types of data interpretation such as "Compare to norm or standard", "Compare multiple" and "Determine severity". These codes and their operational definitions are listed in Table 3.0.5 below.

Table 3.0.4 Codes and operational definitions for self-generated ideas

Self-generated Ideas	Description	Example
Recommendations	A recommendation for further action or investigation	<i>so possibly we have to, after the full inspection, have to find out what is <u>the total price</u> the developer needs to invest in this building for a full refurbishment to make it in good condition (NV1: 36)</i>
Inferred fact	Information derived from a previously known fact	<i>So the crack in rear corner of the ground floor brick wall, well, we will assume that to be <u>non-structural</u> based on the information that has been given (IV1: 136)</i>
Recalls	Anything explicitly recalled from past experience	<i>It's <u>an area</u> that is known for <u>lots of industrial activity</u> (EV2: 57)</i>
Hypothetical solutions	A guess at a solution	<i>I get the feeling that it is, probably, something like this, you know the <u>yield might be something like 12%</u> (EV1: 117)</i>
Resolutions	A resolution about discrepancy or about a situation	<i>So I'd question the areas for starters. Those areas don't make sense to me (EV2: 38)</i>
Self-references	A reference to self-practice	<i>I think that I am used to dealing with <u>hectares and square feet</u> (EV1: 20)</i>
Techniques	References to valuation theory, methods, principles and procedures	<i>But the method that I would kind of like to do is to then kind of take off is on the <u>traditional sort of valuation of taking a rental value of £21,000, take off the current ground rental of 3750</u> (EV1: 106)</i>

Table 3.0.5 Codes and operational definitions for problem solving operators

Problem Solving Operators	Specific Operators	Description	Example
<b>Data Examination</b>	Read	Reads verbatim from the instruction and supporting data without generating any protocol	<i>...and it says evidence of substantial crack in the ground floor rear brick wall which has been poorly repaired (EV2: 17)</i>
	Identify	Selectively identifies a particular cue from a set of instructional information	<i>We do know that the subject property has got more than 50 percent worth of offices (IV1: 23)</i>
	Examine: compare-to-norm, standard or expected	Interpret the significance of a cue using criteria or standard	<i>Because that give us a surprisingly low site coverage area (EV1: 10)</i>
	Examine: compare-multiple	Interpret the significance of a cue by comparing it to other cues	<i>But, I sort of thought that the comparable number 2 is, probably, the most closest and closest in size (EV1: 89)</i>
	Examine: determine-severity	Interpret the significance of a cue by qualifying further the seriousness of an abnormal finding	<i>...that crack on the wall can be very dangerous (NV1: 18)</i>
<b>Data Exploration</b>	Note-absence-data	Note that a particular cue lacks specific information or is not in the instruction data	<i>But we do not have any information as to what the rent is geared on the rent review basis (EV2: 4)</i>
	Search	Request, ponder or question the meaning of a specific instruction data	<i>Okay, so do I need to presume anything on these reviews or is just up to me to decide? is the rent going to increase every 7 years or is it going to stay the same? (IV2: 9)</i>
	Apply	Carry out or use a procedure, perform calculations	<i>So 6765 times £23 per square metre...we think the rental value for comparable 4 might be in the region of £155,595, say £156,000, based on £23 a square metre (IV1: 59)</i>

<b>Data Explanation</b>	Infer	Infer consequences or causes beyond the information given in the instruction	<i>I think there were some builder materials using asbestos on the roof so possibly this building was made in the 70s may be late 80s. (NV1: 9-10)</i>
<b>Hypothesis</b>	Generate	Make a guess at a solution or opinion, state an assumption underlying valuation analysis	<i>So I may suggest that value might fifty hundred and seventy five thousand pounds now (EV1: 67)</i>
	Evaluate	Interpret a specific cue as being consistent or inconsistent with a hypothesis	<i>So that kind of give us a broad view of where it might be (EV1: 68)</i>
<b>Discrepancy Processing</b>	Recognition	State a discrepancy or describe an anomalous situation existing among one or more data cues and one or more knowledge states	<i>But we can see an example here of a significant part of the ground floor without any first floor above it. So I can see the ground and I can see the ceiling but I can't see nothing in between EV2: 36-37)</i>
	Resolution	Resolving discrepancy by ignoring, explain-away or system-thinking	<i>So I'd question the areas for starters. Those areas don't make sense to me (EV2: 38)</i>
<b>Meta-reasoning</b>	Plan	State what is or was desired, plan a strategy, outline tasks/items to be tackled, plan for future selection of a task/item	<i>What we need to establish is fair comparable rent and the yield... We also obviously need to establish the cost of bringing it up to a good decorative order...(IV1:6)</i>
	Cue-diagnostics	Make a general comment about a specific data cue	<i>Of course we have the breakdown of offices, stores etc but it is no good to us because we don't have that sort of analysis in the comparable (IV1: 84)</i>
	Self-evaluation	Reflect on task process, analysis or self as analyst, review progress made	<i>I think, probably, what it is that, I am sorry! I've probably done it wrong (EV1: 18)</i>

	Experiential-memory	Recall information from past experience or specific valuation encounter	<i>Alright I was thinking of a yield...the market at the moment is anywhere between 8 and 10 (IV2: 71)</i>
<b>Summarisation</b>	Repeat-data or hypothesis	Repeat significant facts acquired from the instructional data or a hypothesis previously generated	<i>So we've previously decided we will use the rent of £23 per square metre to analyse the yield of comparable 4 (IV1: 78)</i>

Although these detailed activity codes helped to maximise the informative coding of subjects' verbal protocols, they were used only to provide detailed qualitative interpretations of how valuers deal with the commercial valuation task cognitively. The thought sequence, and mental model, of valuers' problem-solving behaviour was based on quantitative analysis of the main generic codes, since this appears to be the most effective and efficient level to provide an abstract representation of valuation problem solving.

The problem-solving strategies are the higher order procedures (also referred to as 'meta cognition' in the literature), including forward and backward reasoning, that participating valuers used to develop or generate solutions in problematic valuation situations. Consistent with Patel and Groen (1991, p. 93) conception of forward reasoning as an inferential process of working "forward from the given information to the unknown", a unit of forward reasoning was operationalised in this present study as a sequential antecedent-to-consequence link in the verbal protocols of the participants. Conversely, a unit of backward reasoning was operationalised as a consequence-to-antecedent link. Figure 3.0.4 below depicts these operationalisations alongside the codes for the elements (antecedent and consequence) of forward and backward reasoning.

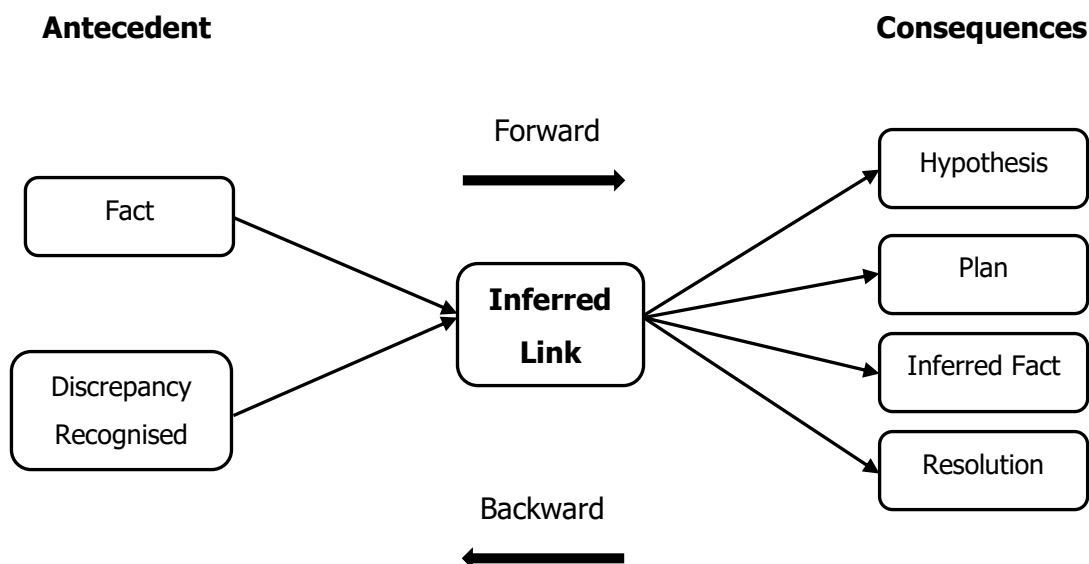


Figure 3.0.4 Operationalisation of forward and backward reasoning

As illustrated in Figure 3.0.4 above, if the antecedent occurs before the consequence, the reasoning is in the forward direction: else it is a backward link. This operationalisation of forward and backward reasoning and the codes developed were used to code the protocols based on the definitions provided in Table 3.0.4 and Table 3.0.5 with the exception of the antecedent code "fact", which was operationally defined as a statement that relates to information given of previously derived during the course of undertaking the valuation. For instance, a previously formulated hypothesis would be classified as a fact if linked to one of the consequence operators in either a forward or backward direction. The next subsection provides detailed description of how the operational definitions and codes for knowledge states, problem-solving operators and strategies were applied to the valuation protocols.

### ***3.8.1.3 Coding the verbal protocols***

The coding of subjects' verbal protocols was carried out at both segment and episode levels to yield a dual coding scheme. Segments were coded to identify knowledge states and problem solving operators that subjects deployed during the commercial valuation task, while episodes were coded for elements of forward and backward reasoning. An episode was operationalised as a set of semantically related operators based on the pattern described in Figure 3.0.4. And, to form a complete

episode, one antecedent operator must be linked to at least one consequence operator in either a forward or backward reasoning fashion.

The coding of protocols at segment level proceeded in sequentially manner using the codes in Figure 3.0.3 and the operational definitions in Table 3.0.4 and Table 3.0.5. First, the knowledge states contained in the transcripts were underlined and coded. The process of coding was to look for and underline the main clause or noun phrase in each segment directly on the transcript. These were then coded depending on whether they pertained to the instruction, valuation information or self-generated ideas or solutions. For example, segment 124 of EV1 protocols "*What I then need to consider is what adjustment to make with the condition*" involves a qualifier "What I then need to consider is" to the main clause (underlined) which refers to a procedure within the valuation process and is coded as "Technique–adjustment to valuation opinion".

Second, each knowledge state identified is then associated with one of the possible problem-solving operators which represent discrete problem solving segments of undertaken commercial valuation. After identifying the main problem solving operator associated with each protocol segment, the specific problem-solving operator used to produce the knowledge or states within each segment were then identified based on the operational definitions in Table 3.0.5. For instance, in the earlier example provided, the qualifier appears to signal the tentative nature of the cognitive act being undertaken in regards to the knowledge state "Technique–adjustment to valuation opinion" which, in this case, is a control process of indicating an intended action. Based on this, the segment was then coded "Meta-reasoning; plan" to reflect the main and specific problem solving operators that have been used to modify the knowledge state within the segment.

Once the knowledge states and problem solving operators have been identified and coded, the problem-solving strategies that help to generate ideas and resolve issues during the valuation were then identified by coding the protocols at episode level. This level of coding involved the researcher establishing a link between two or more

protocol segments and the direction of such link based on the operationalisation of forward and backward reasoning in Figure 3.0.4. A sample of protocol episode from EV1 transcript and the coding for problem solving strategy is shown below, with the complete coded protocol provided in Appendix C.

	<i>Protocol Segment</i>	<i>Knowledge State</i>	<i>Problem Solving Operator</i>	<i>Problem Solving Strategy</i>
124	<i>What I then need to consider is what <u>adjustment to make with the condition</u></i>	<i>Technique - Adjustment to valuation opinion</i>	<i>Meta-reasoning: plan</i>	<i>Fact – 124 &amp; 125 linked forward to Plan – 126</i>
125	<i>The condition is said to be <u>vandalized and fairly poor and there is structural crack at the back</u></i>	<i>Physical attribute: condition of property</i>	<i>Summarization: repeat-data</i>	
126	<i>So I think I am being inclined to start looking at this as the benchmark and <u>adjust downward a little bit to make some sort of adjustment for that condition really</u></i>	<i>Technique - Adjusting downward to reflect condition</i>	<i>Meta-reasoning: plan</i>	

#### **3.8.1.4 Analysing and interpreting the codes**

The participants' verbal protocols were analysed in three stages. In the first stage (and as described above), the analysis set out to reveal the cognitive processes underlying a commercial-valuation problem solving through a deductive coding of protocols in accordance with a problem-based coding scheme adapted from the literature. In the second stage, a detailed interpretation was undertaken both quantitatively and qualitatively; the quantitative interpretation focused on the frequency of use of different cognitive activities that were identified in the subjects' verbal protocols while the qualitative interpretation focused on how subjects used each category of the cognitive activities identified as well as a broader interpretation of the way they deal with the commercial valuation task. Additionally, an event-sequence analysis was undertaken to reveal the pattern of thought of valuers. This was done through Jeong's (2005) Discussion Analysis Tool (see section 5.4 for further details on this). In the third stage, a cognitive structure was devised,

describing and integrating the cognitive activities identified in subjects' verbal protocols.

### **3.8.2 Interview data analysis**

As indicated earlier in this chapter, this research also made use of interviews as a method of data collection to augment verbal protocol analysis. The interview sessions were transcribed into verbal reports and this provided the basis on which a thematic analysis was undertaken.

The data was first read twice to identify themes, which in this case relate to the core processes which influenced commercial-valuation problem solving. Contrary to the content analysis utilised in analysing the verbal protocols, thematic analysis is an inductive method (Ezzy, 2002). Thus, there were no predetermined categories to classify the themes that emerge from the interviews data. Rather, data extracts capturing a distinct thought were identified and coded into a theme based on commonality of meaning. Next, the researcher then organised and combined common themes into core categories which then form the basis for developing a theoretical model of commercial-valuation reasoning and problem solving. The themes and core categories that emerged from the analysis were compared and contrasted until there were no further themes to be identified and the data was fully accounted for (Patton, 2002).

## **3.9 RESEARCH QUALITY**

Establishing the quality of the research findings require effective communication of the methods. Accordingly, the previous sections of this chapter have clearly articulated and justified all aspects of the research process including the qualitative framework (See Section 3.4) and a Critical Realist approach underpinning this research. Although no specific criteria exist for Critical Realist research (Healy and Perry, 2000), a number of measures have been developed in literature for assessing the quality of qualitative research in general. Koch (1996), however, maintained that the measures adopted in any given research may either be selected or developed by



the researcher based on the philosophical and methodological assumptions guiding the research (see also Koch and Harrington, 1998; Leininger, 1994). In line with this view, three measures of quality are considered essential in this research: (1) credibility, (2) triangulation, and (3) generalisability. These measures are elaborated further in the following sub-sections.

### **3.9.1 Credibility**

Credibility of a research refers to the positivist concept of internal validity (Guba and Lincoln, 1989; Mertens, 2003) or the trustworthiness (Denzin and Lincoln, 2000) of the findings in a qualitative sense. Various strategies of enhancing credibility of qualitative research have been suggested in literature including 'thick description' and 'member check' (Cordon and Sainsbury, 2006; Creswell, 2003) used in this research.

'Thick description', as implemented in this research, was achieved through a plausible and content-rich account of the phenomenon under investigation and the use of participants' verbatim quotes to illustrate concepts emerging from the research. This ensures that both the researcher and the participants' views were represented in the text fairly. 'Member check', on the other hand, involves verifying the data collected by the research participants (Mertens, 2003). Thus, following the verbalisations of the valuation task and the follow up interviews, participants were provided with the transcripts to validate the content as they intended. Additionally, and to ensure the validity of the analysis, the data was independently analysed by a fellow researcher. Differences were resolved in the case of the verbal protocol data while the emergent themes and core categories from the interviews were established following a discussion (Ezzy, 2002).

### **3.9.2 Triangulation**

Triangulation is another way of achieving credibility in research data collection and analysis (Patton, 2002). This, according to Maxwell (2005), consists of checking the data collected from multiple sources and techniques in order to ensure consistency of

evidence across sources and methods and, hence, eliminate any validity threats. This approach to strengthening the quality of research is also emphasised from a Critical Realism perspective (Yeung, 1997). As indicated earlier in section 3.3.1 under the research philosophy, Critical Realism ontology assumes that some realities exist; although our knowledgeable claims are fallible (Lopez and Potter, 2005) and not equally so (Danermark et al., 2002; Yeung, 1997). This, in essence, means that claims about reality need to be thoroughly examined in order to form a complete understanding of reality.

Different types of triangulation have been proposed in literature. These include triangulations for data, researchers, theories and methodologies (Denzin, 1989; Snow and Anderson, 1991; Stake, 2000; Patton, 2002). However, data triangulation has been strongly recommended in a qualitative research (Denzin, 1989; Stake, 1995) where Critical Realism ontological assumptions underpin the research (Yeung, 1997). Layder (1998) also advocated the use of multi-strategy approach which combines both empirical data and theory. In support of these views, this study employed both data and theory triangulation. With regards to data triangulation, the interview protocols which were collected after the verbalisations of the valuation task were triangulated against the verbalisation protocols. Theory triangulation, however, involves using different theories on the development of expertise (see sections 2.3 and 2.4.1) for the interpretation of the cognitive processes and structure in conducting commercial valuation.

### **3.9.3 Generalisability**

In every research, an explanation of the phenomenon under investigation may involve some level of generalisation (Yin, 1994) which can lead in the development of theory (Healy and Perry, 2000). However, such generalisation has been noted in literature to have several limitations, especially in the context of a qualitative research (e.g. Easton, 2003; Flyvbjerg, 2006; Tsoukas, 1989) which focuses on description rather than explanation (Craib, 1992). Although generalising from a qualitative study is compatible with Critical Realism, this is only possible when causality is the focus of the research (Easton, 2000). Thus, in keeping with the

tradition of Critical Realist ontology and giving the qualitative nature of this study, generalisability was not considered as a research goal. Although generalisability of research findings has been proposed as one of the indicators of quality of research (Guba and Lincoln, 1989; Hammersley, 1995; 2009), the findings from a qualitative research can achieve different forms of generalisation from Critical Realist stand point (Danermark et al., 2002). As implemented in this research, generalisability could be achieved through the use of thick description (Corden and Sainsbury, 2006) and the use of established theory to describe empirical data (Tsoukas, 1989; Yin, 1994). Another approach considered is using the findings from this research to develop a descriptive mental model which can be applied to other contexts.

### **3.10 ETHICAL CONSIDERATIONS**

Addressing ethical issues is arguably one of the ways of maintaining the quality of the research, especially when the research requires collecting qualitative data. In this research, the ethical issues that were considered include obtaining informed consent and maintaining participants' anonymity; these were in addition to maintain the ethical requirements of the University. These ethical considerations are discussed in the following sub-sections

#### **3.10.1 Informed consent**

According to Sim (1986, p. 584), informed consent refers to "*the voluntary and revocable agreement of a competent individual to participate in a therapeutic or research procedure, based on an adequate understanding of its nature, purpose and implications*". In other words, there are four key requirements of informed consent: disclosure, comprehension, competence and voluntariness (Sim, 1998).

In this study, although the expert valuers were the primary participant for both the verbal protocol task and the follow-up interviews, it was necessary to obtain consent from other participants as well; APC candidates and undergraduate students who participated in the research. Accordingly, all participants were initially sent an information pack directly by the researcher through email communication. The

information pack detailed the research aim and process and participants' rights, including the right to withdraw from the research participation any time without providing reasons. Prior to the actual data collection sessions, written consents were obtained (via email reply) from volunteers who accepted to participate in the research. Verbal consents were also obtained from all participants to audio-tape their verbalisation and responses during the verbal protocol task and interviews respectively.

### **3.10.2 Anonymity**

Participant anonymity is often a major ethical concern in a qualitative research, especially where sensitive personal information is provided and may be shared. Anonymity can be maintained either in a strong or weak form (Yow, 1994; Wengraf, 2001). In the strong form, the informants will not be able to recognise themselves in the published account. A weak format is where the general public will not be able to recognise the informants, except people who are familiar with them very well (Wengraf, 2001).

In this study, the weak form of anonymity was adopted. Accordingly, and in order to prevent individual participants from being recognised by the general public in the published account, the research used pseudonyms in the communication of the research findings and, by changing certain identifying details (such as names, occupation, age etc.) on data records which could have facilitated easy recognition of the research participants by the general public. Additionally, all the participants were assured that all information collected about them will remain confidential and not disclosed to the general public.

## **3.11 EVALUATION OF METHODOLOGY**

One of the key areas this present research relates to the effect of the approach and methods of data collection selected for property valuation. By adopting a qualitative framework in exploring the cognitions of the valuer, this research develops a comprehensive understanding of the cognitive structures that identify and describe

the knowledge states and cognitive processes used in commercial valuation problem solving. More specifically, the selection of the Cognitive Task Analysis technique of Verbal Protocol Analysis meant that highly insightful and rich complex data were gathered. This allows the researcher to interpret thoughts of valuers into cognitive structures that provide a deeper level of understanding of how the valuer solve problem; this has not been possible in previous related studies.

However, conducting the fieldwork was challenging. The time and thought put in to the analysis of the valuation by some participants (within expert and intermediate groups) was so extensive that it resulted in verbal reports that were wider in scope and content than expected, and therefore time-consuming for the researcher to analyse. The considerable amount of time required to make sense of the verbal reports was further complicated by the fact that within the body of literature on Verbal Protocol Analysis, every author has created their own systems to make sense of the data. Therefore, it was difficult to develop an appropriate scheme to code the verbal reports generated by participants. The coding scheme adapted in this research was based on a preliminary analysis of participants' protocol contents and previous schemes proposed in the analysis of medical problem solving. This may not necessarily reflect the cognitive processes that pertain to commercial valuation domain.

Although the coding scheme adapted in this research contributed greatly to the contextual understanding of the valuer cognitive structures, the interpretation of the results was problematic. There were instances where a main problem-solving operator could embody a one- or two-tiered categorisation of cognitive activities. However, the inclusion of all the cognitive activities in the mapping of thought sequence and development of cognitive structures of valuers was rarely possible due to differences in their level of interpretation; only the main problem solving operators were used. As a consequence, only surface, as opposed to deep, accounts of certain cognitive processes were presented in this research.

### **3.12 SUMMARY**

This chapter has presented several methodological issues that are considered relevant to the research problem being investigated. In particular, the chapter

highlighted the widely used Cognitive Task Analysis as a useful guiding approach to data collection and analysis from a qualitative perspective. The chapter also explained the value in the use of mixed methods of data collection, including semi-structured interviews and Verbal Protocol Analysis. A specific framework was provided, illustrating how these methods were used. Consistent with a Realist's approach, the framework also demonstrated how theory development was grounded from the empirical data. In effect, the explanation of findings presented in the next chapter involves the synthesis of empirical data and theoretical insight; the ultimate aim of this is to abstract the underlying mechanisms or mental model of problem solving in this case.

## **CHAPTER 4**

### **FINDINGS**

#### **4.1 INTRODUCTION**

This chapter presents the results of the analysis of the empirical data obtained through verbal protocol analysis and interviews and the interpretation of the results that would later form the basis of answering the research question for the study. For the first stage of the analysis, the verbal protocols of expert, intermediate and novice valuers were analysed to gain insights on the knowledge state, problem-solving operators and strategies (as defined and conceptualised in sections 3.8.1.2 and 3.8.1.3 of the methodology chapter) utilised during the process of 'thinking aloud' in valuing the commercial property. This analysis entails imposing pre-determined categories of elements on the data (see Appendix C for a complete coded protocol) and identifying the elements that were relevant to each of the research question. In other words, a coding scheme was developed (in section 3.8.1.2) and the relative occurrence of salient events and strategies were obtained through the verbal protocol analysis and presented in tabulated forms. Description and interpretation of the results are provided after each table. This is supported by the related segments of subjects' think-aloud verbal reports in order that a clear picture of their cognitive processes can be drawn and compared between the three groups of valuers.

The results in this first stage of analysis were later validated with the analysis in stage two. For this stage of analysis, the data obtained through the semi-structured interviews with expert valuers were analysed and reported in the form of data report segments of their perception of the key components of commercial- valuation problem solving.

#### **4.2 KNOWLEDGE STATES USED DURING THE VALUATION TASK**

In this sub-section, the results of the analysis of the knowledge state used by expert, intermediate and novice valuers are presented followed by a comparison between

them. The knowledge state is a type of protocol representation (Newell and Simon, 1972) which identifies units of valuation knowledge used by the valuer in valuing commercial property. This included their knowledge of theory and application of valuation concepts, procedures and methods, analysing the physical, legal, geographical, environmental and market information that is relevant to the type of property being valued and providing explanations or solutions to valuation problems.

The knowledge state identified by subjects was classified into three broad categories: data analysis, technique and self-generated ideas. This categorisation was based on the evidence gathered from valuation literature on the context and process of conducting valuation (see section 1.5); the exception being that of self-generated ideas which was developed by the researcher to capture issues raised the participants which were neither based on the data presented nor on the concepts, methods and techniques of valuation. Appendix D contains the results of the analysis of the use of the knowledge states as well as the number of times that the subject used them. A summary is given in Table 4.0.1 below.

Table 4.0.1 Summary of knowledge states used by valuers (percentages are shown in parentheses)

Knowledge state	Novice Valuer	Intermediate Valuer	Expert Valuer
Data analysis			
Instruction analysis	2 (4)	0 (0)	9 (5)
Property analysis	11 (20)	25 (13)	18 (10)
Comparable analysis	9 (16)	36 (19)	37 (19)
Sub-Total	22 (39)	61 (32)	64 (33)
Self-generated ideas			
Hypothetical solution	0 (0)	10 (5)	27 (14)
Inferred fact	4 (7)	4 (2)	14 (7)
Resolution	0 (0)	0 (0)	4 (2)
Recommendation	10 (18)	27 (14)	15 (8)
Recall	0 (0)	12 (6)	10 (5)
Self-reference	6 (11)	31 (16)	30 (16)
Sub-Total	20 (36)	84 (43)	100 (52)
Technique	14 (25)	47 (24)	29 (15)
Total	56 (100)	192 (100)	193 (100)



### 4.2.1 Knowledge states used by expert valuers

The analysis in Table 4.0.1 above revealed that expert valuers had collectively used about 193 instances of knowledge state during the verbal protocol analysis of valuing the commercial property. In particular, expert valuers carried out different levels of data interpretation which focused on instruction, subject property characteristics and comparable evidence which together is equivalent to 64 times in terms of frequency of use. A further detailed analysis of the protocols indicated that different types of interpretations of specific cues in the subject and comparable property data occur during the expert valuers' acquisition of relevant cues to form the basis of forming their valuation opinion.

There were several instances where expert valuers used criterion evaluation (with the help of either an established standard or general positive/negative weighting) to interpret the quality of information attribute and guide the selection of specific data cue for further consideration in the valuation. Expert valuer 1 provides a series of interpretation of the suitability of comparable property number 2 which is coded as follows:

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
EV 1	74	<i>I've got two comparable then of two storeys warehouse office accommodation</i>	<i>Comparable evidence - Two comparable of two storeys</i>	<i>Data-examination: identify</i>
EV 1	75	<i>and I was a little bit kind of concern with comparable number 2...that is actually very good</i>	<i>Comparable evidence - Comparable 2 is actually very good</i>	<i>Data-examination: determine-severity</i>
EV 1	76	<i>because, it is very similar size it described is very close to the subject property in Nitchells, very similar sort of size and so on and let a year ago, which is okay</i>	<i>Comparable evidence</i>	<i>Meta-reasoning: cue-diagnostics</i>

<i>EV 1</i>	<i>77</i>	<i>So, probably, I think comparable 2 is probably the best to give us deal on the rental value</i>	<i>Comparable evidence - Comparable 2 is the best comparable</i>	<i>Data-examination: compare-multiple</i>
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At segment 74 the expert valuer 1 identified that comparable properties 2 and 3 were the only two comparable of two-storey warehouse accommodation. Using a positive weighting criterion, he then interpreted comparable 2 as actually very good (segment 75) and the best to give a deal on the rental value (segment 77). Expert valuer 1 arrived at this interpretation based on his diagnosis of the size, location and timing of letting of the comparable at segment 76. At the initial stage of the valuation, Expert valuer 2 also provided an evaluation of some legal attributes of the subject property which is coded below

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
<i>EV 2</i>	<i>2</i>	<i>and my initial notes show that it's <u>a long leasehold property</u></i>	<i>Legal attribute – Property tenure</i>	<i>Data-examination: read</i>
<i>EV 2</i>	<i>3</i>	<i>and there's 102 years unexpired with an overview of rent at £3750 per annum reviewed 7 yearly</i>	<i>Legal attribute – lease terms</i>	<i>Data-examination: identify</i>
<i>EV 2</i>	<i>6</i>	<i>and 7 years is quite a <u>short review period</u> for a property of a ground lease of that length</i>	<i>Legal attribute - Short review period</i>	<i>Data-examination: compare-to-norm</i>

Expert valuer 2 identified that the property tenure to be valued is long leasehold property (segment 2). He also identified some of the lease terms including the unexpired terms, the present ground rent payable and the review cycle (segment 3). At segment 6, Expert valuer 2 then noted that the seven yearly review cycle was a short review period. This interpretation could be an evidence of the use of knowledge of standard rent reviews that are normally associated with leases of varied durations.

In addition to the use of criterion evaluation, expert valuers also qualitatively evaluated certain data cues in the process of their initial data interpretation and

selection of the relevant cue for the valuation. This type of data interpretation represents task situation awareness knowledge and provides evidence of meta-reasoning capabilities, for example:

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
<i>EV 1</i>	12	<i>and that is the side that I guess is <u>really interesting</u> -</i>	<i>Physical attribute</i>	<i>Meta-reasoning: cue-diagnostics</i>
<i>EV 2</i>	69	<i>In its existing condition, you couldn't do a lot with the property</i>	<i>Physical attribute</i>	<i>Meta-reasoning: cue-diagnostics</i>
<i>EV 1</i>	38	<i>so I was just kind of thinking that is this sort of <u>abnormally that is there</u></i>	<i>Valuation instruction</i>	<i>Meta-reasoning: cue-diagnostics</i>

The analysis in Table 4.0.1 above also showed that all the six self-generated ideas were referred to or used by both expert valuers in valuing commercial property. Specifically, the analysis suggested that expert valuers can generate hypothetical solutions or inferential information, resolution to discrepancy observed, strategic recommendations for further investigation, recall of knowledge of market trend or previous valuation case and evaluation of their analysis or the quality of their reasoning. Together, this category of knowledge state is equivalent to 100 times in terms of use.

Further inspection of expert valuers' verbal protocols suggest that their self-generated ideas are more likely to be linked to specific problems identified and also based on knowledge or assumptions external to the valuation task. The following provide examples from the verbal protocols of expert valuer 2:

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
<i>EV 2</i>	8	<i>You've told me that we assume that it wasn't made of deleterious materials on site although I did note under the construction details <u>it does have asbestos</u></i>	<i>Environmental attribute - Presence of asbestos</i>	<i>Discrepancy-processing: recognition</i>

EV 2	9	<i>and a property of that age would <u>naturally have asbestos</u></i>	<i>Resolution - Natural presence of asbestos with age</i>	<i>Discrepancy- processing: resolution: system- thinking</i>
EV 2	10	<i>and would be assumed to <u>have an asbestos register</u> for the property</i>	<i>Solution - Asbestos register</i>	<i>Hypothesis- generation: trigger</i>
EV 2	11	<i>which I'd expect to see the asbestos register.</i>	<i>Recommend - Inspection of asbestos register</i>	<i>Meta- reasoning: plan</i>

At segment 8, Expert valuer 1 noted the possibility of presence of asbestos from the construction details of the subject property. He immediately generated a resolution to this by observing that property of that age would naturally have asbestos (segment 9). The word naturally is arguably an evidence of the use of schema-based knowledge as it subsumes an activation of previous cases of buildings which would normally contain asbestos materials. In dealing with the problem of asbestos, Expert valuer 2 then generated an hypothetical solution (segment 10) and recommended further action that would be required (segment 11). Another example of this occurred during the analysis of the subject property asking price by Expert valuer 1 as coded below:

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
EV 1	60	<i>It is interesting to note that the asking price is £200,000 two years ago.</i>	<i>Comparable evidence - Asking price</i>	<i>Data- examination: identify</i>
EV 1	61	<i>What happen in the market base since then is that the kind of occupy the mind before. So <u>values are fallen back a bit</u></i>	<i>Recall - Trend in rental value</i>	<i>Meta- reasoning: experiential- memory</i>
EV 1	62	<i>And as that was an asking price, I guess it was <u>achieved in the market place.</u></i>	<i>Comparable evidence - Asking price</i>	<i>Meta- reasoning: cue- diagnosticity</i>
EV 1	63	<i>So, therefore, is <u>a little unreliable</u></i>	<i>New fact - Asking price a little bit unreliable</i>	<i>Data- explanation: infer</i>

At segment 60, Expert valuer 1 identifies that the asking price of the subject property two years ago is £200,000. He then recalled his knowledge of the market trend (segment 61) which he relied on in further diagnosis of the asking price and the inference on its reliability as a relevant cue in forming an opinion of value.

Finally the analysis in Table 4.0.1 above also revealed that expert valuers use valuation technique and also consider their application during the verbal protocol analysis task. Relative to others, this category of knowledge states was used less frequently (an equivalent of 29 times in terms of use). A further inspection of the techniques used by both expert valuers suggest that they frequently use this knowledge state to identify and reflect on their preferred valuation methods and procedures that need to be followed to arrive at an opinion of value. The following provide instances where Expert valuer 1, for example, engages in the generation, application and self-evaluation of valuation concepts, methods and procedures.

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
EV 1	106	<i>But the method that I would kind of like to do is to then kind of take off is on the traditional sort of valuation of taking a rental value of £21,000, take off the current ground rental of 3750</i>	<i>Technique - Leasehold capitalization</i>	<i>Meta-reasoning: plan</i>
EV 1	107	<i>Again, there is a bit of caution that, <u>not sure if there is reversionary or not</u></i>	<i>Property analysis</i>	<i>Meta-reasoning: self-evaluation</i>
EV 1	108	<i>But if I just kind of assume that <u>the 3750</u> would be okay,</i>	<i>Property analysis</i>	<i>Meta-reasoning: self-evaluation</i>
EV 1	109	<i>that would give a profit rent of 17,250, I think,</i>	<i>Technique - Profit rent</i>	<i>Data-exploration: apply</i>
EV 1	110	<i>which are then capitalized at YP at an appropriate yield</i>	<i>Technique – Capitalisation</i>	<i>Meta-reasoning: plan</i>
EV 1	112	<i>Traditionally, I would like to kind of do that with <u>the dual rate approach</u> and,</i>	<i>Technique - Dual rate capitalistaion</i>	<i>Meta-reasoning: plan</i>

EV 1	113	<i>actually, I think that, probably wouldn't make much of a difference mathematically</i>	<i>Technique - Dual rate capitalistaion</i>	<i>Meta-reasoning: self-evaluation</i>
EV 1	114	<i>So there is room we might do it as a single rate.</i>	<i>Technique - Single rate capitalistaion</i>	<i>Meta-reasoning: plan</i>
EV 1	115	<i>because at such an unexpired term it wouldn't actually make much of a difference</i>	<i>Technique - Single rate capitalistaion</i>	<i>Meta-reasoning: cue-diagnosticsity</i>
EV 1	116	<i>But I would, probably, just dive into my current parry valuation table and come up with a YP</i>	<i>Technique - Reading Parry Table for YP</i>	<i>Meta-reasoning: plan</i>
	-	-	-	-
EV 1	119	<i>But that would then lead me down to, you know that sort of valuation if I just ignore the kind of advantage of a single rate and <u>do it into perpetuity</u></i>	<i>Technique - Capitalisation in perpetuity</i>	<i>Meta-reasoning: plan</i>
EV 1	120	<i>8.3333 times 17250, that would give me about 145,000</i>	<i>Technique - Capital value</i>	<i>Data-exploration: apply</i>

The above clearly indicate that expert valuers had access and used relevant domain conceptual knowledge during the verbal protocol analysis of the valuation task.

#### 4.2.2 Knowledge states used by intermediate valuers

The results of the analysis in Table 4.0.1 above indicated that intermediate valuers had collectively used about 192 instances of knowledge states during the verbal protocol analysis of conducting valuation of the commercial property. The category of knowledge states that occur most frequently in the verbal protocols of intermediate valuers is self-generated ideas (84 times) which are followed by data analysis (61 times) and technique (47 times).

As clearly shown in Appendix D, intermediate valuers appear to have collectively focused their property analysis on physical and legal attributes only. They also did not refer to the instruction problem statement in their analysis. This is in contrast to

the expert valuers who had collectively referred to all the property attributes including the valuation instruction problem statement (such as the purpose and basis of valuation). Intermediate valuers also used different types of interpretations during their initial selection of relevant cues for the valuation. Unlike the expert valuers, however, their data interpretations relied only on qualitative evaluation and positive/negative weighting only. The following provides few instances of how these types of data interpretation were used to analyse comparable evidence at different segments of intermediate valuers' verbal protocols.

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
IV 1	14	<i>We've got three comparables to determine the fair market rent...</i>	<i>Comparable evidence - Comparable evidence for rent</i>	<i>Data-examination: identify</i>
IV 1	15	<i>First two of which are <u>similar in size</u>...similar in 5,000 square metres, just over a 1000 square metres, just over for the second comparable</i>	<i>Comparable evidence - First two comparable are similar in size</i>	<i>Data-examination: compare-multiple</i>
IV 1	16	<i>The third one is about half the size, perhaps, <u>a bit small</u>... (pause) Will note that... (pause)</i>	<i>Comparable evidence - Comparable 3 is a bit small</i>	<i>Data-examination: determine-severity</i>
IV 2	24	<i>comparable 4, Windson Street, Nichells, Birmingham freehold for sale that's price 975,000,</i>	<i>Comparable evidence</i>	<i>Data-examination: read</i>
IV 2	25	<i>and ours has been in the market for 2 years at 200,000...<u>that is very useful</u></i>	<i>Comparable evidence - Asking price</i>	<i>Meta-reasoning: cue-diagnostics</i>

The results of the analysis presented in Table 4.0.1 above showed that intermediate valuers had collectively referred to five out of the six self-generated ideas during the valuation task. These include hypothetical solution (10 times), inferential fact (4 times), recommendation (27 times), recall (12 times) and self-reference (31 times). Similarly to the expert valuers, the ideas generated by intermediate valuers were linked to the fact/problem identified from the instructional information and also, in most cases, based on knowledge and assumptions external to the valuation task.

For instance, in the process of comparable analysis, intermediate valuer 1 noted that there was no comparable to determine the ground rent and remarked as follows:

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
IV 1	96	<i>I don't quite know what to do with the limited information I've got here</i>	<i>Comparable analysis</i>	<i>Meta-reasoning: self-evaluation</i>
IV 1	97	<i>I suppose we've got to look at a couple of choices</i>	<i>Recommend - Analysis of valuation options</i>	<i>Meta-reasoning: plan</i>
IV 1	98	<i>...we can assume that the ground rent in 2010 is the market rent and just value the leasehold interest assuming that is currently at a rack rent or we can make assumption about the rental growth, perhaps put a value of £4,000 per annum and value it on the base of term and reversion</i>	<i>Recall - Valuation options</i>	<i>Meta-reasoning: experiential-memory</i>
IV 1	99	<i>I am going to go for the first option.</i>	<i>Recommend - Valuation option</i>	<i>Meta-reasoning: plan</i>
IV 1	100	<i>because I don't have any evidence about what the current market rent is... it may have gone up, it may have gone down...</i>	<i>Valuation option</i>	<i>Meta-reasoning: self-evaluation</i>

The use of the word 'I don't quite know what to do' triggered a script, at segment 97, that indicated that the valuer would have to consider the various courses of action to dealing with the problem of limited information in valuation. This is, arguably, evidence of use of script-based knowledge. At segment 98, intermediate valuer 1 recalled two options and decided that he was going to go for the first one based on the fact that there was lack of evidence to support the second option (segment 100).

Finally, intermediate valuers also referred to valuation technique in their valuation problem solving. Unlike the expert valuers, however, the techniques generated mainly focused on application of concepts such as performing calculations to



determine market rent, profit rent, yield and capital value. They did not provide any level of detail or explanation of valuation concepts, principles and methods as the expert valuers did.

### 4.2.3 Knowledge states used by novice valuers

The analysis in Table 4.0.1 above revealed that novice valuers had collectively used about 56 instances of knowledge states during the verbal protocol analysis of valuation task of the commercial property. They had referred to all the subject property attributes (except legal), some aspects of the instruction problem statement and comparable evidence which is equivalent to 22 times in terms of frequency of use. They also refer to valuation technique (14 times) and two self-generated ideas (20 times). The remaining self-generated ideas such as hypothetical solution, resolution and recall were not referred to. A further inspection of the verbal protocols generated by novice valuers showed that, unlike the expert valuers but similarly to the intermediate valuers, their data interpretations indicated the use of qualitative evaluation and positive/negative weighting only. The following provides instances from novice valuer 2 verbal protocols where these types of data interpretations occurred during comparable analysis

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
NV 2	11	<i>In terms of size, comparable 1 and comparable 2 were most similar to the subject property.</i>	<i>Comparable evidence: comparable 1 &amp; 2 most similar</i>	<i>Data-examination: compare-multiple</i>
NV 2	13	<i>Comparable 4 was a freehold so it was not per say applicable to the leasehold valuation. Again the terms were not applied here.</i>	<i>Comparable evidence</i>	<i>Meta-reasoning: cue-diagnostics</i>
NV 2	15	<i>Location wise I also compared, 1 and 2 are close to our property than 4</i>	<i>Comparable evidence: comparable 1 &amp; 2 are close than 4</i>	<i>Data-examination: compare-multiple</i>

NV 2	16	<i>but 3 is the furthest away and less applicable when it comes to location</i>	<i>Comparable evidence – comparable 3 is further away and less applicable</i>	<i>Data-examination: determine-severity</i>
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At segment 11, 15 and 16, novice valuer 2 provided a criterion evaluation of the size and location of some of the comparable evidence in relation to the subject property using positive/negative weighting such as 'most similar', 'close to our property than', 'furthest away and less applicable'. At segment 13, the novice valuer 2 also provided a diagnosis of the tenure of comparable 4 by qualitatively evaluated as 'not per se applicable to the leasehold valuation'. An inspection of novice valuer 1 verbal protocols indicated that similar types of data interpretations occur during the valuation task. In terms of the self-generated ideas, a detailed inspection of novice valuers' verbal protocols generated during the valuation task suggests that they were primarily driven by the fact provided in the valuation instruction as the following illustrates:

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
NV 1	35	<i>What I am going to say as well is that the subject property is in <u>really bad condition</u></i>	<i>Physical attribute – really bad condition</i>	<i>Data-examination: determiner-severity</i>
NV 1	36	<i>so possibly we have to, after the full inspection, have to find out what is <u>the total price the developer needs to invest in this building for a full refurbishment to make it in good condition</u></i>	<i>Recommend - Cost of improvement analysis</i>	<i>Meta-reasoning: plan</i>
NV 1	37	<i>so basically from this £188,000 we need to take out the price <u>what is going to be spent on the refurbishment for the property and</u></i>	<i>Recommend - Adjustment for cost of improvement</i>	<i>Meta-reasoning: plan</i>

After capitalising the profit rent to determine the market value of the leasehold interest in the subject property, the novice valuer interpreted the condition of the subject property as 'really bad' (segment 35) and this then triggered the recommendation for the cost of refurbishment to be established and adjusted for to

reflect the present condition of the property. With regards to valuation technique, novice valuers mainly use this to refer to the calculations or valuation procedures that they have performed during the verbal protocol analysis of undertaking the valuation task. For example, after analysis of comparable, the novice valuer 2 provided the valuation procedure adopted which was coded as follows:

Seg. No	Segment Text	Knowledge State	Problem Solving Operators
NV 2 22	<i>To calculate the leasehold valuation I used the freehold value by taking the 1,088 as the area, times this by the £21 per square metre and this gave me my <u>full rental value</u></i>	<i>Technique – full rental value</i>	<i>Data-exploration: apply</i>
NV 2 23	<i>I then minus this from the current rent specified which was £3750, this gave me a <u>profit rent</u> of around £19,000</i>	<i>Technique - profit rent</i>	<i>Data-exploration: apply</i>
NV 2 24	<i>I then YP that for the long term lease of 125 years and</i>	<i>Technique - Capitalize profit rent</i>	<i>Data-exploration: apply</i>
NV 2 25	<i>then my yield, what I did was I divided 1 by the amount of years, 125, which gave me an assumed freehold <u>yield of 8%</u></i>	<i>Technique – freehold yield</i>	<i>Data-exploration: apply</i>
NV 2 27	<i>for leasehold I upped it by 1% because it is quite a long term lease so I upped that to 9 and I think ..... for 3 and 35% for tax on my dual rate</i>	<i>Technique - leasehold yield</i>	<i>Meta-reasoning: plan</i>

Novice valuers did not provide detailed explanation or rationale behind the valuation concepts, principles and methods applied.

### **4.3 PROBLEM-SOLVING OPERATORS USED TO REPRESENT KNOWLEDGE STATES**

In this sub-section, the problem-solving operators used by experienced, intermediate and novice valuers are analysed and compared. These problem-solving operators are the inferred cognitive processes which, according to Hassebrock and Pritual

(1992), modify an existing active knowledge state or produce a new active knowledge state. In analysing the valuation instruction, which is also a specific data cue, each segment of the verbal protocols produced by the valuers comprises one or more knowledge states and a problem-solving operator that produces or modifies the associated knowledge state or states.

### 4.3.1 Quantitative analysis of relative use of problem solving operators

The results that are presented in Appendix E investigate the frequency of subjects' use of problem-solving operators during the conduct of the valuation task. A summary is provided in Table 4.0.2 below.

Table 4.0.2 Summary of problem-solving operators used by valuers (percentages are shown in parentheses)

Problem-solving operators	Problem-solving operators	Novice Valuer	Intermediate Valuer	Expert Valuer
Data Examination	Read	6 (9)	18 (8)	19 (9)
	Identify	7 (11)	9 (4)	9 (4)
	Examine	9 (14)	11 (5)	22 (11)
Data Exploration	Apply	10 (15)	30 (13)	10 (5)
	Search	3 (5)	15 (7)	7 (3)
	Elaborate	0 (0)	0 (0)	0 (0)
	Note absence data	0 (0)	6 (3)	5 (2)
Data Explanation	Infer	4 (6)	4 (2)	14 (7)
Hypothesis Generation	Trigger	0 (0)	7 (3)	13 (6)
	Further-specification	0 (0)	0 (0)	2 (1)
	Association	0 (0)	0 (0)	2 (1)
	Generalisation	0 (0)	0 (0)	0 (0)
Hypothesis Evaluation	Confirmation	0 (0)	0 (0)	1 (0)
	Disconfirmation	0 (0)	0 (0)	0 (0)
	Discrimination	0 (0)	0 (0)	0 (0)
	Causal relationship	0 (0)	0 (0)	0 (0)
Discrepancy Processing	Recognition	0 (0)	0 (0)	4 (2)
	Resolution	0 (0)	0 (0)	4 (2)
Meta Reasoning	Plan	14 (21)	42 (19)	28 (13)
	Experiential memory	0 (0)	12 (5)	12 (6)
	Cue diagnosticity	6 (9)	15 (7)	21 (10)
	Self-evaluation	6 (9)	31 (14)	30 (14)
Summarisation	Repeat data	1 (2)	20 (9)	6 (3)
	Repeat hypothesis	0 (0)	3 (1)	0 (0)
Total No.		66 (100)	223 (100)	209 (100)

#### ***4.3.1.1 Problem-solving operators used by expert valuers***

The analysis presented in Table 4.0.2 above revealed that while performing the task of valuing the commercial property, expert valuers had collectively referred to about 18 problem-solving operators which was equivalent to 209 times in terms of frequency of use. The analysis further revealed that the main problem-solving operators, out of the 18, that expert valuers referred to were: read, identify and examine (data examination), search, note-absence-data and apply (data exploration), infer (data explanation), trigger (hypothesis generation), plan, experiential memory, cue diagnosticity and self-evaluation (meta reasoning) and repeat data (summarising). Others such as: further specification and association (hypothesis generation), confirmation (hypothesis evaluation), recognition and resolution (discrepancy processing) and repeat hypothesis (summarising) were used less frequently. There was also variation in the problem-solving operators used by each of the expert valuers as presented in Appendix E.

#### ***4.3.1.2 Problem-solving operators used by intermediate valuers***

From the results of the analysis presented in Table 4.0.2 above, the intermediate valuers had referred to 14 problem-solving operators and collectively recorded 223 occurrences in terms of frequency of use. Some of the main problem-solving operators referred to included: read, identify and examine (data examination), search, note-absence-data and apply (data exploration), trigger (hypothesis generation), plan, experiential memory, cue diagnosticity and self-evaluation (meta reasoning) and repeat data (summarising). Others such as: infer (data explanation) and repeat hypothesis (summarisation) were used less frequently. Based on the results presented in Appendix E, there was substantial difference in the number of problem-solving operators referred to and their frequency of use by each of the intermediate valuers.

#### ***4.3.1.3 Problem-solving operators used by novice valuers***

In the process of performing the task of valuing the commercial property, novice valuers only referred to 10 problem-solving operators and 66 occurrences in terms of frequency of use. The main problem-solving operators referred to were: read,

identify and examine (data examination), apply (data exploration), plan, cue diagnosticity and self-evaluation (meta reasoning). Others such as infer (data explanation), and repeat data (summarising) were used less frequently. There was, however, no substantial difference in terms of the number of problem-solving operators referred to as well as their frequency of use by each of the novice valuers as presented in Appendix E.

#### **4.3.2 Qualitative analysis of how problem-solving operators were used**

As the results in Table 4.0.2 above indicate, both expert, intermediate and novice valuers had used the eight main problem-solving operators in their verbal protocol analysis of the commercial-valuation task. These main problem-solving operators included: data examination, data exploration, data explanation, hypothesis generation, hypothesis evaluation, discrepancy processing, meta reasoning and summarising. However, in terms of how these problem-solving operators were used, a number of interesting qualitative differences were observed from the detailed examination of the verbal protocol data.

First, both expert and intermediate valuers were generally more rigorous in their reading of the valuation instruction than the novice valuers. The same applies to the problem-solving operator 'examine', which was used to selectively identify and form initial interpretations of specific property or comparable attribute(s) from the particular set of instructional data. Through the problem-solving operator 'examine', the valuers would, for instance, interpret the quality of an information attribute by either comparing it to what is usually the norm, to another cue or by stating the degree of abnormality as illustrated under section 4.2 of this chapter. The fact that both expert and intermediate valuers appear to have used this problem-solving operator could suggest that they had broad knowledge of criteria for making judgments and decisions in regards to the reliability of valuation and comparable data than the novice valuers.

Second, analysis of the data exploration procedures revealed that the intermediate valuers were more likely to use the problem-solving operator, 'apply' than expert and novice valuers when performing commercial-property valuation. As set out in Table 4.0.2 above, intermediate valuers used this operator about 30 times, which is far more than the experienced and novice valuers did. This is not surprising and seems to emphasize the natural role for graduate surveyors who are still undergoing professional training in practice. A further analysis of the subjects' verbal protocol revealed that they all used the problem-solving operator 'apply' mainly to determine the unit of comparison (rent per square metre or square foot) for further examination and also to work out the rental value and yield applicable to the subject property. In addition, the problem-solving operator 'apply' was used to carry out a procedure involving application of valuation technique. Analysis of the subjects' verbal protocol transcript revealed that they all used the operator to determine the leasehold unexpired tenure and profit rent which is then capitalized at appropriate yield. The fact that expert valuers did not engage in considerable application of valuation procedures and methods could be evidence of automaticity in the valuation process. Other types of data exploration operators that were identified from the verbal protocol transcripts are 'search' and 'note absence of data'. Again there were quantitative and qualitative differences between the subjects on the use of these operators. For instance, novice valuers could not identify missing information in the instruction. Also, the expert and intermediate valuers were more likely to elaborate when searching than novices. For example intermediate valuer 1 note:

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
IV 1	67	<i>We need to know some <u>details about any leases or in place for comparable 4. If it sold with vacant possession or whether it is sold with tenant in situ?</u></i>	<i>Comparable evidence - Details of lease on comparable 4</i>	<i>Data-exploration: search</i>

In searching for the lease details of comparable 4, Intermediate valuer 1 went further to suggest two options relating to what is usually the case when a property is sold. The knowledge that he used to make this suggestion is not directly attributable to anything that is provided in the instruction data. Similarly, at segment 86, Expert valuer 1 raised concern about lack of adequate information on comparable properties 2 and 3. He then ask a leading question about the floor distribution of the two

comparable premises which could be attributable to the activation of a knowledge structure that provided Expert valuer 1 with a template of normal pattern of value distribution in regards to different floor areas.

	Seg. No	Segment Text	Knowledge State	Problem Solving Operators
EV 1	86	<i>I am just... the sort of concern I have with those two comparable that there is not quite enough information there, whether the floor area is equally distributed between the two floors or whether the first floor is much smaller and so on</i>	<i>Comparable evidence - Comparable floor distribution</i>	<i>Data-exploration: search</i>
EV 1	87	<i>Because, generally we would expect the first floor to be much less valuable than the ground floor accommodation.</i>	<i>Recall - Normal pattern of value distribution</i>	<i>Meta-reasoning: experiential-memory</i>

In contrast to expert and intermediate valuers, novice valuers' searches contained inferences that could have easily been made based on the information provided in the valuation instructions. For example, Novice Valuer 1 asked at segment 11 'how long was the property not occupied?'. As this question was followed by statement from the instruction data (segment 12) that the property 'has been in the market for the past two years', it is not an elaboration.

Third, the results in Table 4.0.2 showed that expert valuers appear to have given more emphasis to the use of the problem-solving operators 'infer' (data explanation) and 'diagnostic hypotheses' which were both focused on content and meaning. In particular, the valuers' goal was to interpret the quality or significant role of a given data and then generate an inference/hypothesis to explain the underlying causes or effects of the data cue with regards to their valuation knowledge and experience or other factual information provided. Accordingly, expert valuers could be said to have richer domain knowledge, both about valuation in general and about the specific case domain.



Fourth, the results presented in Table 4.0.2 revealed some differences in the use of meta-reasoning operators of planning, experiential memory, cue-diagnostics and self-evaluation. The data collected for this research suggested that valuers used these meta reasoning related operators to evaluate the reasoning process during the verbalisation of the given valuation task. In particular, the valuers used statement of plans to indicate intended action or schedule an activity, experiential memory to recall relevant information or previous valuation cases, cue-diagnostics to make a general comment about possible explanations of a case, and self-evaluation to evaluate the quality of evolving inferences or diagnostic hypothesis. While there appear to be no consistent difference between the use of these meta-reasoning operators by the expert valuers, on the one hand, and the intermediate valuers, on the other, the incidence of use seemed very low for novice valuers. Also, novice valuers did not generate any recall during the verbalisation of the valuation task, suggesting that they did not have enough relevant knowledge and experience to guide them in the valuation.

#### **4.4 PROBLEM SOLVING STRATEGIES USED TO GENERATE KNOWLEDGE STATES**

This sub-section investigated the general problem solving strategies that the expert, intermediate and novice valuers employed to generate ideas to deal with problematic situations during the commercial valuation task. To achieve this, the analysis examined the issues that subjects considered during the valuation task and how they find and construct problems in the process. The findings in respect of the issues considered by the subjects are listed in Table 4.0.3 below. However, since not all the subject considered these issues, the breakdown of the issues considered by each subject and the order in which they were considered are further set out in Table 4.0.4 below.

The analysis revealed that all subjects, except IV 1, engaged in a general analysis of the valuation instruction information by way of commenting or querying certain aspects of the instruction. After the general analysis of the valuation instruction, all subjects moved to the issue of comparable evidence and provided comparative

analysis of the sales and letting evidence in order to establish the relevant inputs into the actual valuation calculation. All subjects found that the comparable information is not enough to arrive at a valid opinion of value. All subjects also considered how the traditional leasehold valuation can be applied to value the subject property. At the end of the valuation, all subjects raised concern about the poor state of repair of the subject property and introduced the issue of adjusting for this. The following provides a more-detailed analysis of some of the issues that each subject analysed during the conduct of the valuation task and how they find and construct problems in their analysis of those issues

Table 4.0.3 Issues considered by valuers during the valuation

<b>Issues</b>	<b>Description</b>
Instruction information	All subjects, except IV 1, started the valuation by analysing instructions generally and raising concern about some information provided
Low site coverage	EV 1 (only) questioned the low site coverage and identified that the access to the rear yard is either restricted or too big
Leasehold tenure	EV 1, EV 2 and IV 1 analysed the leasehold tenure and found that the lease terms did not state the basis on which the ground rent should be reviewed
Differences in areas	EV 1 and 2 identified the issue of differences in floor areas and provided cause-effect analysis of this
Impact of crack	Most subjects raised concern about the crack in the brick wall. Some subjects recommended further action to assess whether the crack is causing structural problems
Asking price	EV 1 analysed the asking price and found that the information was unreliable given the state of the market
Asbestos	EV 2 and NV2 identified the possibility of the presence of asbestos due the age of the property. Only EV 2 provides further details on what to do to address this
Comparable evidence	All subjects examined and noted the comparable evidence provided were insufficient to establish a valid opinion of value. Some subjects were more detail in their examination
Application of method	All discussed how they would use the traditional valuation method to value the property
Further adjustment	Most subjects ended the valuation by indicating the adjustment to make to the valuation figure to reflect the condition of the subject property

Table 4.0.4 Issues considered by each valuer in the valuation task (Seg. = segment, or segment number range)

EV 1	Seg.	EV 2	Seg.	IV 1	Seg.	IV 2	Seg.	NV 1	Seg.	NV 2	Seg.
Instruction information	1-6	Instruction information	1	Comparable evidence	1-47	Leasehold tenure	1-10	Instruction information	1-12	Instruction information	1-4
Low site coverage	7-24	Leasehold tenure	2-7	Further adjustment	48-50	Instruction information	11-17	Impact of crack	13-22	Asbestos	5
Leasehold tenure	25-38	Asbestos	8-11	Comparable evidence	51-68	Comparable evidence	18-65	Comparable evidence	23-29	Further adjustment	6-9
Differences in areas	39-52	Differences in areas	12-15	Leasehold tenure	69-76	Application of method	66-84	Application of method	30-33	Comparable evidence	9-21
Impact of crack	53-56	Impact of crack	16-28	Comparable evidence	77-85	Further adjustment	85	Further adjustment	34-36	Application of method	22-28
Asking price	57-68	Differences in areas	29-38	Application of method	86-131						
Comparable evidence	69-105	Comparable evidence	39-59	Impact of crack	131-136						
Application of method	106-119	Application of method	60-85	Further adjustment	137-146						
Further adjustment	120-127	Further adjustment	69-77								

#### 4.4.1 Analysis of issues considered by expert valuers

##### 4.4.1.1 Expert valuer 1

EV 1 briefly provided an overall evaluation of the valuation instruction at the start of the valuation (segment 1-3). He then, through forward chaining, constructed a problem that entails analysing the instructional information to 'look for things that, perhaps, don't make sense' (segment 4-6).

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
5	<i>And, I suppose, probably, part of my experience as expert witness, in particular, is that and signing off a lot of valuation is that</i>	<i>Self-reference - Expert witness experience</i>	<i>Meta-reasoning: experiential-memory</i>	<i>Fact – 5 linked forward to Plan – 6</i>
6	<i>I look for things that, perhaps, don't quite make sense or just query</i>	<i>Recommend - Instructional analysis</i>	<i>Meta-reasoning: plan</i>	

The expert witness experience that EV 1 recalled in segment 5 'And, I suppose, probably, part of my experience as expert witness, in particular, is that and signing off a lot of valuation is that' is evidence of activation of pre-existing knowledge of valuation practice that EV 1 believed could be used in analysing the valuation instruction. It is also, arguably, the use of script-based knowledge as it subsumes a number of triggered words, such as 'part of my experience', that indicated that some form of analysis would be considered. Working forward from this, EV 1 then recommends a move relating to querying the instructional information in order to identify the aspects that, perhaps, don't quite make sense (segment 6). An EV 1 plan of this move is tailored to fit the work of expert witness in valuation.

In his analysis of the instructional information, EV 1 examined the site coverage and noted that 'the site area at a 1,088 square metre is disproportionately larger than the size of the building' (segment 7-9). He then preceded, again in a forward-reasoning fashion, to identify the consequence of the low site coverage – a very big yard space. He also identified that access to the rear yard was quite restricted. He

arrived at this conclusion after providing a diagnosis of the extensive accommodation narrow side the rear yard (segment 11-12).

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
10	<i>Because that give us a surprisingly low site coverage area,</i>	<i>Physical attribute - Low site coverage</i>	<i>Summarization: repeat-data</i>	<i>Fact – 10, 11, 12 &amp; 13 linked forward to Infer – 14</i>
11	<i>and certainly then it talks about something, the extensive of accommodation narrow side the rear external yard</i>	<i>Physical attribute</i>	<i>Data-examination: read</i>	
12	<i>and that is the side that I guess is <u>really interesting</u> -</i>	<i>Physical attribute</i>	<i>Meta-reasoning: cue-diagnostics</i>	
13	<i>rear external yard accessed by shutter and covered away from the front of the property,</i>	<i>Physical attribute</i>	<i>Data-examination: read</i>	
14	<i>I kind of envisage that that sort of implies that <u>the access to the rear area was quite restricted</u></i>	<i>New fact - Restricted rear area access</i>	<i>Data-explanation: infer</i>	
15	<i>But, actually, giving the site area versus the floor area,</i>	<i>Physical attribute - Low site coverage</i>	<i>Summarization: repeat-data</i>	<i>Fact – 15 linked forward to Infer – 16</i>
16	<i>I kind of thought that that rear yard would be a very big piece of yard space</i>	<i>New fact - Big yard space</i>	<i>Data-explanation: infer</i>	<i>Infer – 16 linked backward to Fact – 17</i>
17	<i>and I thought that, <u>is that the case?</u></i>	<i>Analysis of yard space</i>	<i>Meta-reasoning: self-evaluation</i>	

At segment 18, EV 1 noted that he had 'mis-calculated the site coverage area'. His verbal protocol transcript indicates that his mistake was as a result of the fact that he had confused square metres with square feet (segment 19-20). Switching between forward and backward reasoning, EV 1 then returned and re-estimated the

site coverage at about 50% which in his view 'will make much more sense' than the original estimate (segment 21-24)

EV 1 then moved to the issue of property tenure (segment 25-38) where he again engaged in a switch between backward and forward reasoning. He identified, in particular, that the rent review is at the current market value but noted through backward reasoning that the basis on which the present ground rent is set was not provided in the instruction data (segment 27-28). With this, EV 1 concluded, through forward reasoning and based on assumption and further analysis of other lease terms, that the leasehold tenure 'isn't reversionary' (segment 32). He further constructed a problem relating to the assumption he has made, which is, that he recommended that determining the actual ground rent would require verifying the lease terms and understanding the rent review clause in the lease document (segment 34-36).

EV 1 identified the purpose and basis of the valuation as for potential sale and market value respectively (segment 39-43) and then moved the analysis to the issue of differences in floor areas (segment 44-48). At segment 45, EV 1 inferred in a forward reasoning fashion that 'either there is a bit of over hanged...or something is not counted'. He then constructed a problem that directly dealt with that. That is, by requesting visualisation of the subject property in order to ascertain how it actually looks (segment 48). Following on from this, EV 1 examined some property attributes including the current use and the absence of contamination (segment 49-52) and then moved to the issue of crack in the rear corner of the subject property. At segment 53, EV 1 raised concern about the fact that the crack had been poorly repaired. At segment 54, he found a potential problem of passing judgment on the nature and impact the crack might have on the property as coded below:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
53	<i>I think the thing that worries me again was that there is a substantial crack in the rear corner of the brick wall that has been poorly repaired</i>	<i>Physical attribute</i>	<i>Data-examination: read</i>	<i>Fact – 53 &amp; 54 linked forward to Plan – 55</i>

54	<i>You can only kind of make any sort of judgment about what that is like if you have a look at it and sort of see</i>	<i>Analysis of crack condition</i>	<i>Meta-reasoning: self-evaluation</i>
55	<i>And is the sort of things that I might well want to <u>co-inspect with Building Surveyors</u> to come and have a look at and so is this kind of cracks...something to bear in mind.</i>	<i>Recommend - Co-inspection with Building surveyors</i>	<i>Meta-reasoning: plan</i> <i>Plan – 55 linked backward to Fact – 56</i>
56	<i>I am not sure or rarely know whether it is a kind of crack that is causing structural problems</i>	<i>Analysis of crack condition</i>	<i>Meta-reasoning: self-evaluation</i>

At segment 54, EV 1 summarised the factual aspect of professional requirement on the ability of the valuer to comment on the structural impact of the crack. This reflection also triggered the activation of a script for a course of action by recommending the specific valuation procedure that could be used for further investigation – co inspection with a Building Surveyor. To justify this, EV 1 then switched to backward reasoning and identified that the crack may be causing structural problems (segment 56).

At segment 57, EV 1 moved the analysis to the comparable sale and lettings information. In his analysis, EV 1 first examined the asking price of the subject property two years ago (segment 58-68). EV 1 found that the asking price was unreliable given that 'values had fallen back in the intervening period'. He identified, at segment 67, that values might be 'fifty hundred and seventy five thousand pounds now' in order to establish a broad view of where the market value may lie. When EV 1 finished analysing the asking price, he then moved to other comparable evidence.

EV 1 engages in a series of evaluative processes aimed at seeking appropriate comparable evidence to establish the rental value applicable to the subject property (segment 69-105). Utilising a number of criteria such as size, proximity and timing

of letting, he was able to establish comparable 2 as the most appropriate and closest to the subject property (segment 77) but found a potential problem of how to apply the rental value to the subject property due to lack of information on the pattern of value distribution (segment 84-89). He then constructed, through forward reasoning, a problem relating to gathering more information on the comparable in order to 'be able to compare them more directly' (segment 90-92). Based on further analysis, EV 1 adopted a rental value of £21,000 per annum for the subject property. At segment 106, EV 1 identified his preferred valuation method. After determining the profit rent (segment 108-109) and the unexpired term remaining on the lease (segment 111), he constructed a problem involving the application of the approach using a capitalisation rate of 12% (segment 112-119). Once the EV 1 had arrived at and reflected on an initial opinion of value (segment 120-123), he moved on to the issue of adjustment to reflect the condition of the property (segment 124). He recalled the problem with the condition of the property and constructed a problem relating to how this might be adjusted for (segment 126). At segment 127, EV 1 reaffirms his thought process to signify the end of the task. Throughout the comparable analysis and application of valuation method, the analysis of EV 1 verbal protocols revealed that he engages in a constant switch between forward and backward reasoning.

#### ***4.4.1.2 Expert valuer 2***

EV 2 briefly analysed the instructional information at the start of the valuation task. Similarly to EV 1, he constructed a problem that entailed commenting on what the 'instructions are silence on' (segment 1). The context in which EV 2 used the term 'silence' indicates that he used it to encapsulate a number of possibilities ranging from lack of information to inconsistency in the information provided. As part of his analysis, EV 2 examined the issue of property tenure (segment 2-7). He noted, at segment 4, that the instruction did not provide the basis on which the ground rent was geared on review but did not construct any method to deal with that problem. At segment 8, EV 2 introduced the issue of asbestos by noting that 'a property of that age would naturally have asbestos' (segment 9). He then dealt with this swiftly and in a forward-reasoning manner by constructing a problem involving the need to inspect the asbestos register as part of the valuation process (segment 10-11).



At segment 12, EV 2 then moved to the floor area (segment 14-15) and later to the issue of the substantial crack in the brick wall (segment 16-18). He provided a series of analyses which are coded below:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
12	<i>An interesting note here you've said that the extensive first floor accommodation, 50% of the total floor area may not suit some occupiers.</i>	<i>Physical attribute</i>	<i>Data-examination: read</i>	<i>Fact – 12 &amp; 13 linked forward to Plan – 14</i>
13	<i>It doesn't go into any <u>more details</u> about why it might not suit some occupiers.</i>	<i>Physical attribute - More details on first floor accommodation</i>	<i>Data-exploration: search</i>	
14	<i>So we'd have to <u>question that...</u>?</i>	<i>Recommend - Questioning first floor accommodation</i>	<i>Meta-reasoning: plan</i>	<i>Plan – 14 linked backward to Fact – 15</i>
15	<i>is there a mezzanine floor that should be taken out? Would it affect the inside? Is it an internal warehouse that has got a mezzanine stopping full height eaves</i>	<i>Recall - Floor description</i>	<i>Meta-reasoning: experiential-memory</i>	
16	<i>and it says the property appears to be in adequate structural repair and condition containing no deleterious materials and it says evidence of substantial crack in the ground floor rear brick wall which has been poorly repaired</i>	<i>Property attribute</i>	<i>Data-examination: read</i>	<i>Fact – 16 linked forward to Plan – 17</i>

17	<i>Well that's obviously something that would have to be questioned</i>	<i>Recommend - Questioning substantial crack with adequate structural repair</i>	<i>Meta-reasoning: plan</i>	<i>Plan – 17 linked backward to Fact – 18</i>
18	<i>especially if you're saying it's in adequate structural condition.</i>	<i>Property attribute</i>	<i>Summarization: repeat-data</i>	
19	<i>The property required full refurbishment,</i>	<i>Property attribute</i>	<i>Data-examination: read</i>	<i>Fact – 19 linked forward to Infer – 20</i>
20	<i>I think it's particularly significantly <u>dilapidated</u> building</i>	<i>New fact - Property is significantly dilapidated</i>	<i>Data-explanation: infer</i>	
21	<i>and obviously there are signs of vandalism,</i>	<i>Property attribute</i>	<i>Data-examination: read</i>	<i>Fact – 21 linked forward to Infer – 22</i>
22	<i>it's been completely stripped internally</i>	<i>New fact - Completely stripped internally</i>	<i>Data-explanation: infer</i>	
23	<i>I suspect it was a <u>repossession</u> and the property has been left in particularly <u>un-refurbished</u> condition</i>	<i>Solution - Property repossessed: Un-refurbished condition</i>	<i>Hypothesis-generation: trigger</i>	
24	<i>There is sign of the cracking in the back wall</i>	<i>Property attribute</i>	<i>Data-examination: read</i>	<i>Fact – 24 &amp; 25 linked forward to Infer – 26</i>
25	<i>but that wouldn't be <u>uncommon</u> with buildings of this nature just particularly with <u>heavy industrial use</u></i>	<i>Recall - Common cracks</i>	<i>Meta-reasoning: experiential-memory</i>	
26	<i>I would think there's probably a lot of damp in the main structure of the building</i>	<i>New fact - Lot of damp in the main structure</i>	<i>Data-explanation: infer</i>	

27	<i>and the offices look like they've been <u>heavily vandalized</u></i>	<i>Physical attribute - Heavily vandalized</i>	<i>Data-examination: determine severity</i>	<i>Fact – 27 linked forward to Infer – 28</i>
28	<i>and I would say that it's something <u>more than just a poor decorative order.</u></i>	<i>New fact - More than just a decorative order</i>	<i>Data-explanation: infer</i>	

Similarly to EV 1, the above analysis provides an example of instances from EV 2 verbal protocols which illustrate how he worked forward using scripts associated with knowledge in the form of schema and occasionally switched to backward reasoning to justify or elaborate on action taken on recommended. EV 2 noted the aspect of the property data which reported that 50% of the total floor area may not suit some occupiers (segment 12). He also noted that the instruction did not provide any more details about why it might not suit some occupiers (segment 13) and, this then triggered a script to identify what to do in such situation – question the data. EV 2 then immediately switched to backward reasoning to elaborate further by providing different descriptions of floor areas which might have accounted for that (segment 15).

In working forward, the EV 2 also relied on schema-based knowledge by activating knowledge of previous valuation cases. This occurs, for instance, when he was analysing the issue of crack in the brick wall. He identified that the crack condition is something that is common to building with heavy industrial use as is the case with the subject property (segment 25). He then worked forward to identify the consequence of the crack – possibility of a lot of damp in the main structure of the building. Prior to this, he also analysed the issue of full refurbishment; focusing on identifying factors that could have accounted for that (segment 19-22).

At segment 29, EV 2 again returned to the issue of floor areas and, like EV 1, noticed differences in the floor areas (segment 36-37) and recommended that this be questioned. He made this recommendation having failed to find a satisfactory explanation to the earlier question he asked at segment 31:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
31	<i>so I'm not quite sure where the extensive first floor is</i>	<i>Property attribute</i>	<i>Meta-reasoning: self-evaluation</i>	

At segment 39, EV 2 moved the analysis to the comparable evidence. Similarly to EV 1, he engaged in a series of evaluative process using multiple criteria such as size, location and access to facility (segment 40-59). Unlike EV 1, however, he did not identify a particular comparable to adopt for the valuation. At segment 60, EV 2 identified the valuation method to adopt. He then asked some questions that comprised a series of questions relating to who the client is, the property interest being valued, the capitalisation period and rental value for the subject property (segment 61-68). EV 22 then introduced the issue of cost of improvements (segment 69-77) after which he then constructed a problem regarding the application of the valuation method he earlier identified at segment 60. That is, he identified a rental value of £2 a square foot, determine the profit from rent and, with an assumed yield of 11%, capitalised the profit rent in perpetuity to arrive at a valuation opinion of say £170,000 (segment 78-85).

#### **4.4.2 Analysis of issues considered by intermediate valuers**

##### ***4.4.2.1 Intermediate valuer 1***

IV 1 identified the need to establish the fair comparable rent and cost of improvement at the start of the valuation (segment 6). After questioning the researcher on the extent of instructional analysis required, he then proceeded straight to comparable analysis (segment 9-68). In his analysis, IV 1 first identified that the last comparable property could be used to determine the yield (segment 10) while the remaining three comparable properties provided the basis of establishing the fair market rent (segment 14). That is, at that point he disaggregated the comparable analysis into the broad categories of yield and rental analysis.

IV 1 dealt with the rental analysis first, focusing on identifying the most appropriate and reliable comparable property for the valuation (segment 14-45). Similarly to the two expert valuers, he engaged in a series of evaluative processes that comprised the use of multiple criteria to judge the quality of comparable evidence. Also like the two expert valuers, he found the potential problem of lack of detailed information on the comparable evidence such as:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
27	<p><i>No break down here of office areas to industrial areas.</i></p> <p><i>There is certainly no <u>breakdown of rent...</u> from office rent to industrial rent</i></p>	<p><i>Physical attribute - No breakdown of rent</i></p>	<p><i>Data-exploration: note-absence-data</i></p>	

To address this, IV 1 then proceeded to construct a problem that involved making a note of this in the valuation report under uncertainty of the valuation, and possibly looking for more comparable evidence (segment 46-47). After identifying the appropriate rental value per metre square, IV 1 briefly introduced the problem of adjustment for repair and condition, constructing a problem involving his preferred approach to dealing with repairs. That is, adjusting the value at the end of the valuation based on what it will cost to bring the subject property to the state of repair similar to the closest comparable property (segment 48-50). IV 1 then moved to yield analysis (segment 52-68), noting again the problem of relying on only one comparable property for evidence (segment 57) with lack of detailed information; whether sold with vacant possession or with tenant *in situ* (segment 67).

After identifying appropriate rental value and yield from the comparable evidence, IV 1 then moved to the issue of property tenure (segment 69-76). He identified that the present ground rent was set in 2010. Contrary to the two expert valuers, he did not raise any concern at this stage regarding lack of detail on the basis on which the ground rent is set. Instead, he returned back to comparable analysis to work out the rental value (segment 77-85) and profit rent of the subject property (segment 86-90). In all of the above analysis, IV 1 mainly worked forward from established fact.

At segment 91, IV 1 identified his preferred leasehold valuation method (term and reversion technique) and, like the expert valuers, engaged in a switch between forward and backward reasoning using a combination of fact and knowledge in the form of schema as illustrated below:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
91	<i>So is difficult to, I will normally put the term and reversion on a leasehold valuation, value the term up to the next reviews and value the reversion at the current market rent</i>	<i>Technique - Leasehold valuation approach</i>	<i>Meta-reasoning: plan</i>	<i>Plan – 91 linked backward to Fact – 92</i>
92	<i>But we don't know what the <u>market rent</u> should be</i>	<i>Legal attribute – market rent</i>	<i>Data-exploration: search</i>	
93	<i>In my experience of valuation, which suggests the <u>rent is about £7 a square metre for a ground rent</u></i>	<i>Recall - Market ground rent</i>	<i>Meta-reasoning: experiential-memory</i>	
94	<i>However, we don't have enough <u>information</u></i>	<i>Comparable evidence - Limited information</i>	<i>Data-exploration: note-absence-data</i>	
95	<i>If I was doing this valuation in practice, I will make sure that I <u>get comparable for ground rent</u></i>	<i>Recommend - More comparable search</i>	<i>Meta-reasoning: plan</i>	
96	<i>I don't quite know what to do with the <u>limited information</u> I've got here</i>	<i>Comparable analysis</i>	<i>Meta-reasoning: self-evaluation</i>	<i>Fact – 96 linked forward to Plan – 97</i>
97	<i>I suppose we've got to look at a couple of choices</i>	<i>Recommend - Analysis of valuation options</i>	<i>Meta-reasoning: plan</i>	<i>Plan – 97 linked backward to Fact – 98</i>

98	<p><i>...we can assume that the ground rent in 2010 is the market rent and just value the leasehold interest assuming that is currently at a rack rent or we can make assumption about the rental growth, perhaps put a value of £4,000 per annum and value it on the base of term and reversion</i></p>	<p><i>Recall - Valuation options</i></p>	<p><i>Meta-reasoning: experiential-memory</i></p>	<p><i>Fact – 98 linked forward to Plan 99</i></p>
99	<p><i>I am going to go for <u>the first option</u>.</i></p>	<p><i>Recommend - Valuation option</i></p>	<p><i>Meta-reasoning: plan</i></p>	<p><i>Plan – 99 linked backward to Fact – 100</i></p>
100	<p><i>because I don't have any evidence about what the current market rent is... it may have gone up, it may have gone down...</i></p>	<p><i>Valuation option</i></p>	<p><i>Meta-reasoning: self-evaluation</i></p>	

IV 1 noted that the lack of information to establish market rent makes it difficult to use the traditional term and reversion method of valuation that he had earlier identified (segment 92-96). This fact then triggered a script to identify two courses of action - assume that the ground rent set in 2010 is the market rent, or assume rental growth (segment 97-98). IV 1 decided on the first option and then switched to backward reasoning to justify his action (segment 100).

With this and other assumptions (including sinking fund rate and tax), IV 1 then proceeded to the actual valuation calculations relying mainly on backward reasoning to justify or elaborate on the use of techniques where necessary. That is, he capitalised the profit rent for unexpired term of 102 years to arrive at initial valuation opinion (segment 101-130). Unlike the two expert valuers, IV 1 did not recognise that for an unexpired term of 102 years, the Years Purchase (YP) in perp should have been used. At segment 132, IV 1 revisited the issue of substantial crack within the brick wall. Similarly to EV 1, he found that:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
133	<i>As a valuer, can only sort of carry out, we are only competent to carry out superficial <u>inspection of the premises and its condition</u></i>	<i>Property analysis</i>	<i>Meta-reasoning: self-evaluation</i>	
134	<i>If we are concerned with structural problems with the building...we need to advise the client accordingly, <u>recommend structural survey of the building</u></i>	<i>Recall - Dealing with structural problems</i>	<i>Meta-reasoning: experiential-memory</i>	
135	<i>However, it also says it appears to be in adequate structural repair and condition</i>	<i>Physical attribute</i>	<i>Data-examination: read</i>	<i>Fact – 135 linked forward to Infer - 136</i>
136	<i>So the crack in rear corner of the ground floor brick wall, well, we will assume that to be <u>non-structural</u> based on the information that has been given</i>	<i>New fact - Crack in the brick wall is non-structural</i>	<i>Data-explanation: infer</i>	

At segment 136, IV 1 identified in a forward-reasoning fashion that the crack in the brick wall is non-structural. He arrived at this conclusion based on the fact that the instruction says that the property appears to be in adequate structural and repair conditions (segment 135). He then returned back to the issue of adjustment that he had identified earlier (segment 48-50). In considering the appropriate adjustment to make on the initial valuation opinion, IV 1 found that it was not possible to cost the refurbishment works without comparable information and constructed a problem that involves consulting a building or quantity surveyor to establish costs for the necessary works (segment 137-143). At segment 144, IV 1 assumed cost of work and based on that adjusted the initial valuation opinion to arrive at the final valuation opinion (segment 145-146).



**4.4.2.2 Intermediate valuer 2**

IV 2 identified that the property interest to be valued is the long leasehold at the start of the valuation (segment 4). He then moved on to the issue of property tenure (segment 5-10). Like the EV 1 and 2 and IV 1, he examined some terms of the lease and asked the following question in relation to the provision on ground rent review:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
9	<i>okay, so do I need to presume anything on these reviews or is just up to me to decide? <u>is the rent going to increase every 7 years or is it going to stay the same?</u></i>	<i>Legal attribute - Rent review mechanisms</i>	<i>Data-exploration: search</i>	

IV 2 constructed a problem to deal with this later and then proceeded to examine some instructional information that comprised commenting on or judging the quality of information relating to repair and condition (segment 11-17) and, also working forward from known fact to inferred consequence as shown below:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
12	<i>has suffered act of vandalism, <u>is not very good</u></i>	<i>Physical attribute - Act of vandalism is not very good</i>	<i>Data-examination: determine-severity</i>	<i>Fact – 12 &amp; 13 linked forward to Infer – 14</i>
13	<i>the roof leaks, that is not very good either</i>	<i>Physical attribute - Roof leaks is not very good</i>	<i>Data-examination: determine-severity</i>	
14	<i>that means is in extremely poor equity of order</i>	<i>New fact - Property in extreme poor equity of order</i>	<i>Data-explanation: infer</i>	

IV 2 then moved to comparable analysis, engaging in a series of evaluative processes in order to establish appropriate rental value for the subject property (segment 18-61). The evaluative criteria employed by IV 2 are similar to those used

by all other subjects and include timing of letting, location, size and quality of accommodation. In his analysis and similarly to EV 1, IV 2 identified that providing the asking price of the subject property is very useful but, unlike EV 1, he failed to demonstrate this in his analysis. He also engaged in a switch between forward and backward reasoning during the analysis.

At segment 62, IV 2 questioned self on the yield to adopt for the valuation. At this stage he did not construct any problem to identify the yield. Rather, he moved on to the issue of valuation method. At segment 66, IV 2 identified the unexpired term as 102 years and working forward from this found that the long leasehold interest can be capitalised in perpetuity to arrive at valuation opinion. After identifying the capitalisation approach, he then returned back to the issue of yield and constructed a problem which involved trying different yields and mainly relying on forward reasoning using a combination of fact and knowledge in the form of schema as illustrated below:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
71	<i>Alright I was thinking of a yield...the market at the moment is <u>anywhere between 8 and 10</u></i>	<i>Recall - Present yield applicable to subject property</i>	<i>Meta-reasoning: experiential-memory</i>	<i>Fact – 71, &amp; 72 linked forward to Plan – 73 &amp; 74</i>
72	<i>the one I have in Northampton Robin was office property that is <u>not really a useful one plus 8%</u>,</i>	<i>Recall - Office yield from Northampton</i>	<i>Meta-reasoning: experiential-memory</i>	
73	<i>...okay let's have a look <u>yield 13%</u></i>	<i>Recommend - Try yield of 13%</i>	<i>Meta-reasoning: plan</i>	<i>Plan – 73 linked backward to Fact – 74</i>

74	<i>but is going to be <u>high</u> because you are losing 3750 you are paying that to the Council every year, just taking a chunk out of your income so you are not going to be getting low yield...</i>	<i>Use of Yield of 13%</i>	<i>Meta-reasoning: self-evaluation</i>	
75	<i>can I just say that I am going to try 14%...7.428.</i>	<i>Recommend - Try yield of 14%</i>	<i>Meta-reasoning: plan</i>	<i>Plan – 75 linked backward to Fact – 76</i>
76	<i>I think I might be under valuing it there</i>	<i>Use of Yield of 14%</i>	<i>Meta-reasoning: self-evaluation</i>	

The yield that IV 2 recalled in segment 71 'Alright I was thinking of a yield...the market at the moment is anywhere between 8 and 10' is evidence of activation of pre-existing knowledge of valuation practice that IV 2 believed could be used in guiding the choice of different yields which were subsequently reflected upon through backward reasoning (at segment 74 and 76). At segment 86, IV 2 identified the need to adjust for the refurbishment work but, unlike the two expert valuers and IV 1, he did not construct any problem to demonstrate how this can be done.

#### **4.4.3 Analysis of issues considered by novice valuers**

##### **4.4.3.1 Novice valuer 1**

At the start of the valuation exercise, NV 1 identified the leaseholder as the client asking for the valuation (segment 3) and the purpose of valuation as 'assessment of market value of the long leasehold interest (segment 4). She then noted that:

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
5	<i>The information provided on the property is <u>not really enough</u> to make a full valuation for this property</i>	<i>Property data</i>	<i>Meta-reasoning: cue-diagnosticsity</i>	<i>Fact – 5 linked forward to Plan – 6</i>

Working forward from the above comment and similarly to the expert valuers, NV 1 constructed a problem which involves seeking more information from comparable data (segment 6) and questioning aspects of the instruction for more clarity (segment 7). During this early stage of the conduct of the valuation, NV 1 questioned the age of the property and, based on the fact that the building materials used may have contained asbestos materials, she identified, through forward reasoning, that the subject property was built in the 70s or late 80s (segment 8-9).

<i>Seg. No</i>	<i>Segment Text</i>	<i>Knowledge State</i>	<i>Problem Solving Operators</i>	<i>Problem Solving Strategy</i>
8	<i>How old is the property?</i>	<i>Physical attribute – Age of property</i>	<i>Data-exploration: search</i>	
9	<i>I think there were some builder materials using <u>asbestos</u> on the roof</i>	<i>Environmental attribute - Presence of asbestos</i>	<i>Data-examination: identify</i>	<i>Fact – 9 linked forward to Infer – 10</i>
10	<i>so possibly this building was made in <u>the 70s may be late 80s.</u></i>	<i>New fact - Property built in the 70s or late 80s</i>	<i>Data-explanation: infer</i>	

At segment 9, although NV 1 did note the presence of asbestos, contrary to EV 2, she did not discuss further actions that are needed to deal with this. She also questioned and identified the void period and implied that the reason the property was void is because it was on the market for sale (segment 10-12).

At segment 13-14, NV 1 briefly noted that the condition of the subject property 'is not very good' and in need of full refurbishment. She then moved on to discuss the issue of crack in the brick wall. Similarly to the two expert valuers and IV 1, she was concerned, using backward reasoning, that the crack might be 'dangerous'. The context in which NV 1 used the term 'dangerous' indicates that she used it to encapsulate a number of potential effects including structural damage and health and safety risk. At segment 16-17, she then constructed a problem which involved conducting full inspection to further analyse the nature and impact of the crack. Following on this, NV 1 then identified that the new regeneration programme in the

area could have positive impact on the value of the subject property (segment 19-22) and moved on to analyse the comparable evidence.

NV 1 analysed the comparable evidence at segment 24-30. Similar to other subjects, she identified comparable property number 2 as the closest to give an opinion of rental value based on a comparative assessment of different factors such as the location and condition of the comparable property in relation to the subject property. However, unlike the experienced and intermediate valuers, her analysis did not provide detailed assessment of each of the comparable properties and the asking price information provided for the subject property. As part of the comparable analysis, she worked out the yield from the leasehold tenure and then proceeded to the issue of application of valuation method (segment 30-33) using both forward and backward reasoning. During the application of valuation method, NV 1 first worked out the rental value and profit rent for the subject property and then capitalise this at a leasehold yield of 9%/3%/35% to arrive at an opinion of value at segment 33. She then moved to the issue of adjustment and constructed a problem (through forward reasoning) which involved finding out the cost of improving the property and adjusting valuation opinion for this (segment 34-36). At segment 37, NV 1 reported valuation opinion to indicate an end to the valuation task.

#### ***4.4.3.2 Novice valuer 2***

NV 2 started the valuation task by first examining some instructional information, including the purpose of valuation (segment 1-4). She then moved on to the issue of asbestos which she noted, at segment 5, 'might be a problem for offices'. Similar to NV 1, she did not go on to construct any problems to deal with that. At segment 6-8, she contemplated on the condition of the property and the issue whether or not adjustment should be made for this in the valuation. Contrary to the two expert valuers and IV 1 who had discussed the same issue in more details, NV 2 did not go on to deal with the issue, she instead proceeded to analyse the comparable evidence (segment 9-21).

Similarly to NV 1 and other subjects, she carried out a comparative evaluation of the comparable evidence using multiple criteria including tenure, proximity to subject property and property type (segment 11-18). At segment 19, she found out that comparable 2 was the best to establish the rental value. Based on this, NV 2 calculated the rental value applicable to the subject property (segment 20-21) and then moved on to construct a problem relating to applying this to do a leasehold valuation. In the process of this, she discussed how the valuation inputs (profit rent and yield) were derived and applied using the traditional dual-rate method of leasehold valuation.

#### **4.4.4 Summary of the general problem solving strategy used by expert, intermediate and novice valuers**

The above analysis revealed that the expert, intermediate and novice valuers all went about the task of valuing the property using the information provided generally in a similar way. That is, they all addressed the valuation task as a series of problems rather than a single problem. This shows that all subjects used the general problem-solving procedures of problem decomposition (Simon, 1973) during the valuation.

In respect of differences between the subjects, the analysis indicated that there was no great difference in the number of problems found and constructed by each subject. Intermediate and novice valuers, however, did not find that the differences in floor areas needed to be addressed during the valuation, while both expert valuers spent a considerable amount of time on analysing this. This finding may indicate that intermediate and novice valuers will fail to find problems and unusual situations beyond those that are explicitly stated in the instruction as a problem. A further analysis also revealed that expert and intermediate valuers returned to issues that they had previously analysed after analysing further information or when they reflect on their previous analysis, for example EV 1 returned and re-estimated the site coverage when he discovered he had made a mistake. EV 2 re-evaluated the issue of substantial crack in the brick wall after examining further information and noted that there could be a lot of damp in the main structure of the building. This result

indicates that they kept their thoughts and analyses under constant review during the entire valuation. Novice valuers did not revisit any problems in the manner in which the expert and intermediate valuers did.

The verbal protocol analysis also shows that subjects engage in a switch between forward and backward reasoning as means of generating solutions to deal with problematic situations during the commercial valuation task. The relative use of these chaining strategies by expert, intermediate and novice valuers during the valuation task was identified to yield the results that are presented in Table 4.0.5 below.

Overall, the results indicated that expert, intermediate and novice valuers tended to generate solutions to problematic situations during the valuation task using mainly forward reasoning (63%, 62% and 60% respectively) but sometimes switched to backward reasoning (37%, 38% and 40% respectively). These results clearly suggest that all subjects engage in some form of problem solving during the valuation.

Although all subjects groups mainly worked forward, the results in Table 4.0.5 below indicate differences in the proportion of chaining strategy types used based on the level of expertise. In particular, the results show an increasing use of forward reasoning and a decreasing use of backward reasoning with increasing level of expertise.

Table 4.0.5 Proportion of chaining strategies used by valuers to construct problems and solutions

	Novice Valuer							Intermediate Valuer							Expert valuer						
	Antecedent							Antecedent							Antecedent						
	Fact		Disc		Total			Fact		Disc		Total			Fact		Disc		Total		
	For	Back	For	Back	For	Back	Both	For	Back	For	Back	For	Back	Both	For	Back	For	Back	For	Back	Both
Consequence																					
Hypothesis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	3
Plan (Goal)	2	4	0	0	2	4	6	15	12	0	0	15	12	27	16	4	0	0	16	4	20
Inference	4	0	0	0	4	0	4	5	0	0	0	5	0	5	13	4	0	0	13	4	17
Resolution	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	0	4	8	12
Total	6	4	0	0	6	4	10	20	12	0	0	20	12	32	29	19	4	0	33	19	52
Prop (%)					60	40	100					62	38	100					63	37	100



## **4.5 PERCEPTION OF EXPERT VALUERS ON VALUATION PROBLEM SOLVING**

This sub-section reports the results of the interviews conducted with two expert valuers who participated in the valuation task and two others who did not. The primary goal of the interview sessions was to reveal the core dimensions of valuation problem solving, as perceived by the expert valuers, and how this may develop. The results obtained from these interviews form the basis of triangulating the findings of the verbal protocol analysis discussed in the previous sections of this chapter.

### **4.5.1 Core dimensions of valuation problem solving**

How do expert valuers normally solve challenging valuation problems? What are the key differences between the way expert valuers solve problems now as compared to when they were less competent? Based on a thematic analysis of expert valuers' responses to these interview questions, four key components were identified: (1) knowledge, (2) cognition, (3) collaboration, and (4) professional practice. A discussion of each aspect supported by extracts from responses to interview questions is provided below to guide the conception of valuation problem solving in Chapter 5.

#### ***4.5.1.1 Knowledge***

Respondents had a deeper understanding of their valuation domain Knowledge which was multidimensional and perceived as the basis for valuation problem solving. Although knowledge gained from traditional academic content areas such as valuation concepts and principles provide the beginning point for problem solving, it was not sufficient. Such knowledge needs to be integrated with the knowledge which is obtained in practice in order to make judgment on how valuation tasks may be dealt with. For example, the quote below indicates the integrative process of the use of knowledge and judgment in valuation problem solving.

*"I [Valuer] think the kind of four processes that I do [in reasoning through challenging valuation tasks] is really to kind of go back to first principles...you know those fundamental principles and, I find myself of more and more kind of thinking that, um, very basic things like the difference between value, price and worth and things like that in fairly basic kind of valuation concepts and actually build it up from*

*first principles and doing that in a quite analytical and logical way, really with the view to kind of looking at how you can do something or whether you can do something. Um, I think that that then get tempered a little bit with kind of experience and the more experience you've got the more you've encountered a similar kind of problem before and you kind of have that to fall back on how it's been, you know how it's being done"*(EV1, Episode 3, Interview).

Other forms of knowledge were also considered vital for valuation problem solving as was the ability to draw on this knowledge. Knowledge of judgement made from previous valuations was reported as informing subsequent valuation problem solving particularly in ensuring that one arrives at the right conclusion or valuation opinion. Respondents also reported reasoning based on own instinct and confidence; suggesting the use of tacit knowledge in valuation problem solving.

### **Experiential Knowledge**

*"You don't jump into conclusion I think as quickly, you have the ability to draw on your experience of what happens, what else you've done in the past... in a rapidly changing market you've got to be careful that it's not influencing your process but nevertheless if you've done a similar valuation recently, you can draw on that knowledge."*(EV2, Episode 5, Interview).

*"You've had difficult factory or warehouse to value in the past, umm, and you can use that experience, apply that experience to other current problems"*. (EV3, Episode 4, Interview).

*"...there's always a first time to do a particular valuation – there's always the first time you do an industrial unit and the first time you do an office building and the first time that you measure a building that hasn't got straight walls, er, and the first time you come across a building where it's empty and there are potential issues regarding the structural deficiencies of the building, the property which is leased and the lease doesn't make sense – every time you've got one you've got that experience within yourself to help address the challenges of the next one, but it's all about experience at the end of the day"*(EV4, Episode 4, Interview).

### **Personal Knowledge**

*"...but there is a lot more experience brings with it a degree of instinct that something isn't right at that level which you don't get out of books but by doing*

*valuation day in and day out. Which bit of the brain tells me that, I am not quite sure?" (EV 3, Episode 5, Interview).*

*"I think confidence in just thinking that you have been doing this for 18 years, valuation for 18 years, I was pretty green and very cream when I started doing it. Umm, I think I haven't been on course to make me more decisive or anything like that. I think you just become more experience, more confidence, not over confidence hopefully or arrogant, and you just use your experience" (EV3, Episode 4, Interview).*

The nature of knowledge, particularly the experiential knowledge, was perceived as dynamic and constantly changing; requiring updating through learning. Respondents almost always reported improvement in their experience as more and more valuations are undertaken and are aware of their responsibilities to develop knowledge for and from practice. One of the mandatory requirements for valuation practice is for professionals to commit to lifelong learning so it is valuable that valuers recognise the need to update their knowledge regularly. Respondents reported refining their reasoning with increased knowledge of practice.

*"Well, you've got to rely on experience to date [in valuation problem solving] but your experience is constantly changing isn't it, your experience is constantly growing because you're valuing more and more property and you will value the same property more than once in your professional career. It's a very strong chance that you will do that and I've got a number of colleagues that have" (EV4, Episode 3, Interview).*

*"The main difference [between the way I reason now as compared to when I was less competent] is, umm, building up knowledge and being aware of the fact that just because you've been doing it the same for 20 years doesn't always make it right because you might be missing out on new technology or whatever. So you've got to keep your knowledge up to date" (EV3, Episode 5, Interview).*

*"...now I [Valuer] think that over the last few years I've refined these skills [reasoning skills] dealing with more lawyers and dealing with more clients. I [Valuer] think the key difference rarely was that I was less good at that [reasoning]... because I didn't quite have the same level of experience..." (EV1, Episode 5, Interview).*

The use of knowledge as the basis for reasoning in valuation was observed to be oriented towards making judgement on different valuation tasks. As explained earlier in the previous section on knowledge, expert valuers often make decisions on how to perform a task based on their practice and conceptual knowledge. Another area where reasoning was oriented towards judgement is checking the initial valuation opinion, using experience of other valuers as a frame of reference. Valuation problem solving was also reported as judgment making in regards to the level of involvement and engagement with the task and the extent to which third party information would be relied on.

*"[In valuation problem solving], it never does any harm [to make a judgement] to get second opinion from another valuer if you've got something that you are really struggling with just to make sure that you are not missing something obvious so that you are going down... the right line."* (EV3, Episode 3, Interview).

*"Well, you are appointed as an expert in your field to provide an advice on valuation...and, we can make this as hard or as easy as you want to because you could try and not address any challenging issues and the report would be full of questions that need addressing at a later date or you could provide too much information which actually opens you up for further potential mitigation if you're relying on third party information and not saying where you have relied on it, so you have to state the source and then if you are asked to give your professional judgement you've got to base it on what that third party resource has told you".* (EV4, Episode 3, Interview)

#### **4.5.1.2 Cognition**

Once the task(s) are identified and the context of decision making understood, different approaches to thinking are then employed by respondents in problem solving, ranging from integrating different types of knowledge (as demonstrated earlier) to weighting up the quality of different chunks of data to support valuation opinion. Overall, respondents' approaches to valuation problem solving, as identified in the analysis of the results of the interviews, resembled analytical and reflective thinking processes, the goal of which varies from determining the quality of evidence to support valuation opinion to understanding the property being valued and making sure that the outcome of the valuation is right.

### **Analysis**

*"It's [valuation problem solving is] a data collection exercise, so we are as train folks collecting data on the property, collecting data on the market in which the property relates, umm, getting all the evidence that comes to us and weighting up the quality of that evidence to come to the opinion."* (EV2, Episode 3, Interview).

### **Reflection-in-action**

*"...you do, you very much stand back and look at now, you know you take stock of what property you are valuing, you take stock of the issues that are faced and you reason them through, either on your own given the experience that you've got, you liken it to a similar valuation that you've done in a different location – the building issues are exactly the same, it's just in a different location."* (EV4, Episode 5, Interview).

### **Reflection-on-action**

*"You don't jump into conclusion I think as quickly, you have the ability to draw on your experience of what happens, what else you've done in the past... in a rapidly changing market you've got to be careful that is not influencing your process but nevertheless if you've done a similar valuation recently, you can draw on that knowledge"* (EV2, Episode 5, Interview)

#### **4.5.1.3 Collaboration**

Collaborative problem solving provides another context within which knowledge and cognition are used in the process of reasoning through valuation task(s). Respondents frequently articulate valuation problem solving as a collaborative process with other colleagues, who possess different, but complementary, knowledge and skills required for judgement and decision making in valuation problem solving. This further reinforced the multidimensional nature of the knowledge base expert valuers used in valuation problem solving. In the following two quotes, respondents report engaging in collaborative process to widen up their scope of data search and determine appropriate valuation technique to adopt in dealing with valuation task problem(s)

*"Speaking with as many people as possible, umm, so it is not just doing a valuation in isolation but would involve colleagues in the investment teams, in the occupational teams etc. So widening the network of the data is helpful."* (EV2, Episode 4, Interview).

*"You've got to rely on the experience that your colleagues have got and also the working relationships that you have got with your colleagues to make sure that you can address or throw questions to them and get them to help you address a difficult question and it's not just a valuation technique, it's also on construction details."* (EV4, Episode 3, Interview).

Respondents also reported instances where they have used collaborative decision making as means of helping colleagues who are less competent and also as means of learning and gaining more experience from other colleagues who are more competent.

*"...we have a kind of big idea that, you know... and many other big firm, no valuation should ever be one person work. It should always involve more than one person. You know rarely it should have kind of different views and just choose the fact out of the best and is that process of actually discussing it, I think it tend to pass on the reasoning and decision making skills."* (EV1, Episode 6, Interview).

*"As a chartered surveyor...what you cannot obtain on day one is years of experience and the only way you're going to get experience is continuing to work in that field but whilst you're training in that environment you've got to suck up the experience that your colleagues have got in valuing similar property and the only way to it is to talk to each other and to come to a reasoned decision and to rely on that information that you have collated in order to report to the client."* (EV4, Episode 3, Interview).

*"When I was less competent obviously I relied on other people telling me their experiences in order to provide answers to the questions I'd got in my property. I'm now asking, I'm now being asked by my colleagues to give them help when they are trying to answer difficult questions to their own properties. So it's all about learning and holding that information really, and you can't take that away from me."* (EV4, Episode 5, Interview).

Thus, expert valuers interviewed continually increase their knowledge base, not only by thinking critically about their practice but also, by engaging in a collaborative problem solving with their colleagues.

#### **4.5.1.4 Professional practice**

The final context within which the interaction between knowledge and cognition takes place in valuation problem solving is professional practice. Respondents are

aware of the fact that their valuation problem solving needs to be guided not only by the limit of their own knowledge but also by the scope of their professional practice. Valuation problem solving was also reported as being influenced by ability to recognise the consequences of action or inaction.

*"So I think people get frightened – oh I've got to do a valuation and they want me to answer that particular question, well you answer it as far as you are limited to within your capacity as a chartered surveyor."* (EV4, Episode 3, Interview).

*"You are probably more aware of the issues behind the decisions now, what could go wrong if it is not looking quite right, your sort of understand the grey area in between more."* (EV2, Episode 5, Interview).

In their valuation problem solving process, respondents are quite innovative and sometime adopt the use of computer in their valuation problem solving; although this was less frequently articulated. One respondent, in relation to commercial property valuation, identified where the use of information technology may support valuation analysis and problem solving.

*"We use, depending on the type of valuation that you are doing, and if we assume commercial investment property valuation, we then normally do on the computer using a standard package we use are just for capitalization here but there are other similar packages that would do the cash flow for the valuation."* (EV2, Episode 3, Interview)

#### **4.5.2 Development of valuation problem solving skills**

How do expert valuers view developing valuation problem solving? The discussion below represents the contextual themes that contribute to an understanding of expert valuers' conception of the development of skills in valuation problem-solving.

##### ***4.5.2.1 Embedded and refined in practice***

The development of valuation problem solving by the expert valuers interviewed occurs in context, it is embedded in specific circumstances and in the context of practice. Respondents reported that doing a valuation job provides appropriate

avenues and activities to practice and develop their reasoning abilities. In other words, their development of reasoning is perceived as a consequence of their workplace activities such as undertaking and reviewing valuations as well as explaining the basis of ones valuation to clients. Teaching valuation problem solving was also reported as an effective way to develop reasoning.

*"Um, I think for me this [valuation problem solving] develops over time, by having to go through the process of first undertaking valuation and more and more checking other people's valuations. And I think that the two probably biggest influences in developing that skills I've had is rarely client challenging valuations and there is a bit of old adage that the best way to learn is to teach it and I think you have to keep talking through to the client this is how we have arrived at. This is why it kind of refines the reasoning and decision making skills."* (EV1, Episode 4, Interview).

*"[The development of valuation problem solving is] merely in experience...there's always a first time to do a particular valuation – there's always the first time you do an industrial unit and the first time you do an office building and the first time that you measure a building that hasn't got straight walls, er, and the first time you come across a building where it's empty and there are potential issues regarding the structural deficiencies of the building, the property which is leased and the lease doesn't make sense – every time you've got one you've got that experience within yourself to help address the challenges of the next one, but it's all about experience at the end of the day."* (EV4, Episode 4, Interview).

Also, the desire to take on new and challenging aspects of valuation practice was found to promote the development of reasoning. One expert valuer reported, as indicated in the quote below, having to consider doing something outside their scope of professional practice and to look at it and research into it.

*"...I think that, probably, one of the thing that I've always done a period of time is being happy to tackle new areas, to look at it and research and go into it to try and do something that I've never done before because I know that a number of valuers, um, there is this particular person like [name] that I worked with quite some years ago and she is very much will only do, she is very much good at what she does but she will only do what she does and will not branch out into any new areas. She is just no I am not doing that. I don't do that. And I think that if you have the attitude, you don't actually develop reasoning and decision making skills."* (EV1, Episode 5, Interview).



#### **4.5.2.2 Influenced by professional attributes**

Confidence and understanding emerged as significant professional attributes that drives the ability to develop reasoning. As respondents become more experienced, they perceived an improvement in their confidence level which reinforces correct reasoning. In the quotes below, expert valuers likened the development of reasoning to becoming more confidence in practice and having understanding of the various sources of information and issues that may affect the reliability of their use.

*"I think [the way to develop valuation problem solving is to be] confidence in just thinking that you have been doing this for 18 years, valuation for 18 years, I was pretty green and very cream when i started doing it. Umm, I think I haven't been on course to make me more decisive or anything like that. I think you just become more experience, more confidence, not over confidence hopefully or arrogant, and you just use your experience. You've had difficult factory or warehouse to value in the past, umm, and you can use that experience, apply that experience to other current problems. Judgment on the way and things you've done in the past, hopefully they were right, you've been doing it the right way all these years but, I think is becoming more confidence...and then the confidence comes from almost when the start to ask what you think as opposed to ask what they think. Is almost like you've made it because Andrew is come to ask me to value something and not the other way round, umm, which doesn't mean that you always got it right but that start to build as you get more valuations under your belt, you become more and hopefully more competent and more confidence of doing it at the same time." (EV3, Episode 4. Interview).*

*"[Developing valuation problem solving is an] experience-based thing but it based on not relying on only one piece of information, making sure that if you have got a selection of data that hopefully are saying similar thing. That is giving you confidence. Umm, understanding where your information is coming from and the issues that could go behind it, umm, so is it a special purchaser. These are some of the reason why a transaction is taking place. Is it a forced situation, having an understanding of what could have influence the transaction helps." (EV2, Episode 4, Interview).*

## **4.6 SUMMARY**

This chapter provides the descriptive and explanatory results from multi-level analysis of the empirical data. The application of both the conceptual and analytical frameworks developed in chapter 3 and 4 respectively help to reveal different cognitive processes actually used in commercial valuation problem solving, including the knowledge states, problem solving operators and strategies. As section 4.2 revealed, three broad categories of knowledge states comprising data analysis,

technique and self-generation were used by all subjects. Section 4.3 further revealed that eight types of conceptual operators were used to modify or create these knowledge states. These include data examination, data exploration, data explanation, hypothesis generation, hypothesis evaluation, discrepancy processing, meta-reasoning, and summarising. Section 4.4, also presented the results of the investigation regarding the general problem solving strategies that subject used to deal with problematic situation during the simulated valuation. Both expert and intermediate valuers were different from the novice valuers in terms of frequency of use of these cognitive processes and also in terms of how they were used in the valuation problem solving. The sub-section 4.3.1 also presented the qualitative analysis that form the basis of triangulating the cognitive processes revealed from the verbal protocol analysis of the simulated valuation.

Although each cognitive process provided a way to understand valuation problem solving, the synthesis of the findings emerging from the analysis of data help to conceptualise a model that describe the way the cognitive processes interact in valuation problem solving. This conceptualisation is a key theoretical contribution emanating from the findings of this research and is provided in the next chapter alongside a greater level of discussion of the findings in relation to extant literature and emerging theoretical explanation.

## **CHAPTER 5**

### **DISCUSSION**

#### **5.1 INTRODUCTION**

The previous chapter presented the findings resulting from the analysis of think-aloud protocols and interviews data. The findings helped to develop an understanding of the cognitive structures (in section 5.5) that identify and describe the knowledge states and cognitive processes (in the form of problem solving operators and strategies) valuers used in commercial valuation. The present chapter discusses these knowledge states and cognitive processes with references to further extant literature. The cognitive processes identified in this research have been identified by prior research in different domains of expertise and were summarised in Chapter 2. Therefore, the discussion of valuers' cognitive processes relies heavily on this previous literature. What is most notable about the findings in this research is not about the individual cognitive processes, such as problem-solving strategy, but rather the interactions of the processes, which provide the complex nature of valuers' problem solving. Importantly, this chapter also discusses how the cognitive processes were synthesised to develop cognitive structures of valuation problem solving.

#### **5.2 KNOWLEDGE STATES USED IN THE VALUATION TASK**

Knowledge states are what one thinks about or refers to during the course of performing a task. They are units of information or domain-specific knowledge that are recognised as potentially useful in problem solving (Azevedo et al., 2007; Hassebrock and Prietula, 1992). These might include, for example, property specific attributes (which could either be physical, legal, geographical and environmental), reference to valuation concepts, methods and other ideas that are self-generated. General discussion on the factors influencing value and which the valuer needs to consider is provided in Chapter 1 under section 1.5. The results of the analysis presented in sub-section 4.2 demonstrate that, similarly to the study of expertise in other subject domains, the content and organisation of knowledge states used in a

commercial property valuation task is significant in differentiating different levels of valuation expertise.

The analysis presented in the previous chapter revealed that the expert and intermediate valuers shared a fairly similar frequency of use of instances of knowledge states that they managed to generate during the valuation task, and that both generated and used instances of knowledge states more frequently than the novice valuers. A total of about 193 instances of knowledge states were referred to the expert and intermediate valuers while the novice valuers referred to only 56. This clearly showed both expert and intermediate valuers, given the practice and experience they have had, are more comprehensive in analysing the valuation instruction

Therefore, it could be inferred that the expert and intermediate valuers were rapidly able to develop a rich mental framework to integrate their knowledge with the circumstances of a specific property and the comparable information attributes, and to anticipate potential consequences through the conceptual operation they had utilised to carry out their valuation analysis within a short period of time. Consistent with other domains of expertise such as writing assessment (Barkaoui, 2007; Condon, 2009), this could be largely attributable to their practice, experience and a collection of conceptual and procedural knowledge that they have developed over time. It thus suggests, as argued by Hassebrock and Prietula (1992) that they were better at rapidly recognising pattern of knowledge states to augment the problem-solving operators utilised during the valuation problem solving task.

The results of the analysis further demonstrated that expert and intermediate valuers evaluated more throughout the task than the novices. It is obvious that they evaluate roughly three times as much as novices. This is consistent with other domains of expertise, such as mathematical problem solving (Schoenfeld, 1992) and engineering design (Ball et al., 1997) where the amount of evaluation has been established as an indicator of expertise. Expert and intermediate valuers did not only evaluate more than the novices, they did so with more and better evaluative criteria.

In particular, they were more likely to return to the valuation instruction statement to re-evaluate their analysis against standard criteria or given fact. They are also more likely to question the information in the valuation instruction and as such were more critical than the novices. This clearly demonstrated the nature of expert and intermediate valuers' analytical approach which appears to rely heavily on schema-based knowledge. The ideas that novices generated were mainly derived from the fact presented in the valuation instruction (i.e. primarily driven by script-based knowledge).

A further inspection of the analysis presented in Table 4.0.1 revealed that both the expert and intermediate valuers are more likely to generate their own ideas, based on knowledge and assumptions external to the valuation task than the novice valuers who tended to focus more on the contents of the instruction pack provided to the exclusion of other knowledge states. This, in essence, means that both the expert and intermediate valuers were more creative while novices appear shallow in their generating of ideas. Perhaps more importantly, the results also suggest, as in most domains such as physics (Larkin, 1981; Simon and Simon, 1978) and mathematics (Suto and Greatorex, 2008), that expert and intermediate valuers have greater and organised knowledge that facilitated problem recognition and the solution to the problem. Novices, on the other hand, lack the organisation of a schema and this accounted for their limited recognition of knowledge states.

In terms of knowledge states relating to valuation technique, a detailed inspection of the verbal protocols revealed that while the intermediate valuers appear to have referred to instances of this knowledge state more than the expert and novice valuers, expert valuers' use of valuation concepts and methods was richer because it also identified the strength and weaknesses of techniques.

## **5.3 COGNITIVE PROCESSES USED TO GENERATE KNOWLEDGE STATES**

In order to understand the cognitive processes in conducting commercial property valuation, a content analysis of the verbal protocols collected in the valuation task was conducted using the analytical framework developed in chapter 3. The findings of the analysis which were presented in the previous chapter are discussed in the following sub-sections.

### **5.3.1 Problem-solving operators**

Problem-solving operators, as previously defined in section 3.8.1.2 and 4.3 of chapters 3 and 4 respectively, are the inferred cognitive processes which, according to Hassebrock and Prietula (1992), modify an existing active knowledge state or produce a new active knowledge state. In other words, the problem-solving operators help to identify the knowledge and problem-solving behaviours that characterise problem solving in commercial property valuation.

The quantitative analysis presented in 4.3.1 of the previous chapter showed that the expert valuers used more problem-solving operators (18 types) than the intermediate and novice valuers who had used 14 and 10 types of problem-solving operators respectively. The analysis further showed that while there were no overall differences between expert and intermediate valuers in term of frequency of use, the novice valuers recorded far more less instances of problem-solving operators (66 times) as compared to both intermediate and novice valuers (193 and 192 times respectively). Therefore, it could be inferred that both expert and intermediate valuers had a rich and organised pattern of thought to represent the problem (Hassebrock and Prietula, 1992). The results presented in Table 4.0.2 clearly showed that the expert and intermediate valuers had used more-varied problem-solving operators as they exploit their knowledge to provide a deeper and richer interpretation of property and market information provided in the valuation instruction. As a result, they were able to provide quality valuation analysis.

In the qualitative analysis of the use of problem solving operators (see section 4.3.2 of Chapter 4), it was revealed that both the expert and intermediate valuers used meta-reasoning (a set of operators used by problem solvers to control their own thoughts) a great deal in their valuation analysis. This facilitates the process of planning strategies and goals for the valuation, and makes it possible to conduct it in a more-efficient way as specific relevant property and market information could be easily identified and diagnosed and the solutions generated during the valuation analysis could be evaluated and summarised more effectively. The novice valuers, on the other hand, constructed a representation of the valuation task in a slow, step-by-step manner which failed to explore the valuation in any depth after interpretation of some selected data cue in the instruction. The relative absence of meta-reasoning among novice valuers in the valuation analysis compares with all other expertise domains such as engineering design (Ball et al., 1997).

In their exploration of data, expert valuers often did not engage considerably in applying valuation procedures and techniques, suggesting a high degree of automaticity during performance of a valuation task. This is not surprising as novices are believed to rely on step-by-step approach to performing the task (Anderson, 1982; Beilock et al., 2002), during which poorly learned skills are “controlled by declarative knowledge that is held in short-term memory and attended step-by-step” (Beilock et al., 2003, p. 300). Experts, on the other hand, usually rely more on automatic processes during performance of well-learned skills, which are “supported by procedural knowledge that operates without the need for explicit or attended monitoring” (Beilock et al., 2003, p. 300).

## **5.3.2 Problem solving strategies**

### ***5.3.2.1 Problem finding and construction***

The analysis of the issues participants considered during the verbalisation of the valuation task shows that practical valuation problems are, as argued by Dillon (1982), emergent problems in that the problem solvers would have to find them by searching for their attributes. The findings reported in sub-section 4.4 show that the valuers recruited relied first and foremost on their initial interpretation of targeted

cues to identify information relating to possible problems from the valuation instructions, and the property and market information, provided. They then integrate the information with their pre-existing knowledge of the valuation domain to diagnose problematic valuation situations and to find and construct problem attributes and solutions. These findings are consistent with Dillon's theory of problem finding and solving.

Although there was no great difference in the number of problems found and constructed during the verbalisation of the valuation task by all subjects, expert and intermediate valuers' construction of problems was significantly detailed and focused; novice valuers' construction of problems was much less rich in details. The results further indicated that the ability of expert and intermediate valuers to find and construct problems was aided by knowledge organised in schema form while that of novice valuers was predominantly factual as they were less able to integrate their valuation knowledge with the information provided in the valuation instructions. As explained in section 2.4.2.1 of chapter 2, a schema in the present context is a structure of preconceived domain specific or general knowledge which can be activated during problem solving. Sweller (1990, p. 120) stated that a schema is "*a cognitive construct that allows problem solvers to recognise problems and problem states as belonging to a particular category requiring particular moves for solution*". This type of knowledge organisation is believed to have been instrumental to the way expert and intermediate valuers were able to find and construct problems that are richer than the novices did.

In addition, expert valuers and some intermediate valuers returned to change the construction of problems at times, indicating that they had kept those problems under review throughout the performance of the valuation task. These findings clearly indicate that, like in some other domains of expertise, the problems that valuers deal with during practical commercial valuations are complex and ill-defined (Frensch and Funke, 1995; Simon, 1973; Voss and Post, 1988). The following subsections discuss the strategies subjects used to find and construct problems.



### ***5.3.2.2 Disaggregation***

In finding and constructing problems during performance of the valuation task, all subjects appear to use a problem-solving strategy of problem disaggregation (Simon, 1973). Simon argued that one way of solving an ill-defined problem is to break it into a series of small well-defined problems. . In particular, the results of this study showed that where the domain knowledge is partially lacking, expert, intermediate and novice valuers solve a creative problem within their domain of expertise by dividing the problem into a number of sub problems that are dealt with systematically. The small problems are themselves ill-defined and, as such still had to be identified and constructed. This research did not, however, find any differences in participating valuers' use of this problem-solving strategy.

### ***5.3.2.3 Recognition***

In addition to the use of problem disaggregation, participating valuers also appeared to rely heavily on a universal problem solving strategy of recognition (Newell and Simon, 1972) rather than relying on normative step-by-step valuation process such as the one prescribed by the Appraisal Institute (1996), in finding and construction problems. Expert, intermediate and novice valuers all recognised that certain valuation principles, procedures or method could be applied in the actual valuation procedure. For instance, they all recognised the need to adjust the valuation opinion to reflect state of repair of the subject property. However, while intermediate and novice valuers were able to state only the principles, procedures and methods in general ways in most cases, expert valuers could provide more details either to justify the principles, procedures and methods identified or to demonstrate the strength and weakness of applying them in the specific valuation. Expert valuers also appear to be more proficient and can apparently recognise and resolve discrepancies of both the subject property and comparable attributes for the valuation task as a whole; intermediate and novices valuers often failed to recognise unusual situations beyond those that are explicitly stated in the valuation instructions. These differences, it is argued in this study, are due to expert valuers ability to use knowledge in a schema form, which enables them to recognise problem attributes and to recommend appropriate solutions (Chi et al., 1981).

#### **5.3.2.4 Means-ends analysis**

The findings reported in this study also indicated that expert, intermediate and novice valuers all appeared to work mainly forward, but sometimes switched to backwards search in constructing problems and solutions to problematic valuation situations. This is interesting and appears to contradict the position in expert-novice literature, which has established, in several domains of expertise, that experts tend to work forward while novices tend to work backward, using a means-end strategy (Hunt, 1989; Larkin et al, 1980a; 1980b; Chi et al., 1982). The widespread use of backward reasoning by all valuers categories in this research will suggest that the commercial-valuation task was, indeed, complex and ill-structured. Backward reasoning can, therefore, be associated with problem solving and, as the results of this study suggest, is more likely to be attributable to complex and ill-structured tasks rather than to just novices *per se* (Groen and Patel, 1991). This finding is further reinforced in Elstein et al. (1978) where experts were reported to use more forward and backward reasoning than novices.

Although all subjects appear to mainly work forward, the results in Table 4.3 indicate a slight increasing use of forward reasoning with increasing level of expertise. Sweller (1991) maintains that the ability of experts to work forward is mainly as a result of their schema-based knowledge while Charlin et al. (2000) are of the opinion that knowledge in the form of illness scripts usually enables medical practitioners work forward in order to diagnose diseases. The findings of this study did not directly support either of the two phenomena. The former explanation, however, appears consistent with the findings in this study that expert valuers use schema-based knowledge in their problem solving. A further explanation for the increasing use of forward reasoning could be that expert valuers do have an extensive, highly-organised knowledge base which permits more-rapid recognition and rapid schema triggering than less experienced (intermediate and novice) valuers who lack a coherent and inter-connected knowledge base (e.g. Lesgold et al., 1981; 1988).

## 5.4 MAPPING OF THOUGHT PROCESSES

This section provides the sequence of thought of expert, intermediate and novice valuers using event-sequence analysis. In particular, the problem-solving operators for each subject group were organised in sequential order to distinguish the pattern of thought between the three groups of valuers. Figure 5.0.1, Figure 5.0.2 and Figure 5.0.3, below, represent, respectively, expert, intermediate and novice valuers' transitional state diagrams used in analysing patterns of reasoning during performance of the commercial valuation task. These transitional state diagrams were obtained through Jeong's (2005) Discussion Analysis Tool. Nodes represent the research's categories of problem-solving operators and the varying sizes of shadow/glow reflect the node's frequency. The arrows linking these nodes represent the direction and strength of the interaction between the problem-solving operators; the lines are coloured grey if probability is not significantly higher than expected. Numbers in the diagrams represent the probability of one category of problem-solving operator being followed by another. For instance, in the expert valuers' state diagram, the probability of hypothesis-related operators being followed by data-exploration operators is 25%.

The patterns of sequences of thought of expert valuers suggest that they engaged in interpretation (i.e. data examination and exploration: 34% of segments of their protocols were categorised as data examination (24%) and data exploration (10%)) and evaluation of their reasoning process (i.e. meta-reasoning: 43%). Expert values' data examination or exploration is more likely to be followed with meta-reasoning related operators (39% and 55% respectively). Once engaged in meta reasoning related operators, they spent more time in this process (54%) and are more likely to revisit the data they had examined (23%) for further exploration (13%). Data explanation was mainly preceded by data examination and more likely to be followed by meta-reasoning (36%) or re-examination of data (36%). During the valuation exercise, expert valuers also relied on self-generated ideas in the form of hypothesis (8%) which are more likely to be followed by operators of the same category (25%) or justified through examination or exploration of selected data cue (19% and 25% respectively).

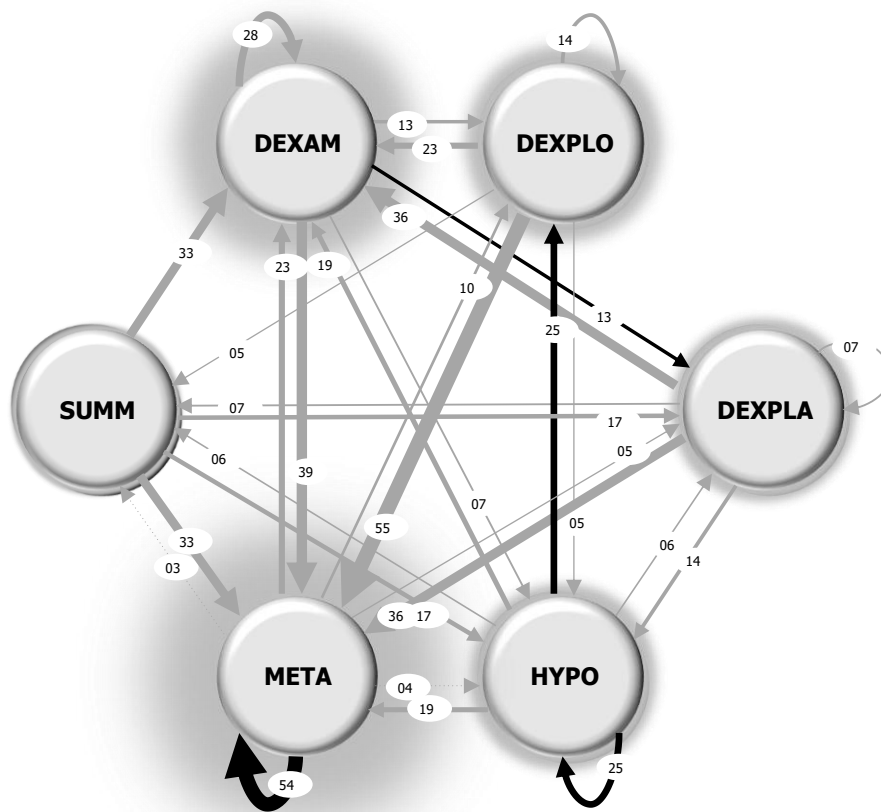


Figure 5.0.1 Transitional state diagram of expert valuer sequential problem solving operators in valuation

DEXAM = Data Examination, DEXPLO = Data Exploration, DEXPLA = Data Explanation, HYPO = Hypothesis, META = Meta Reasoning, SUMM = Summarisation

The patterns of sequences thought of intermediate valuers were centred on interpreting data (i.e. data examination and exploration: 40% of segments of their protocols were categorised as data examination (17%) and data exploration (23%) and evaluating their reasoning process (i.e. meta-reasoning: 45%). Contrary to the expert valuers, the intermediate valuers appear to have spent more time interpreting data but once they have examined or explored the data in full, they are more likely to follow this by meta-reasoning operators (33% and 48% respectively). Similarly to the expert valuers, the intermediate valuers' used hypothesis operators to generate ideas/solution to challenging valuation problems and are more likely to follow this by meta-reasoning (43%) or exploration of data (29%) in support of their ideas/solutions. Overall data explanation was rarely used (percentage was based on only four protocol segments) but was mainly preceded by data examination (7%)

and more likely to be followed by meta reasoning (50%), re-examination of data (25%) or further exploration of data (25%) to justify their explanations.

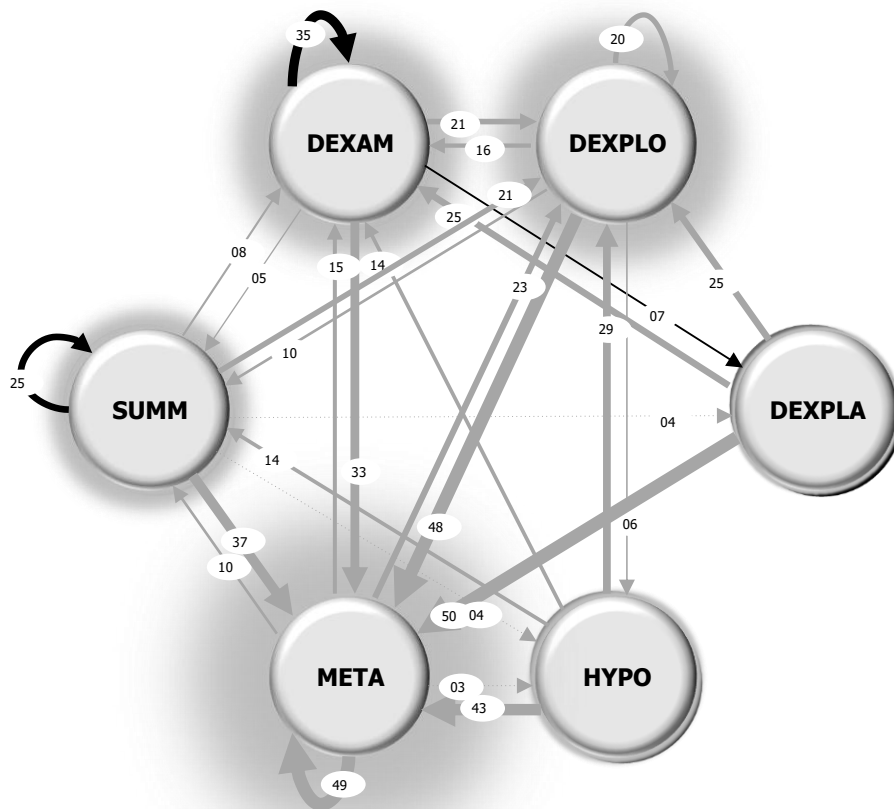


Figure 5.0.2 Transitional state diagram of intermediate valuer sequential problem solving operators in valuation

DEXAM = Data Examination, DEXPLO = Data Exploration, DEXPLA = Data Explanation, HYPO = Hypothesis, META = Meta Reasoning, SUMM = Summarisation

The patterns of sequences thought of novice valuers were centred on data interpretation and evaluation of reasoning process; also, hypothesis generation was rarely used. Contrary to both expert and intermediate valuers, more than 50% of their verbal protocols were categorised as data examination and exploration. Once engaged in data examination or data exploration, they spent more time in the process (41% and 38% respectively) and were more likely to follow their examination or exploration with meta reasoning (36% and 31% respectively). Similarly to the intermediate valuers, the novice valuers rarely use data-explanation operators (the percentage was based on only four protocol segments) which are mainly preceded by data examination (18%) and more likely to be followed by meta-

reasoning (25%), re-examination of data (50%) or further exploration of data (25%) to justify their explanations.

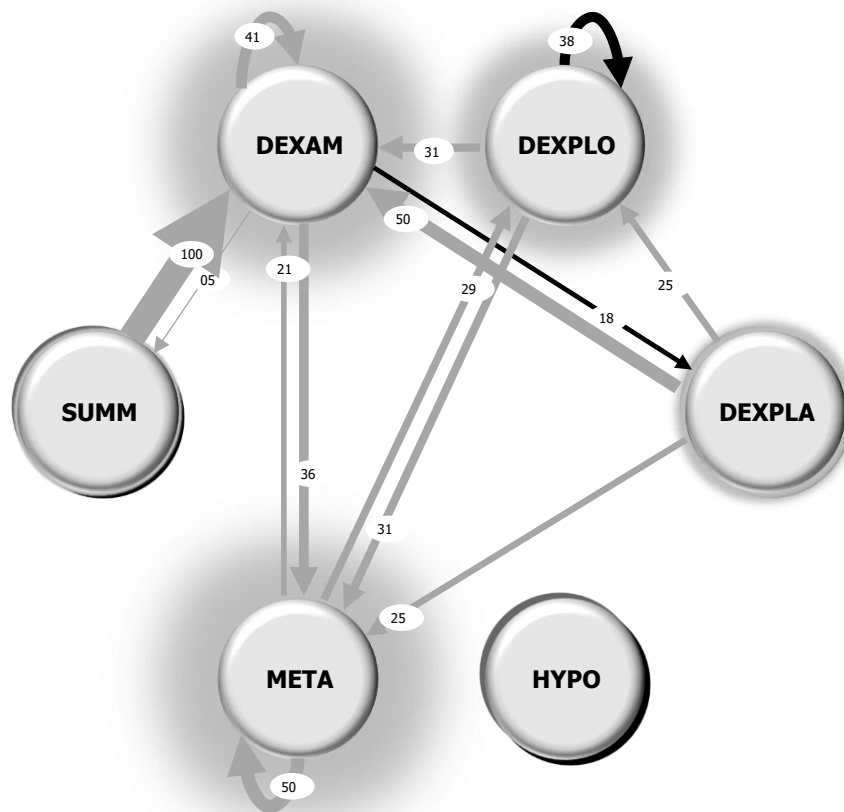


Figure 5.0.3 Transitional state diagram of novice valuer sequential problem solving operators in valuation

DEXAM = Data Examination, DEXPLO = Data Exploration, DEXPLA = Data Explanation, HYPO = Hypothesis, META = Meta Reasoning, SUMM = Summarisation

Overall, the analysis presented above seems to suggest that both expert and intermediate valuers had structured thought-processes which demonstrate more cohesiveness and interrelatedness between problem-solving activities. These findings are also consistent with previous studies that have investigated expert novice differences in terms of their cognitive structures (e.g. Chi and Koeske, 1983; Le Maistre, 1998; Perez et al., 1995; Villachica et al., 2001). In Perez et al. (1995), for instance, the authors argued that one of the fundamental differences between expert and novice instruction designers was the structure of the understanding they demonstrated in relation to the design problem they were asked to solve. Expert designers established more complex interconnectedness between entities of the problem as compared to novices who had a few linkages. The present research also

confirmed that novice valuers' structured processes of solving the valuation problem showed fewer linkages between problem-solving operators, which may suggest underdeveloped cognitive structure or quick disengagement from task. In addition, the results of the analysis indicate that, although expert, intermediate and novice valuers show a pattern of thought revolving around data interpretation and meta-reasoning activities, expert valuers spent more time than the intermediate and novice valuers did on the latter, scheduling valuation analysis or establishing valuation strategies, diagnosing previously acquire information to update the outcomes of their past valuation problem solving. These findings are also consistent with findings of previous studies (e.g. Beilock and Carr, 2001; Beilock et al., 2002; Kitsantas and Zimmerman, 2002; McPherson and Kernodle, 2003; Thomas and Over, 1994) which have established that experts demonstrate better planning, goal setting and self-monitoring and evaluation than novices.

Although the results of the event-sequence analysis presented in this section provide useful insights on valuers' cognitive structure in valuation problem solving, the transitional state diagrams represent only the pattern of sequence of the problem-solving operators deployed in the valuation task. It was, therefore, necessary to develop a more unified cognitive structure which integrates the three semantic elements (knowledge states, problem-solving operators and strategies) derived from the verbal protocol analysis was essential in providing a deeper understanding of how valuers develop cognitively. The next section discusses how this was achieved in this research

## **5.5 DEVELOPMENT OF EXPERT VALUER COGNITIVE STRUCTURE**

As argued earlier in section 3.8.1.2, three types of protocol representation: (a) knowledge states, (b) problem-solving operators and, (c) problem solving strategies (Hassebrock and Prietula, 1992; Newell and Simon, 1972) fostered an understanding of valuers' cognitive development in valuation problem solving. The previous sections separately discussed each of these representations in relation to the findings presented in the previous chapter. This section illuminates how the synthesis of the

findings led to the development of a descriptive model of expert-valuer cognitive structure.

A cognitive structure, in the context of this study, is a functional abstraction of the commercial valuation task given to the valuers which provides a deductive framework of cognitive processes for carrying out commercial valuation. The descriptive model of expert-valuer cognitive structure was developed using a synthesis of the results presented in sub-section 4.4 (related to the valuers' construction of problem and solutions) and their use of knowledge states, problem-solving operators and strategies. The model is hypothesised to be a qualitative description of how an expert valuer cognitively carries out commercial valuations and, entail and integrates knowledge state, problem-solving operators and strategies used to analyse and interpret data and to make market inferences. The expert valuer model of cognitive structure developed from this study is shown in Figure 5.0.4 below.

The intermediate and novice valuers' models follow the same structure but differ in terms the emphasis given to the use of knowledge state and problem solving operators during the valuation process. The expert model of cognitive structure developed in this study is also a problem representation of undertaking a commercial valuation task. This, according to Newell and Simon (1972), enables a problem solver to actively acquire information, make inferences, anticipate solutions and develop plans for future decision making. Qin and Simon (1995) also maintained that a mental model provides a source of information based on which predictions and inferences can be made. These processes, it is argued in this study, were embedded in the problem-solving behaviours of valuers as they make use of various problem solving operators and strategies while integrating their prior knowledge states with relevant data cue to conduct a commercial-valuation task effectively.



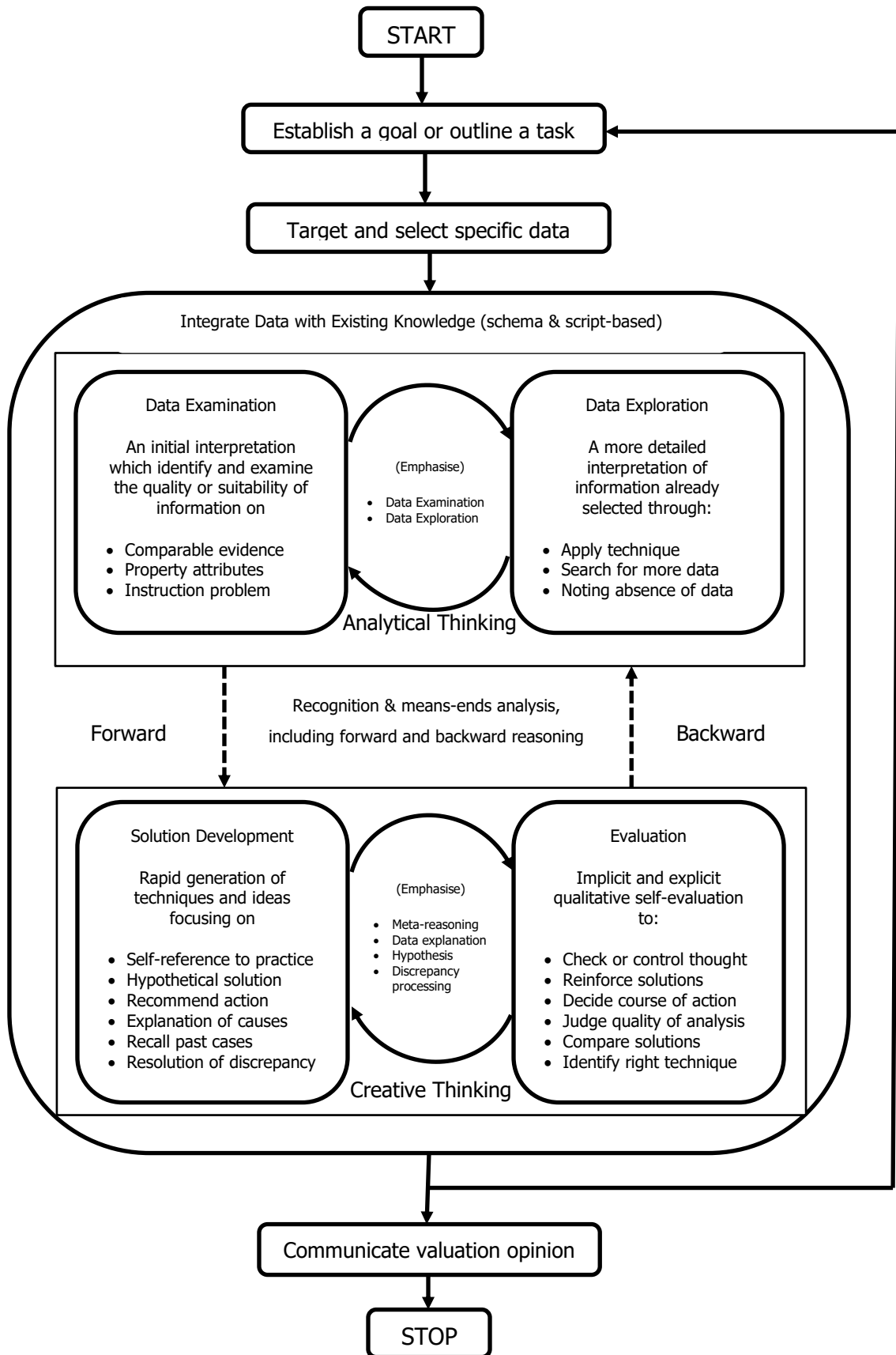


Figure 5.0.4 A descriptive model of expert valuer cognitive structure

The model presented in this study shows that, where available data is inadequate, valuers solve a valuation problem by dividing the problem into a number of sub-problems that are solved by engaging in two main types of thinking: analytical and creative thinking. Analytical thinking involves sequential processes acquiring information, evaluating the information and specifying further analysis or searching for more information. At this level, the valuer aim is to provide detailed interpretation of the valuation instruction alongside property specific and comparable evidence in order to identify problem attributes and to choose which comparable property was best to use to infer market price. Creative thinking, on the other hand, involves the sequential process of developing and evaluating solutions. These two processes continue in successive interactions until the valuer has reached valuation opinion and are connected through the use of forward and backward reasoning. In addition, they are preceded by an established goal, which, at the initial stage of carrying out the valuation, might be to determine whether there are inconsistencies in the information provided.

In several other cognitive studies in which rationality is either the central focus or is explicitly implicated in the task (such as a commercial-valuation task), differences in analytic cognitive thinking have shown to be a major determinant of expertise (Stanovich and West, 1998; Stanovich et al., 2000; Toplak et al., 2011). A necessary condition for this type of thinking is one's ability to utilise the necessary problem solving operators (Stanovich, 2004; 2009a; 2009b) which in this case involves obtaining and critically interpreting instructional information including property and market data in order to selectively identify relevant data cues that will form the basis of the valuation opinion. However, it is clear from the results of this study that the ability to reason analytically is not enough to make better decisions in commercial-valuation cases. A valuer must be creative and, in particular, develops effective solutions in challenging and problematic situations. Weisberg (2006) has demonstrated that this type of thinking is a necessity of expertise and that is somehow explained by domain specific knowledge

In terms of differences among subjects, the model showed that both expert intermediate valuers focused mainly on comparable- followed by subject-property attributes while engaging in the analytical thinking process of integrating data with their pre-existing knowledge. On the other hand, novice valuers appear to prioritise subject property attributes, followed by comparable evidence, in their interpretation. The problem-solving operators show that both intermediate and novice valuers prioritise data exploration, which includes applying, searching for and noting absence of data.

While engaged in creative thinking, the expert mental model shows that the experts valuers developed more and richer solutions including self-reference to own valuation practice or method, followed by hypothesis generation, recommending further action or investigation, explaining causes or defects, recalling previous valuation cases and resolution of discrepancies or inconsistencies in the information provided. In terms of the problem-solving operators they deployed, the model shows that that the priority list of expert valuers includes meta-reasoning, followed by data explanation, hypothesis and discrepancy processing. Apart from discrepancy resolution, the intermediate valuers also developed the same types of solution but in different priority order. The novice mental model, on the other hand, shows that the valuers prioritised recommending further actions or investigations, followed by self-reference and explanation of causes and defects using meta-reasoning and data-explanation problem-solving operators. They could not recall any previous valuation cases or generate hypothesis like both the expert and intermediate valuers did.

The differences in model of expert and intermediate valuers on one hand and the novice valuers on the other is consistent with other expert and novice comparison researches (Le Maistre, 1998; Boshuizen and Schmidt, 1992; Chi and Koeske, 1983; Mitchell and Unsworth, 2005; Perez and Emery 1995; Chi et al., 1981; Chi, et al. 1982; Perez et al., 1995; Randel et al., 1996) which have found differences in the structure of knowledge and information acquired by subjects of different levels of expertise. In the study of Le Maistre (1998), for instance, expert instructional designers' design was characterised by well-organized instructional design knowledgebase as they were performing the same task with the novices. Another

consistent study of Chi and Koeske (1983) found that a person of high knowledge-level demonstrated more cohesiveness and interrelatedness in the structure of knowledge and information acquired. The present study found that the expert and intermediate valuers' cognitive structure demonstrated more thorough and comprehensive than the novice valuers' mental model which appears very shallow.

## 5.6 CORE DIMENSIONS OF EXPERT VALUER PROBLEM SOLVING PRACTICE

How do expert valuers view valuation and problem solving? The operational model (shown in Figure 5.0.5 below) represents the four dimensions of the expert valuers' conception of the core processes that occur, and are central to, valuation problem-solving based on the data analysis presented in section 4.5.1 of the previous chapter. Thus, the model provided the wider context which justify and validate the significance of the cognitions in valuation problem-solving.

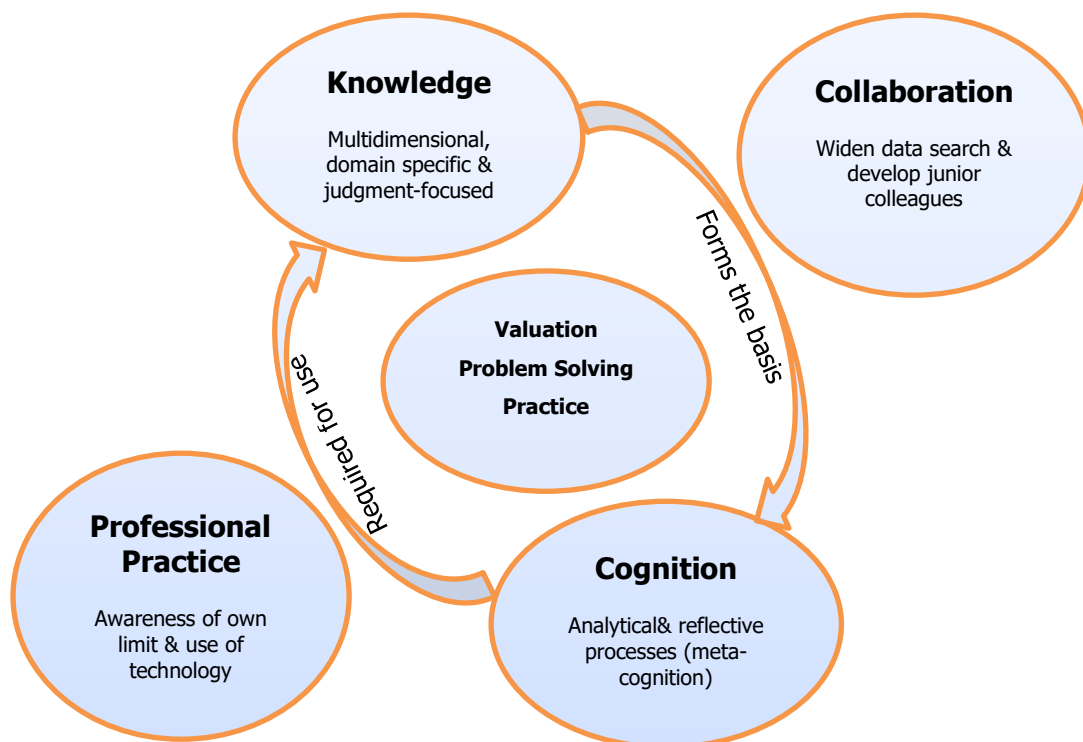


Figure 5.0.5 Operational model of expert valuation problem solving

At the centre of the model presented in Figure 5.0.5 above is the valuer's conception of valuation problem solving practice which emerges from the four dimensions. The first part of the model shows that valuation problem solving is not contextually free; it is always supported by knowledge and cognition. Thus, knowledge and cognition are the two main attributes that are inherent in valuation problem solving. These two components have also been established as central to reasoning and problem solving in many domains of expertise such as in the health professions (Higgs et al., 2008). The link between knowledge and cognition is the expert values' conception of the nature and development of valuation problem solving, with collaboration and professional practice providing some of the context in which the link takes place in the second part of the model. A discussion of each aspect is further provided below.

As reported in literature, expert ability to solve problems is due, in part, to their extensive domain knowledge which they are able to quickly recall and deploy (Ericsson and Lehmann, 1996; Feltovich et al., 2006; Glaser and Chi, 1998). In solving a valuation problem, valuers use their knowledge which is multidimensional and dynamic. The knowledge valuers use, in common with other experts, can be considered as being of three distinctive types: theoretical knowledge (general knowledge on valuation including valuation-based concepts, principles and methods), experiential knowledge (knowledge gained from practice including experience of past cases and methods) and personal knowledge (knowledge intrinsic to individual valuers which are rarely discussed or written down). These classifications bear some similarity to those given by Anderson (1982) and Eraut (1994). The use of knowledge, as evidenced in the analysis provided in section 4.5, is oriented towards judgment. Thus, in solving valuation problems, the valuers use their knowledge to form a judgement which in turn is used as the basis of making decisions about appropriate action to deal with a valuation problem. In comparable evaluation, for instance, the valuer uses the knowledge of the local market to identify appropriate comparable properties to compare against the subject property. The judgment formed by the valuer is used to weight up the quality of the comparable evidence to support valuation opinion.

As demonstrated in section 4.2 of the previous chapter, all the types of knowledge identified above: theoretical, experiential and personal knowledge had been applied by valuers in their valuation problem solving. However, some expert novice differences were noted in the verbal protocol analysis of the simulated valuation with experts recalling and using more (different) types of information, which indicated that they had a greater knowledge of the valuation domain concept, principles and methods than the intermediate and novice valuers. This is consistent with previous literature which has established that the knowledge subjects bring to bear in problem solving is one of the fundamental difference between experts and novices (e.g. Ericsson, 1996; Sternberg and Horvath, 1995).

Although experts require the use of a multidimensional knowledge base in practice, cognitive processes (as shown in Figure 5.0.5 above) are essential for knowledge to be effectively utilised in valuation problem solving. Experts, according to the body of literature on the development of expertise presented in chapter 2, exhibit more efficient (different) methods of cognitive processes (e.g. Cannon-Bowers and Bell, 1997; Etringer et al., 1995; Hoffman, 1998). Lynton (1990, p. 18) argued that critical thinking and other aspects of higher order procedures enable experts to:

*"recognise the many different factors which affect a given situation, to discover what the real problems are, to identify available options and trade-offs involved in each, to recognise the limits of what can be accomplished, and finally to make choices and compromises"*

Based on the results of the analysis presented in section 4.5.1 of the previous chapter, expert valuers emphasised analytical and reflective thinking processes as crucial in valuation problem solving. These processes were also evidenced in the verbalisation of the simulated valuation task and were used by experts to integrate the data gathered with existing knowledge (see Figure 5.0.4 above).

The second part of the model revolves around the understanding that valuation problem-solving is further supported by collaborative processes and professional practice. Collaboration with colleagues was emphasised as a vital process of obtaining and sharing professional knowledge and skills required for effective

valuation problem solving. Also the valuer needs to be guided by the scope of his/her professional practice and use decision aid where necessary. The analysis of the simulated valuation did not provide any evidence to support this second part of the model which may suggest that the verbal protocol analysis, as a method of data collection, may not be able to capture certain higher-order procedures used in problem solving.

## **5.7 SUMMARY**

This chapter has discussed the empirical and theoretical contributions of this research in relation to understanding the research problem: "How do valuers develop and utilise their cognitive expertise in commercial valuation problem solving?". The knowledge states that valuers prioritised in valuation problem solving and cognitive processes used to create or modify them are discussed. A further analysis and synthesis of the empirical data also led to the mapping of thought processes and development cognitive structure, which together provide a mechanism for understanding how valuers solve valuation problems. The chapter also discussed the results of the interviews that provided the triangulation and support to the development of the cognitive structures. The next chapter provides a conclusion to this research.

## **CHAPTER 6**

### **CONCLUSIONS**

#### **6.1 INTRODUCTION**

This chapter commences with an overview of the research, providing an explanation of how the research problem and questions were addressed in this research. It then summarises the research's findings and identifies the research's implications for valuation training and education. Consistent with the nature of exploratory research, some limitations in the methodology of this research were identified (see section 3.11) which, in many instances, may inform the direction of future research. Thus this chapter goes on to identify the matters for future research.

#### **6.2 OVERVIEW OF THE RESEARCH**

The previous chapters have presented the research that contributes towards the understanding of the problem of how valuers develop their cognitive expertise in commercial valuation practice. The need to address this problem stems from the fact that valuers cognitions have not been sufficiently recognised in valuation literature. The research addressed two key research questions; what are the knowledge states and cognitive processes used in commercial valuation problem solving and how might we understand the use of these knowledge states and cognitive processes in valuation problem solving? These questioned were addressed by employing Cognitive Task Analysis to collect and analyse empirical data using verbal protocol analysis of a simulated valuation exercise and interviews with some valuers working in commercial valuation practice in Birmingham, UK.

The literature relating to the development of expertise was discussed from both experiential and cognitive psychology perspectives. The literature review identified a range of possible factors influencing the development of expertise. As explained in section 2.3, these factors view the development of expertise as a consequence of two broad processes: (1) learning from experience, and (2) cognitive process. Both processes are viewed in the existing body of literature as complementary in



understanding how expertise develops; although the theoretical framework of this study was based on cognitive theories of expertise and problem solving. Some methodological issues, such as the need for both theoretical and empirical understanding of the complex phenomenon of expertise from a pluralistic approach, were also highlighted in the chapter.

Accordingly, Chapter 3 then presented an analytical framework with which to collect and analyse empirical data. This framework was guided by Critical Realism theoretical perspective which allows for identification of different knowledge states and cognitive processes and construction of how they interact in commercial-property valuation problem solving. This chapter also described the research design, including the Cognitive Task Analysis adopted as the most-appropriate approach to investigate the research questions. The Cognitive Task Analysis offered a way of delineating how experts use the skills developed to solve complex problems. In particular, it is a methodological approach capable of identifying the knowledge problem solvers encode into schema and model and how they have operationalised this knowledge.

Chapter 4 presented the findings emanating from a systematic application of the theoretical, conceptual and analytical frameworks to analyse the empirical data. This resulted in a successful identification of both knowledge states and cognitive processes pertaining to the commercial valuation problem-solving context. Chapter 5 discussed the key knowledge states and cognitive processes from examining the data through a pre-determined coding scheme and synthesised them into (1) a pattern of thought processes, and (2) a descriptive model of cognitive structure. Together, the pattern of thought processes and model of cognitive structure help to foster an understanding of how expert valuers solve problems and the key differences that exist between them and other valuers who are less competent. The real value of the model constructed was shown to be in its integrative nature of fostering the development of the conceptualisation of values' cognitive structures. Thus the findings presented in Chapter 5 were the insights provided from the interaction of knowledge states and cognitive processes which led to the development of valuers' cognitive structure. Chapter 5 also considered the research validity by triangulating

the elements of the model with the results of analysis of the data obtained from the interviews with expert valuers. The next section summarises these key findings from the empirical data as reported in Chapter 5

### **6.3 SUMMARY OF FINDINGS FROM THE RESEARCH**

The research questions posed in this research: What are the knowledge states and cognitive processes used in valuation problem solving? and How might we understand the use of these knowledge states and cognitive processes in valuation problem solving?, were answered through mapping the thought processes and the development of cognitive structure, which together have helped in understanding the research problem of how valuers develop and utilise their cognitive expertise in commercial valuation problem solving. Therefore, the findings reported in this section are based on the valuable insights gathered from mapping the thought processes and the development of cognitive structure.

#### **6.3.1 Mapping of expert valuer thought processes**

Based on an event-sequence analysis, the content and patterns of sequence of thought of valuers of varying expertise levels were identified and compared in sub-section 5.4 in Chapter 5. The transitional state diagrams of the expert and intermediate valuers show cohesive and interrelated patterns of thought characterised by data-interpretation activities (i.e. data examination and further exploration) and meta-reasoning activities used initially to schedule valuation analysis or establish valuation strategies, re-interpret and diagnose previously acquired information and to update the outcomes of their past valuation problem solving. Although novice valuers demonstrated the same pattern of reasoning, frequencies of linkages were very low. Thus, in the discussion presented in sub-section 5.4, it was noted that the fewer linkages demonstrated by the novice valuers relative to expert and intermediate valuers may suggest underdeveloped cognitive structure or quick disengagement from task.

In terms of the use of the problem-solving operators represented in the transitional state diagrams, the discussions presented in sub-section 5.3.1 indicate that both expert and intermediate valuers had used more-varied problem solving operators, which had helped them to produce deeper and richer interpretation than the novice valuers did. This further re-inforced the earlier suggestion that a novice valuer may have an underdeveloped cognitive structure. Similarly, and in common with domains of expertise such as engineering design (Ball et al., 1997), there were relatively fewer instances of use of meta-reasoning operators among novice valuers in their valuation analysis.

Therefore, it can be concluded that novice valuers need to develop more-complex and deeply structured cognitive processes, including greater proficiency in the use of meta-reasoning as a way of enhancing valuation problem solving.

### **6.3.2 Development of expert valuer cognitive structure**

The transitional state diagrams presented in sub-section 5.4 of Chapter 5 represent the patterns of sequence of thought processes (or problem-solving operators) that valuers use during the verbalisation of the simulated valuation task. Thus, a more-unified cognitive structure that integrates the three semantic elements (knowledge states, problem-solving operators and strategies) derived from the verbal protocol analysis was developed in sub-section 5.5 in order to provide a deeper understanding of how valuers develop cognitively.

The data represented in this model shows that, regardless of the level of expertise, valuers engage in two main types of thinking: analytical and creative thinking. These two levels of thinking enable the valuers to integrate available data with their existing knowledge through recognition and means-ends analysis, including forward and backward reasoning strategies. The data also shows differences in the way experts and novices use cognitive processes with the expert and intermediate valuers being more fluid, thorough and comprehensive than the novice valuers.

The findings also indicate that when engaged in analytical thinking, expert and intermediate valuers use more knowledge states that focused on market-related data. Novice valuers, on the other hand, appear to prioritise property related data in their analysis. Therefore, it can be concluded that the expert valuer, as in other domains of expertise, are able to deploy their domain-specific knowledge effectively. It also means that market-related concerns need to be dealt with first before focusing on property-related features. Expert and intermediate valuers, through the creative thinking process, are also able generate more (and richer) solutions to challenging valuation problems and these were more likely to be immediately followed by evaluation or explanation of data to justify the solutions generated. Novice valuers could not generate solutions to challenging problems which suggest that their valuation analysis was more superficial.

## **6.4 IMPLICATIONS OF FINDINGS FROM THE RESEARCH**

The findings from this research have a number of implications. These are presented in two sections related to valuation professional education (both at the University and in the workplace), and professional development of experienced and new valuation professionals.

### **6.4.1 Implications for professional entry education**

The findings from this research have implications for teaching and learning of valuation both at the University and in the workplace, especially when undergoing Assessment of Professional Competence (APC) training or industrial placements. The present research has revealed that, in comparison with novice valuers, expert valuers have rich cognitive structures which emphasises the need to be highly proficient in meta-reasoning skills and problem-solving strategies such as recognition and means-ends analysis in order to be able to transform knowledge, deal with problematic valuation situations, especially when domain knowledge is lacking, and to monitor and evaluate ones reasoning effectively. This, therefore, creates a gap in student cognitive development which valuation education may have to address by embedding in University curricula explicit learning and teaching approaches that

promote the application of meta-reasoning ability and problem solving strategies in valuation problem solving and decision making.

Thus explicit teaching of valuation problem solving and the role of cognitive processes in the current valuation education curricula is a significant implication of this research. This will require a shift from the didactic teaching strategies (which emphasise teaching of information such as fact, concepts, principles and theories) to experiential learning methods which expert valuers articulated as forming the basis of the development of their problem-solving expertise (see sub-section 4.5.2.1). Problem-based learning is one such experiential learning method that can facilitate a collaborative learning environment where students are able to (re)construct knowledge that is integrated and applied (Sefton, 2001). This can be achieved by designing of a learning environment that create opportunities for students to actively engage with each other and a valuation. With this method, learners would be able to develop meta-reasoning skills and problem-solving strategies by interpreting and solving new problems, making plans, linking existing knowledge with new plans, generating ideas and monitoring their own activities. From the results presented in sub-section 4.5.2.1, reviewing other people's valuations and explaining their own derivation of valuations to others can be added to this list.

However, the use of problem-based learning may not necessarily lead to the development of meta-reasoning processes because cognition is rapid and situated in context. Hence, it is arguable whether learners can actually develop and use these processes while they lack the experts' experience and knowledge. In addition, the context of problem-based learning in the classroom is normally different from the context of valuation practice. As shown in this present study, a major component of valuation expertise is the implicit, tacit information learned from being in the real world observing experienced valuer. Thus, to be effective, problem-based learning need to be designed in such a way that it will mimic the professional practice environment.

### **6.4.2 Implications for professional development**

New graduates would also benefit from recognising the nature of cognitive structures that represent valuation problem-solving behaviour in practice. Established problem-solving operators and strategies form the structure used to interpret data, make market inferences and generate solutions whenever problematic situations are faced. Valuation professionals should be aware of the role of these cognitive processes and their linkages as requirements to perform valuation well under a wide variety of conditions. In this way, they can make conscious effort to pursue quality assured personal development.

The present research also uncovered the various types of knowledge that guide and inform valuation problem-solving in practice and the context in which they are developed. In particular, the value of self-directed learning, learning from professional practice and reflecting on personal valuations can benefit new graduates in developing their valuation expertise. Additionally, the knowledge generated from engaging in challenging valuation tasks and through informal discussions about the basis for derived valuations with more experienced colleagues and clients, are also valuable for informing valuation problem solving.

Consistent with other researches in the domain of medicine (such as Boshuizen and Schmidt, 2000; Edwards et al., 2004; Elstein et al, 1978), it can be inferred from this present research that there is no one generic problem-solving strategy; this is dependent on individuals' level and structure of knowledge. This has implications for valuation practice in the sense that valuation practice cannot simply be based on standards that prescribe the guidelines and protocols to follow in a well-defined valuation scenario. This is because, valuation problems are often ill-defined, and valuers may have different approaches of constructing a solution to the problem. Therefore standards should only act as a guide for actions. Close interpretation of the property and market conditions alongside ability to generate solutions in problematic situations are necessary for effective valuation problem solving.

## **6.5 LIMITATIONS AND FUTURE RESEARCH OPPORTUNITIES**

As with most research, the findings of this present research need to be interpreted in relation to methodological limitations as noted in sections 1.6 and 3.11 and addressed below.

One of the methodological limitations that are often considered by researchers, especially the positivists, is the non-generalisability of the findings from qualitative research. The realist ontology was chosen as a framework to inform this research because of its suitability and congruent with the research phenomena: valuers' cognitions in commercial valuation problem solving. In this philosophical stance, emphasis is not on generalisability of findings but rather on description of entities from individual experiences and explaining the causal mechanisms that generate them (Lopez and Potter, 2005). This limitation necessitates caution to be exercised in the interpretation of the findings. Thus, instead of generalisability, a key important indicator of the quality of this research should be transferability. In particular, given the fact that many of the cognitive processes identified have been noted in other domains of expertise implies that these research findings may be transferable to a broader population of valuation professionals.

There were several areas of delimitation in this research. First, the research focused on the area of commercial valuation practice resulted in deliberate exclusion of valuers working outside this setting (e.g. rural and residential). Valuers' cognitions are likely to be sufficiently different in these fields to warrant separate in-depth investigation on their own right. Second, it is anticipated that investigation of valuers with no familiarity with the market (Birmingham, UK) would add a further element of complexity. This dimension of investigating valuers' cognitions was excluded from this research. Third, this investigates valuers' cognitive processes and structures using one valuation problem and few research participants (six participants). Arguably, this may have accounted for the nonsignificant differences observed in the use of some of the cognitive processes reported in the research. Therefore, further research projects that involve more than one valuation case with larger participants may be needed to test this proposition.

The fourth delimitation resulted from using the expert-novice comparison approach. This approach helped to identify and describe gaps in the cognitive structures of the novice valuers. However, there would be value in future research focusing on expert valuers in order to shed light on how they have developed their cognitive ability from novice to expert based on a reflection of their own journey, practice and experiences. Fifth, cognition is a complex multidimensional and context-dependant human phenomena, in which the journey towards its development is shaped by many other complex and intrinsic factors, including intuition and tacit knowledge. This present study did not seek to interpret or understand the role played by these factors in the cognitive development of expert valuers. Thus, to further our understanding of the dynamics of valuers' cognitive development, investigation of the impact of 'tacit knowledge' would be of value. Additionally, studies investigating the impact of valuers cognitive structures on valuation outcomes would be of value in furthering our understanding of effective valuation problem solving.

A further limitation of this research is that while findings report on a diverse and complex range of cognitive processes used in solving valuation problems, an in-depth discussion of the use of all the processes was outside the scope of this research. As shown in Figure 3.0.3 in Chapter 3, for instance, there were instances where a generic problem-solving operator (e.g. meta-reasoning) could embody a one- or two-tiered categorisation of instances of valuation problem solving. However, not all of the sub operators were considered in the discussion and representation of the findings of the research. This limitation, as noted before, resulted in surface, as opposed to deep, accounts of certain cognitive processes. Further consideration of how sub operators of certain main problem solving operators such as meta-reasoning (plan, self-evaluation, cue-diagnostics and experiential memory) is therefore required. Similarly, the research was also limited in identifying the cognitive processes that are pertinent to the commercial valuation domain. Many of the cognitive processes that this research identified have been noted in previous research of expertise in other domains. Consequently, a further consideration of commercial valuation specific cognitive processes is required.



Following on from the above, a further limitation is noted in the modelling of the valuer's cognitions in commercial valuation problem solving. The pattern of sequence of thought and the emerging model of cognitive structures of valuation problem solving are usually described as 'interim products' (Layder, 1998, p. 78). In other words, there are avenues for the model to be revived and improved in the light of further evidence. For instance, further research through other methods, such as interviews, could reveal other components of the model, including the use of different types of knowledge.

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## **6.6 CONCLUSION**

This research has contributed to the scholarly research that concerns the cognitive development of expertise in the commercial property valuation practice. In particular, the research addressed the gap in the valuation literature by employing a Cognitive Task Analysis, in which multiple sources of empirical data were collected and analysed to infer the knowledge states and cognitive processes which together were used to develop cognitive structures of the expert valuer in commercial valuation problem solving. This is significant to provide an understanding of the use of these processes which may be used as a basis of improving valuation education and learning.

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## **Appendix A**

### **Instructions for Verbal Protocol Analysis**

#### **Instructions**

For this valuation exercise, you will be given an information pack about an industrial/warehouse property and your task is to determine the appropriate valuation opinion (market value). As you carry out your valuation analysis, I would like you to 'think aloud' (verbalising your thought processes). Please be assured that this is not a test and there is no right or wrong answer. I am interested in what you say to yourself as you carry out the valuation. You could refer to any of the information at any time during the session and if you have any question or require additional information please feel free to ask. At the end of your valuation, I would like you to recall some specific facts on the valuation instructions you've just experienced.

#### **Problem Statement**

You have been instructed to prepare a valuation of the long-leasehold interest of an industrial/warehouse premises located in Nechells, Birmingham. The date of valuation you are being asked to prepare is to be set at the most recent date of inspection, 15<sup>th</sup> April, 2012. Enclosed you will find data and information which resulted from a diligent search of the market. As I indicated to you earlier, you may refer to any of the pieces of information at any time during the valuation and if you have any question or desired additional information, please feel free to ask. Please use the attached work sheet to conduct your valuation of the subject property.

#### **Identification of the Subject Property**

Location:	St. James Place, Nechells, Birmingham, B7 4JE
City, County:	Birmingham, West Midlands
Site Area:	1,088m <sup>2</sup>

## **Purpose of Valuation**

The purpose of this valuation is to prepare an assessment of market value of the long-leasehold interest of the above identified property for the purpose of sale, as of April 15, 2012, the most-recent date of inspection.

## **Neighbourhood Data**

Nechells, an area 9.1 square km in size with a density of 3,015 people per square km, is located to the south and east of Birmingham city centre. It is an inner-city area which includes part of the city centre, Digbeth, Millennium Point, East Side and Star City. The area has district neighbourhoods separated by railway lines, arterial roads and commercial areas. Bounded by major roads (Highgate Middleway, Small Heath Highway, Coventry Road, Digbeth High Street), the area consists of pockets of dense residential areas interspersed with commercial and entertainment centres. With nearly 28,000 people, Nechells is notable in Birmingham for being the area with the highest rate of unemployment, crime and poverty and has been the focus of a great deal of urban regeneration by Birmingham City Council

## **Location of Subject Property**

The subject property is some one mile north east of Birmingham city centre fronting on to St. James Place near to the junction with Vauxhall Road. Access to St. James Place is gained via the A4540 Lawley Middleway and in turn the Vauxhall Road.

## **Property Data**

The subject property to be valued is a two storey detached warehouse of concrete frame construction with brick infill elevations under part flat roof/part pitched asbestos-clad roof on steel trusses. The ground floor comprises a warehouse with offices, stores and WCs and benefits from two front roller shutters leading to loading bays and a side roller shutter into the main warehouse accessed from the external yard. The first floor accommodation comprises several partitioned offices, WCs, storeroom, staff room, and warehouse. The extensive first floor accommodation (50% of the total floor area) may not suit some occupiers. There is a narrow side and rear external yard accessed via roller shutter and covered approach from the front of the property. Based on the RICS Code of Measuring Practice, the floor areas are calculated as follows:

Floor	Accommodation	Sq. M	Sq. ft.
Ground	Warehouse	496.5	5,344
	Office		
	Stores		
First	Offices	538.5	5,796
	Staff Room		
	WCs		
	Wash room		
	Store		
	Warehouse		
Total Gross internal Floor Area		1,035	11,140
Or thereabouts			

### **Tenure**

The freehold of the property is owned by Birmingham City Council and is presently held by the client on a ground lease for a term of 125 years from 25<sup>th</sup> December 1989. The present ground rent is £3,750 per annum subject to 7 year reviews.

### **Services**

It is understood that the property is connected to all mains services; although they have not been tested as at the time of inspection.

### **Town Planning and Environmental Considerations**

For the purpose of this valuation exercise, you can assume that the property has full planning consent for its current use and that there are no onerous conditions which would adversely affect value or marketability. You can further assume that there are no previous uses of the site which could have contaminated the land and that the subject property is free of any compulsory purchase or similar orders.

### **Repair and Condition**

At the time of inspection, the property appeared to be in adequate structural repair and condition and contained no deleterious materials. The property shows signs of wear and tear to be expected of a building of this age. It has evidently been vacant for some time and accordingly has suffered from acts of vandalism and roof leaks and is in extremely poor decorative order. Also, there is a substantial crack in the rear corner of the ground floor brick wall which has been poorly repaired. Overall, the property requires complete refurbishment.



## Photographs







## Comparable Sales & Letting

Property	Location	Property Type	Price	Size	Remarks
Subject property	St. James Place, Nichells, Birmingham (1.5 miles west of Birmingham City centre and 2.5 miles south west of junction 6 of the M6 Motorway)	Two storey detached warehouse of concrete frame construction with offices, stores and WC in both floors	N/A	1,035 m <sup>2</sup> 11,140 ft <sup>2</sup>	It is understood that the subject property has been on the market for some two years at an asking price of £200,000.
Comparable 1	Oxford Street, Digbeth, Birmingham (0.5 miles from city centre and 0.8 miles from the subject property)	Single storey pitched roof warehouse with integral office and washroom area together with outbuilding and covered storage area	£1,400 pcm	705.3 m <sup>2</sup> 7,592 ft <sup>2</sup>	This property is in average condition and currently letting. There are good communication links to the Motorway network via the nearby middle ring road. All utilities available
Comparable 2	Lord Street, Nichells, Birmingham (0.5 miles from city centre and 0.8 miles from the subject property)	This comprises of two storey warehouse, office accommodation and off-street loading and car parking	£23,400 pa	1,159 m <sup>2</sup> 12,475 ft <sup>2</sup>	Similar in quality to the subject property but let a year ago. The property has good access and all utilities available
Comparable 3	Moseley Street, Digbeth, Birmingham (0.25 miles from city centre and 1.7 miles from the subject property)	Two storey warehouse with first floor office accommodation, WC's and a canteen mess area	£18,845 pa	573.7 m <sup>2</sup> 6,175 ft <sup>2</sup>	The property of high quality and available on a leasehold basis. The property is about 4 miles from M6 and all the main services are available and connected to the unit
Comparable 4	Windson Street, Nichells, Birmingham (close to Aston University and city centre and about 0.7 miles from the subject property)	This comprises warehouse premises arranged over two floors with 2 goods lifts and forklift access. The main warehousing element is off Windson Street where there are also ancillary office and WC areas in addition to secure parking for around 22 vehicles.	£975,000	6,765 m <sup>2</sup> 72,813 ft <sup>2</sup>	Freehold for sale at the asking price of £975,000. The property benefits from good access to all surrounding areas with the Aston Expressway providing easy access to the M6 motorway at junction 6

## **Appendix B**

### **Guidelines for Semi-structured Interviews**

In this interview session, I will be asking you a series of questions about the commercial property valuation process and knowledge categories and how valuers reason through and solve challenging problems in the process.

#### **Session 1: Commercial Valuation Preparation**

This session seeks your view on the broad overview of commercial property valuation and the aspects requiring thinking or judgment skills.

- Q1. In your opinion, what makes a good commercial property valuation?
- Q2. Assume you have been instructed to prepare a valuation to estimate the market value of a commercial property. Can you break the valuation down, from instruction to reporting, into less than six, but more than three tasks/segments?
- Q3. Of the tasks/segments you have just identified which do you perceive to be problematic and why?

#### **Session 2: Nature, Processes & Development of Reasoning**

This session relates to the reasoning/problem-solving strategies use in commercial property valuation.

- Q1. Assuming you are dealing with a particular problematic commercial property valuation segment, can you explain how you will reason through to form an opinion?
- Q2. What sorts of things do you think influence how you learn to reason through the problematic segments of commercial valuation instructions since you started working as a valuer?

- Q3. How would you compare your level of valuation reasoning in relation with that of a more experienced/specialist valuer in commercial property valuation?
- Q4. If I said "your goal is to help a graduate valuer/surveyor to reason critically"... what do you think this will be? How will you go about doing it?

### **Session 3: Knowledge & its Role in Commercial Property Valuation**

This session seeks your view on the role of knowledge and experience in commercial property valuation.

- Q1. What role do you think theoretical knowledge plays in commercial property valuation practice?
- Q2. What kinds of theoretical knowledge do you use in commercial property valuation instructions?
- Q3. Do you think any of these theoretical knowledge areas needs strengthening or updating periodically? Why/why not?
- Q4. What specific practices, knowledge, skills and lessons from professional development do you think constitute tacit knowledge in commercial property valuation practice?
- Q5. What do you consider to be the role and importance of tacit knowledge in commercial property valuation practice?

### **Session 4: Demographic Data**

Age, Gender, Academic qualification, Professional designation, Years of commercial valuation experience, Place of work, Average number of commercial property valuations conducted in a year

## Appendix C

### Sample of Coded Protocols (EV 1)

Segment No	Segment Text	Knowledge State (Referent)	Problem Solving Operators	Problem Solving Strategy
1	I thought that the exercise that you set here <u>is very good</u>	Valuation instruction	Meta-reasoning: cue-diagnosticity	
2	there is a <u>lot of information</u> there...and,	Valuation instruction	Meta-reasoning: cue-diagnosticity	
3	I think is <u>all clear cut</u> and	Valuation instruction	Meta-reasoning: cue-diagnosticity	
4	One can actually kind of <u>look at it and work through it</u>	Instruction analysis	Meta-reasoning: self-evaluation	
5	And, I suppose, probably, part of <u>my experience as expert witness</u> , in particular, is that and <u>signing off a lot of valuation</u> is that	Self-reference - Expert witness experience	Meta-reasoning: experiential-memory	Fact – 5 linked forward to Plan – 6
6	I look for <u>things that, perhaps, don't quite make sense or just query</u>	Recommend - Instructional analysis	Meta-reasoning: plan	
7	And the sort of things that I just thought of is that the site area, at a 1,088 square meter <u>is disproportionately larger</u> than the size of building	Physical attribute - Low site coverage	Data-examination: compare-to-norm	
8	And I kind of just quickly worked out that <u>the building, probably, occupied is about 5% size coverage and the foot print of the building is about 5% of the site</u>	Technique - Site coverage area	Data-exploration: apply	

9	And so, I just kind of raise that <u>is that really right?</u>	Physical attribute - Site coverage area	Data-exploration: search	
10	Because that give us a <u>surprisingly low site coverage area,</u>	Physical attribute - Low site coverage	Summarization: repeat-data	Fact – 10, 11, 12 & 13 linked forward to Infer – 14
11	and certainly then it talk about something, the extensive of accommodation narrow side the rear external yard	Physical attribute	Data-examination: read	
12	and that is the side that I guess is <u>really interesting</u> -	Physical attribute	Meta-reasoning: cue-diagnosticsity	
13	rear external yard accessed by Rolex Shutter and covered away from the front of the property,	Physical attribute	Data-examination: read	
14	I kind of envisage that that sort of imply that <u>the access to the rear area was quite restricted</u>	New fact - Restricted rear area access	Data-explanation: infer	
15	But, actually, giving <u>the site area versus the floor area,</u>	Physical attribute - Low site coverage	Summarization: repeat-data	Fact – 15 linked forward to Infer – 16
16	I kind of thought that that <u>rear yard would be a very big piece of yard space</u>	New fact - Big yard space	Data-explanation: infer	Infer – 16 linked backward to Fact – 17
17	and I thought that <u>is that the case?</u>	Analysis of yard space	Meta-reasoning: self-evaluation	
18	I think, probably, what it is that, I am sorry! I've probably <u>done it wrong</u>	Analysis of site coverage area	Meta-reasoning: self-evaluation	
19	Because I was doing this <u>very quickly</u>	Analysis of site coverage area	Meta-reasoning: self-evaluation	
20	and I think that I am use to dealing with <u>hectares and square feet,</u>	Self-reference - Measurement practice	Meta-reasoning: experiential-memory	
21	and I had probably <u>mis-calculated the site area and</u>	Analysis of site coverage area	Meta-reasoning: self-evaluation	Fact – 21 & 22 linked forward to Infer – 23



22	probably about half a ten or something	Analysis of site coverage area	Meta-reasoning: self-evaluation	
23	In which case, <u>the site coverage would be about 50%</u>	New fact - 50% site coverage	Data-explanation: infer	Infer – 23 linked backward to Fact -24
24	which <u>will make much more sense</u> . I suspect that is, <u>probably, what it is</u>	Analysis of site coverage area	Meta-reasoning: self-evaluation	
25	The other thing was, it was just <u>more of an interest than anything</u> else, is that the tenure, the leasehold tenure	Property analysis	Meta-reasoning: self-evaluation	
26	the present ground rent is that	Legal attribute	Data-examination: read	
27	I would kind of assume that, certainly, <u>a rent review is at the current market rental value</u>	Solution - A rent review at current market value	Hypothesis-generation: trigger	Hypothesis – 27 linked backward to Fact – 28
28	But it didn't actually say <u>the basis on which the ground rent is set</u>	Legal attribute - No basis of rent review	Data-exploration: note-absence-data	
29	But that said really, I kind of thinking the valuation process. My thought process would, really, is that <u>working back from the 7 years rent review pattern from 1989,</u>	Technique - Rent review periods	Data-exploration: apply	Fact – 29, 30, 31 & 32 linked forward to Infer - 33
30	I imagine there's <u>a review done in 2010</u>	Solution - Review done in 2010	Hypothesis-generation: trigger	
31	And so if that is the <u>current rental value in 2010,</u>	Solution - Current rental value set in 2010	Hypothesis-generation: further specification	
32	it, <u>probably, hasn't change now.</u>	Solution - Rental value hasn't change since 2010	Hypothesis-generation: trigger	
33	So I was kind of, <u>probably, 4 months review so that, probably, isn't reversionary</u>	New fact - Leasehold isn't reversionary	Data-explanation: infer	Infer -33 linked backward to Fact – 34

34	But what I would also say is that in terms of <u>my thought process</u> that is a bit of a kind of...assumptions that I have make	Analysis of property	Meta-reasoning: self-evaluation	Fact – 34 linked forward to Plan – 35 & 36
35	which I think, if I was doing a <u>valuation professionally</u> , I will like to kind of <u>verify that</u>	Recommend - Verification of lease	Meta-reasoning: plan	
36	and <u>understand what the review clause</u> says and whether that is the right ground rent	Recommend – Analysis of review clause	Meta-reasoning: plan	Plan – 36 linked backward to Fact – 37
37	And, there is nothing in <u>my comparable</u> that actually give me a say as to what <u>ground rent values</u> would be	Comparable evidence - No comparable to determine ground rent values	Data-exploration: note-absence-data	
38	so I was just kind of thinking that is this sort of <u>abnormally that is there</u>	Valuation instruction	Meta-reasoning: cue-diagnosticity	
39	Interestingly I was saying so I think then the other thing, <u>I don't think it rarely matter so much</u> , is that	Property analysis	Meta-reasoning: self-evaluation	
40	this doesn't actually state <u>the purpose of valuation</u> .	Problem statement - No Purpose of valuation	Data-exploration: note-absence-data	
41	Yes, I picked it on, is for sale. So we are doing a <u>valuation for potential sale</u> .	Problem statement - Purpose of valuation	Data-examination: identify	
42	That's okay, <u>I understand that</u>	Instructional analysis	Meta-reasoning: self-evaluation	
43	So that would be <u>market value basis</u> , that is fine.	Problem statement - Basis of valuation	Data-examination: identify	
44	So I think that the other thing that I was a little bit surprise about was that <u>the first floor area is bigger than the ground floor</u>	Physical attribute - Differences in floor areas	Discrepancy-processing: recognition	Discrepancy – 44 linked forward to Resolution – 45
45	and, therefore, either there is a bit <u>over hanged or something</u> or there is a bit of kind of the first floor <u>extend over the access to the rear external yard or something is not counted</u>	Resolution - Over-hanged area or extension over the access to the rear yard	Discrepancy-processing: resolution: system-thinking	

46	I mean it does state RICS Code of Measuring Practice and the gross internal floor area_so I just kind of thought <u>that was a bit strange</u> .	Physical attribute - Application of RICS Code of Measuring Practice	Discrepancy-processing: recognition	Discrepancy – 46 linked forward to Resolution – 47 & Plan 48
47	But I mean <u>is fine</u> is just that	Resolution - Differences in floor areas is fine	Discrepancy-processing: resolution: ignore	
48	if I can <u>request a visualisation of what it kind of looks like</u>	Recommend - Visual inspection	Meta-reasoning: plan	
49	I think the other thought process when I was reading through that is that in the valuation we've assumed that the property had full Plan consent for its current use.	Legal attribute	Data-examination: read	
50	<u>which, I think, is described as warehouse</u>	Physical attribute	Data-examination: read	
51	So I kind of assume that that means it was a <u>B8 warehouse use</u>	Solution - B8 warehouse use	Hypothesis-generation: trigger	
52	It says no previous contamination use which is <u>very good</u>	Environmental attribute - Absence of contamination is very good	Data-examination: determine-severity	
53	I think the thing that worry me again was that there is a substantial crack in the rear corner of the brick wall has been poorly repaired	Physical attribute	Data-examination: read	Fact – 53 & 54 linked forward to Plan – 55
54	You <u>can only kind of made any sort of judgment about what that is like if you have a look at it and sort of see</u>	Analysis of crack condition	Meta-reasoning: self-evaluation	

55	And is the sort of things that I might well want to <u>co-inspect with Building Surveyors</u> to come and have a look at and so is this kind of cracks...something to bear in mind.	Recommend - Co-inspection with Building surveyors	Meta-reasoning: plan	
56	I am not sure or rarely know whether it is <u>a kind of crack that is causing structural problems</u>	Analysis of crack condition	Meta-reasoning: self-evaluation	
57	Then again, can I just kind of look at <u>the comparable sales and letting evidence.</u>	Recommend - Comparable analysis	Meta-reasoning: plan	
58	I mean there are <u>several comments</u> really.	Comparable evidence	Meta-reasoning: cue-diagnosticity	
59	The subject property was the top line comparable, <u>has limited use</u>	Comparable evidence - Subject property has limited use	Data-examination: determine-severity	
60	It is interesting to note that the <u>asking price is £200,000 two years ago.</u>	Comparable evidence - Asking price	Data-examination: identify	Fact – 60, 61, 62 linked forward to Infer – 63
61	What happen in the market base since then is that the kind of occupy the mind before. So <u>values are fallen back a bit</u>	Recall - Trend in rental value	Meta-reasoning: experiential-memory	
62	And as that was an asking price, I guess it was <u>achieved in the market place.</u>	Comparable evidence - Asking price	Meta-reasoning: cue-diagnosticity	
63	So, therefore, is <u>a little unreliable</u>	New fact - Asking price a little bit unreliable	Data-explanation: infer	Infer – 63 linked backward to Fact – 64
64	because an asking price is only <u>another opinion of value, is probably a good guide,</u>	Comparable evidence - Asking price	Meta-reasoning: cue-diagnosticity	
65	but that would suggest to me that, probably, the <u>value back in 2 years ago was probably a little bit below £200,000 and,</u>	Solution - Value 2 years ago a little below the asking price	Hypothesis-generation: trigger	Hypothesis – 65 linked backward to Fact – 66
66	probably, <u>values have fallen back in the intervening period</u>	Trend in rental value	Summarization: repeat-data	

67	So I may suggest that <u>value might fifty hundred and seventy five thousand pounds now.</u>	Solution - Initial opinion of value	Hypothesis-generation: trigger	
68	So that kind of give us <u>a broad view of where it might be</u>	Initial opinion of value	Hypothesis-evaluation: confirmation	
69	I think then that out of the three rental comparables, the one in Digberth is of <u>limited use,</u>	Comparable evidence - Comparable 1 is of limited use	Data-examination: determine-severity	
70	It's difficult, really, to know <u>how relevant that is</u>	Comparable analysis	Meta-reasoning: self-evaluation	
71	because it is only <u>a sub-single storey warehouse with inter co office and so on</u>	Comparable evidence	Meta-reasoning: cue-diagnosticity	
72	So I think that is, probably, going to be <u>much better</u>	Comparable evidence - Comparable 1 much better	Data-examination: determine-severity	
73	because this is two storeys and <u>two storeys is not very attractive in the market place</u>	Comparable evidence	Meta-reasoning: cue-diagnosticity	
74	I've got <u>two comparables then of two storeys warehouse office accommodation</u>	Comparable evidence - Two comparable of two storeys	Data-examination: identify	
75	and I was a little bit kind of concerned with comparable number 2... <u>that is actually very good</u>	Comparable evidence - Comparable 2 is actually very good	Data-examination: determine-severity	
76	because, it is <u>very similar size it described is very close to the subject property in Nitchells, very similar sort of size and so on and let a year ago, which is okay</u>	Comparable evidence	Meta-reasoning: cue-diagnosticity	
77	So, probably, I think comparable 2 is probably <u>the best to give us deal on the rental value</u>	Comparable evidence - Comparable 2 is the best comparable	Data-examination: compare-multiple	

78	Comparable number 3, the amount per square foot is <u>much higher</u>	Comparable evidence - Comparable 3 rent is much higher	Data-examination: compare-multiple	
79	but then it is described as 2 storeys warehouse with first floor office accommodation	Comparable evidence	Data-examination: read	Fact – 79 & 80 linked forward to Infer – 81
80	And I wasn't sure <u>whether the warehouse is two storey or whether is just the office accommodation</u>	Comparable analysis	Meta-reasoning: self-evaluation	
81	But I think reading that I am kind of <u>assuming that is also a 2 storey warehouse</u>	New fact - Comparable 3 is a 2 storey warehouse	Data-explanation: infer	
82	<u>Digberth</u> , I don't think Digberth is a <u>much better area</u>	Comparable evidence - Comparable3 location not a much better area	Data-examination: compare-multiple	
83	The <u>overall size is a bit smaller</u>	Comparable evidence - Overall size of comparable 3 is a bit smaller	Data-examination: compare-multiple	
84	and so you've got a kind a roughly <u>£3 a square foot</u>	Technique - Rent psf	Data-exploration: apply	Fact – 84 linked forward to Plan – 85
85	So if I <u>did it on a kind of overall</u> so, I am just putting it into my calculator, <u>18,845 times 75.</u>	Technique - Overall rental value	Meta-reasoning: plan	
86	I am just... the sort of concern I have with those two comparable that there is <u>not quite enough information there, whether the floor area is equally distributed between the two floors or whether the first floor is much smaller and so on</u>	Comparable evidence - Comparable floor distribution	Data-exploration: search	
87	Because, generally we would expect the <u>first floor to be much less valuable than the ground floor accommodation.</u>	Recall - Normal pattern of value distribution	Meta-reasoning: experiential-memory	

88	That is normal unless you get a kind of <u>very restricted height on the ground floor and better space on the first floor or something like that</u>	Recall - Exception to normal pattern of value distribution	Meta-reasoning: experiential-memory	
89	But, I sort of thought that the comparable number 2 is, probably, <u>the most closest and closest in size</u>	Comparable evidence - Comparable 2 is most closest in size	Data-examination: compare-multiple	Fact – 89 linked forward to Plan – 90
90	And it would be nice to actually be able to <u>compare them more directly.</u>	Technique – Direct comparison	Meta-reasoning: plan	
91	If I were <u>doing this in practice</u> , and particularly, if I had identified Law Street, Nitchells, when I inspected the subject property, I will go and look at the <u>other couple of them</u>	Recommend - More comparable search	Meta-reasoning: plan	Fact – 91 linked forward to Plan – 92
92	just to have <u>a bit of comparison</u>	Technique - Comparative analysis	Meta-reasoning: plan	
93	But I think that sort of led me to think that, probably, my thought process is really that the rental value of the subject property is, probably, in <u>a broad similar to comparable number 2</u>	Solution - Rental value of subject property in a broad similar to comparable 2	Hypothesis-generation: trigger	
94	which would give me, and, if I apply that just <u>across the board</u> , that would give me a rental value around about £21,000 for the subject property	Technique – Rental value	Data-exploration: apply	
95	That is a kind of bit <u>less than the Mosely street one</u>	Comparable evidence - Rental value of subject property less than value of comparable 3	Data-examination: compare-multiple	
96	but I am a bit unsure whether that is really kind of, <u>how relevant that is</u> because it is a bit small and so on	Comparable analysis	Meta-reasoning: self-evaluation	

97	Then <u>looking at the kind of capital value</u>	Recommend - Capital value comparable analysis	Meta-reasoning: plan	
98	The <u>only capital value comparable is also in Nitchells</u>	Comparable evidence - Comparable evidence (4) location	Data-examination: identify	
99	but it is <u>much larger</u> and they've got sort of good lift and so on and parking	Comparable evidence - Comparable 4 is much larger	Data-examination: compare-multiple	
100	So it is difficult to, but the overall rate per square foot, that shows is quite low, is <u>£13.48 square foot</u>	Comparable evidence - Low rent psf of comparable 4	Data-examination: compare-to-norm	
101	and also it is <u>freehold rather than our property which is leasehold.</u>	Comparable evidence - Comparable evidence (4) tenure	Data-examination: identify	
102	So I think that kind of, you know, <u>it gives us a bit of a stare</u>	Comparable evidence	Meta-reasoning: cue-diagnosticity	
103	I am <u>struggling a little bit from that</u>	Comparable analysis	Meta-reasoning: self-evaluation	
104	So I think that I am almost struggling that I want <u>a bit of more comparable</u>	Comparable evidence - More comparable evidence	Data-exploration: search	
105	because, you know I've done this and <u>I don't think there is kind of quite enough here to produce a valid opinion of value</u>	Comparable analysis	Meta-reasoning: self-evaluation	
106	But the method that I would kind of like to do is to then kind of take off is on <u>the traditional sort of valuation of taking a rental value of £21,000, take off the current ground rental of 3750</u>	Technique - Leasehold capitalization	Meta-reasoning: plan	



107	Again, there is a bit of caution that, <u>not sure if there is reversionary or not</u>	Property analysis	Meta-reasoning: self-evaluation	
108	But if I just kind of assume that <u>the 3750</u> would be okay,	Property analysis	Meta-reasoning: self-evaluation	
109	that <u>would give a profit rent of 17,250</u> , I think,	Technique - Profit rent	Data-exploration: apply	Fact – 109 linked forward to Plan – 110
110	which are then <u>capitalized at YP at an appropriate yield</u>	Technique – Capitalisation	Meta-reasoning: plan	
111	And we've got quite a lot on the lease; I think is <u>120 years, 125 years.</u>	Legal attribute - unexpired terms	Data-examination: identify	Fact – 111 linked forward to Plan – 112
112	Traditionally, I would like to kind of do that with <u>the dual rate approach</u> and,	Technique - Dual rate capitalistaion	Meta-reasoning: plan	Plan – 112 linked backward to Fact – 113
113	actually, I think that, probably <u>wouldn't make much of a difference mathematically</u>	Technique - Dual rate capitalistaion	Meta-reasoning: self-evaluation	Fact – 113 linked forward to Plan – 114
114	So there is room we <u>might do it as a single rate.</u>	Technique - Single rate capitalistaion	Meta-reasoning: plan	Plan – 114 linked backward to Fact – 115
115	because at such an unexpired term it <u>wouldn't actually make much of a difference</u>	Technique - Single rate capitalistaion	Meta-reasoning: cue-diagnosticsity	
116	But I would, probably, just dive into my current parry valuation table and come up with a YP	Technique - Reading Parry Table for YP	Meta-reasoning: plan	
117	I get the feeling that it is, probably, something like this, you know the yield might be something like <u>12%</u>	Solution - Yield in the region of 12%	Hypothesis-generation: trigger	Hypothesis – 117 linked backward to Fact – 118
118	There is <u>really any comparable</u> that I can draw on that with any certainty	Comparable evidence - No comparable to determine yield	Data-exploration: note-absence-data	

119	But that would then lead me down to, you know that sort of valuation if I just ignore the kind of advantage of a single rate and <u>do it into perpetuity</u>	Technique - Capitalisation in perpetuity	Meta-reasoning: plan	
120	<u>8.3333 times 17250, that would give me about 145,000</u>	Technique - Capital value	Data-exploration: apply	
121	I am kind of thinking this is <u>a kind of a bit of 5 packet valuation and a bit of a board packet answer</u>	Valuation analysis	Meta-reasoning: self-evaluation	
122	But then I would say very comfortably <u>if that was about 145 to 150 thousand,</u>	Capital value	Summarization: repeat-data	
123	that sort of where, that <u>sits comfortable with an asking price of £200,000 two years ago</u>	Capital value	Meta-reasoning: cue-diagnostics	
124	What I then need to consider is what <u>adjustment to make with the condition</u>	Technique - Adjustment to valuation opinion	Meta-reasoning: plan	Fact – 124 & 125 linked forward to Plan – 126
125	The condition is said to be <u>vandalized and fairly poor and there is structural crack at the back</u>	Physical attribute: condition of property	Summarization: repeat-data	
126	So I think I am being incline to start looking at this as the benchmark and <u>adjust downward a little bit to make some sort of adjustment for that condition really</u>	Technique - Adjusting downward to reflect condition	Meta-reasoning: plan	
127	And I think that is the sort of the <u>thought process that I would take for that condition really</u>	Technique - Adjustment to valuation opinion	Meta-reasoning: self-evaluation	

## Appendix D

### Summary of Knowledge States

Knowledge State	Knowledge State	Novice Valuer		Freq .	Intermediate Valuer		Freq .	Expert Valuer		Freq .
		NV 1	NV 2		IV 1	IV 2		EV 1	EV 2	
Valuation information	Instruction	0 (0)	2 (7)	2 (4)	0 (0)	0 (0)	0 (0)	7 (6)	2 (3)	9 (5)
	Property attributes									
	Physical attribute	5 (17)	3 (11)	8 (14)	8 (6)	10 (16)	18 (9)	5 (4)	3 (4)	8 (4)
	Legal attribute	0 (0)	0 (0)	0 (0)	3 (2)	4 (6)	7 (4)	2 (2)	5 (7)	7 (4)
	Location attribute	1 (3)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)
	Environmental attribute	1 (3)	1 (4)	2 (4)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	2 (1)
	Comparable evidence	1 (3)	8 (30)	9 (16)	30 (23)	6 (10)	36 (19)	30 (25)	7 (10)	37 (19)
Sub-Total	8 (26)	14 (52)	22 (39)	41 (31)	20 (32)	61 (32)	45 (37)	19 (26)	64 (33)	
Self-generated ideas	Hypothetical solution	0 (0)	0 (0)	0 (0)	9 (7)	1 (2)	10 (5)	15 (12)	12 (17)	27 (14)
	Inferred fact	4 (14)	0 (0)	4 (7)	2 (2)	2 (3)	4 (2)	6 (5)	8 (11)	14 (7)
	Resolution	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	2 (3)	4 (2)
	Recommendation	8 (28)	2 (7)	10 (18)	19 (15)	8 (13)	27 (14)	8 (7)	7 (10)	15 (8)
	Recall	0 (0)	0 (0)	0 (0)	9 (7)	3 (5)	12 (6)	3 (2)	7 (10)	10 (5)
	Self-reference	2 (7)	4 (15)	6 (11)	17 (13)	14 (22)	31 (16)	23 (19)	7 (10)	30 (16)
	Technique	7 (24)	7 (26)	14 (25)	32 (25)	15 (24)	47 (24)	20 (16)	9 (13)	29 (15)
Sub-Total	21 (73)	13 (48)	34 (61)	88 (69)	43 (68)	131 (68)	77 (63)	52 (74)	129 (67)	
Total No.	29 (100)	27 (100)	56 (100)	129 (100)	63 (100)	192 (100)	122 (100)	71 (100)	193 (100)	

## Appendix E

### Summary of Problem Solving Operators

Problem Solving Operators	Problem Solving Operators	Novice Valuer		Freq	Intermediate Valuer		Freq	Expert Valuer		Freq
		NV 1	NV 2		IV 1	IV 2		EV 1	EV 2	
Data Examination	Read	4 (11)	2 (7)	6 (9)	7 (5)	11(12)	18 (8)	7 (5)	12 (15)	19 (9)
	Identify	4 (11)	3 (11)	7 (11)	6 (5)	3 (3)	9 (4)	7 (5)	2 (3)	9 (4)
	Examine	4 (11)	5 (18)	9 (14)	7 (5)	4 (4)	11 (5)	14 (11)	8 (10)	22 (11)
Data Exploration	Apply	5 (13)	5 (18)	10 (15)	17 (13)	13 (14)	30 (13)	6 (5)	4 (5)	10 (5)
	Search	3 (8)	0 (0)	3 (5)	10 (8)	5 (6)	15 (7)	3 (2)	4 (5)	7 (3)
	Note absence data	0 (0)	0 (0)	0 (0)	6 (5)	0 (0)	6 (3)	4 (3)	1 (1)	5 (2)
Data Explanation	Infer	4 (11)	0 (0)	4 (6)	2 (2)	2 (2)	4 (2)	6 (5)	8 (10)	14 (7)
Hypothesis Generation	Trigger	0 (0)	0 (0)	0 (0)	6 (5)	1 (1)	7 (3)	8 (6)	5 (6)	13 (6)
	Further-specification	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	2 (1)
	Association	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)	2 (1)
Hypothesis Evaluation	Confirmation	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	1 (0)
	Disconfirmation	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Discrepancy Processing	Recognition	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	2 (3)	4 (2)
	Resolution	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (20)	2 (3)	4 (2)
Meta Reasoning	Plan	10 (26)	4 (14)	14 (21)	30 (23)	12(13)	42 (19)	19 (15)	9 (11)	28 (13)
	Experiential memory	0 (0)	0 (0)	0 (0)	9 (7)	3 (3)	12 (5)	5 (4)	7 (9)	12 (6)
	Cue diagnosticity	1 (3)	5 (18)	6 (9)	8 (6)	7 (8)	15 (7)	14 (11)	7 (9)	21 (10)
	Self-evaluation	2 (5)	4 (14)	6 (9)	17 (13)	14 (16)	31 (14)	23 (18)	7 (9)	30 (14)
Summarisation	Repeat data	1(3)	0 (0)	1 (2)	5 (4)	15 (17)	20 (9)	5 (4)	1 (1)	6 (3)
	Repeat hypothesis	0 (0)	0 (0)	0 (0)	3 (2)	0 (0)	3 (1)	0 (0)	0 (0)	0 (0)
Total No.		38 (100)	28 (100)	66 (100)	133 (100)	90 (100)	223 (100)	129 (100)	80 (100)	209 (100)

