Nottingham Trent University

School of Architecture, Design and the Built Environment

Development of a contextualised understanding of the diffusion of innovation among quantity surveyors in the UK construction industry

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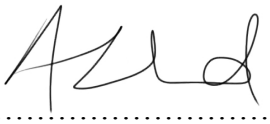
Signed:  ……

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Abstract

The UK construction industry is often described as slow to innovate which can be attributed to the temporary nature of construction projects and its inherently fragmented structure. The nature of innovation is a common area of research in the industry, but the diffusion of these innovations to the members of this social system is an under represented area that this research addresses. This research addresses this shortfall and focuses on providing a contextualised understanding of the key aspects of diffusion of professional practice among quantity surveyors. This is achieved by utilising a particular type of innovation, the New Rules of Measurement, as a vehicle for the analysis. A qualitative research approach that gathers the rich explanatory data is utilised, using semi structured interviews, which is lacking in the diffusion research field. This approach supports a constructivist philosophy and provides a deeper understanding of different actors' diffusion journeys in contrast to the overwhelmingly positivist approach to previous studies of diffusion. This resulted in several original contributions to knowledge including the identification of current measurement practices within the UK construction industry, development of a contextualised understanding and diffusion of professional practice innovation model for quantity surveyors in addition to the identification of barriers to the diffusion process that are unique to the construction industry. This is important as it demonstrates areas that can be utilised and improved to assist in the diffusion of professional practice to the quantity surveying profession.

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I would also like to thank Dr Andrew King for his supervision during this process, and the Nottingham Trent University, specifically Peter Westland, for his ongoing support and encouragement.

Finally, a special mention must go to my wife Katy for her patience and understanding during this process, and also my son Henry, whose arrival may have delayed the completion of this thesis somewhat, but who will hopefully enjoy reading it in the years to come.

Personal Reflexive Statement

Having worked as a quantity surveyor for over 18 years I have seen all manner of professional practices being used by companies, often with little thought because 'that's how we have always done it' with no regard to the wider industry or consideration of any recent innovations. This is of course a side effect of most of the people working in the construction industry being incredibly busy and not having time to concern themselves with what others are doing, but I was concerned that useful and innovative practices were not being utilised and that something was not quite right, especially in the SME arena where I previously spent most of my career. Having moved out of industry and into academia, I have been given the opportunity to now explore this phenomenon through this research and to discover how we interact as quantity surveyors and what journey we go through when it comes to the potential adoption of innovative professional practice.

My background covers both private practice and contracting organisations, but with a particular focus on the measurement and costing of building works, and so the introduction of the New Rules of Measurement (NRM) by the Royal Institution of Chartered Surveyors (RICS) was a golden opportunity to explore an actual innovation within the construction industry in an area that I know well and currently teach at Nottingham Trent University (NTU). This placed me in a unique position in which to discuss this innovation with practicing quantity surveyors as I have both the experience of working with the older methods of measurement and also the new. This in turn allowed the interviews during the data collection phase to be more conversational and less confrontational as I was able to empathise with the respondents and talk in their language. One thing I did learn during this process is that if you start to talk to a quantity surveyor about new measurement practices you need to make sure you have plenty of time available! This resulted in a series of very interesting conversations that have helped to both inform the research findings, and the way in which we teach measurement at NTU.

I have found this process enjoyable and taxing in equal measure, and it is hoped that the findings presented here can help to inform the quantity surveying profession and help to keep it as relevant and thriving as I know it can be.

Contents

Chapter 3 - Literature Review

Chapter 4 - Methodology

Chapter 5 - Data Analysis

Chapter 7 - Conclusion

List of Figures

List of Tables

List of Abbreviations

APC	-	Assessment of Professional Competence
BCIS	-	Building Cost Information Service
BIM	-	Building Information Modelling
CAQDAS	-	Computer Assisted Qualitative Data Analysis
CIOB	-	Chartered Institute of Building
CQS	-	Contractor Quantity Surveyor
CSA	-	Contract Sum Analysis
D&B	-	Design and Build
IAO	-	Innovation Adopting Organisation
IGO	-	Innovation Generating Organisation
IT	-	Information Technology
NRM	-	New Rules of Measurement
NTU	-	Nottingham Trent University
OFT	-	Office of Fair Trading
ONS	-	Office of National Statistics
PAdTL	-	Personal Adoption Threshold
PAwTL	-	Personal Awareness Threshold
PQS	-	Private Practice Quantity Surveyor
QS	-	Quantity Surveyor
QSi	-	Quantity Surveyors International
RIBA	-	Royal Institute of British Architects
RICS	-	Royal Institution of Chartered Surveyors
SAdTL	-	System Adoption Threshold
SAwTL	-	System Awareness Threshold
SCQS	-	Sub-Contractor Quantity Surveyor
SFCA	-	Standard Form of Cost Analysis
SME	-	Small Medium Enterprise
SNA	-	Social Network Analysis

Chapter 1 – Introduction

1.1 The Research Problem

The construction industry is seen as a unique and complex industry (RICS 2013a, Jones and Saad 2003, HM Government 2013) where in many cases construction teams are being formed and reformed for each new project (RICS 2013a). This in turn leads to a lack of collaboration and limited knowledge sharing as learning points from projects are lost when the team breaks up when the project ends (HM Government 2013).

Ashworth *et al*. (2013) identify some of the key characteristics of the industry, with other authors such as Towey (2012) and Cartlidge (2013b) reporting similar themes through their research. The following list is a summary of their findings:

- The physical nature of the product.
- The product is normally manufactured on the client's premises, i.e. the construction site.
- Many of its projects are one-off designs in the absence of a prototype model.
- The traditional arrangement separates design from manufacture.
- It produces investment rather than consumer goods.
- It is subject to wider swings of activity than most other industries.
- Its activities are affected by the vagaries of the weather.
- Its processes include a complex mixture of different materials, skills and trades.
- Typically, throughout the world, it includes a small number of relatively large construction firms and a very large number of small firms.

While these characteristics are nothing new to those working in the construction industry, they do make interesting reading when trying to compare construction to other industries, such as manufacturing. The final point highlighted above, relating to the size of firms, is a key consideration as it is this divergence of the size, experience and type of work that creates such a fragmented industry resulting in widely varying standards, education, practice and professionalism. From a research perspective, it also highlights that any findings will be difficult to generalise across the population.

The Office of National Statistics (2015) provides the following data relating to company size, frequency and output:

Number of Employees	Number of Firms	Output £ Million
1	133,737	20,393
2-3	66,135	
4-7	29,142	39,294
8-13	11,455	
14-24	6,016	
25-34	1,756	
35-59	1,752	10,484
60-79	521	6,154
80-114	405	6,870
115-299	482	27,360
300-599	246	
600-1,199		6,325
1,200 and over		18,266
Totals	**251,647**	**135,146**

Table 1.1 - Number of employees against number of construction firms and total output. (ONS 2015)

As can be seen above, the distribution of the workforce is heavily skewed towards small medium enterprises (SMEs). In contrast, the larger companies account for a higher proportion of the total construction output.

The structure of the industry has also changed over the years with many contractors who used to employ their own trades opting to sub-contract the work instead. Cartlidge (2013a p.252) states that "Many modern main contractors are now simply managing contractors; that is to say, they manage sub-contract works carried out by a range of organisations that are not part of their organisation." This approach makes the industry even more fragmented as each sub-contractor will work for numerous main contractors and as such will be forming and re-forming relationships depending on where the work is. This in turn loses any consistency of approach, working relationships and even trust.

Many authors (for example see Banwell 1964, Latham 1994, Egan 1998, Barrett 2008) have identified the problems associated with the nature of the industry, and this fragmentation and temporary nature of the supply chain is a cause for concern, as it can lead to poor communication and knowledge transfer. The RICS (2013a) believes this makes it difficult to introduce industry wide initiatives and new working practices to improve productivity and efficiency. One way to improve working practices and efficiency is to innovate, or adopt innovations, and this is another area that is widely criticised in the industry, with the UK Government strategy, Construction 2025 (HM Government 2013), highlighting the removal of barriers to innovation as one of its main commitments.

Innovation can be interpreted in many different ways depending on the context in which the innovation is introduced and the specific innovation itself can take many forms from products to services. Using a construction context in their definition, Sexton (2009 p.8) describes innovation as "developing and implementing a new idea in an applied setting" while Jones and Saad (2003 P.xv) argue, "Innovation is a new idea that leads to enhanced performance. It is not a single or instantaneous act but a whole sequence of events that occurs over time and involves all the activities of bringing a new product, process or service to the market."

The notable word within the above definitions is the word *new* implying that the product or service is new and therefore never been seen or used before. It can also refer to an adapted existing product or service that is being used for the first time. The generation of an innovation and its first use are not to be confused. The process of generating innovative products or services is quite well represented in the construction management literature by authors such as Dubois and Gadde (2002), Jones and Saad (2003) and Sexton and Lu (2009). However, many fail to recognise or discuss the journey of those innovations, as they are assessed, trialed and eventually adopted by members of the industry.

1.2 Purpose Statement

If innovation is to solve the perceived problems associated with the construction industry, any new products or services will need to be utilised by the industry and more

importantly the people working in the industry. The process by which an innovation is introduced to, and then adopted by, members of a social system is called diffusion.

Rogers (2003 p.5) defines diffusion as "the process in which an innovation is communicated through certain channels over time among the members of a social system". An important element of the diffusion process is communication. Rogers (2003 p.5) defines communication as "a process in which participants create and share information with one another in order to reach a mutual understanding". Diffusion is not concerned with the generation of innovation, but rather the journey that an actor goes through from their first exposure to an innovation to the eventual adoption or rejection of that innovation.

Rogers (2003) is the most cited and respected authority on the diffusion of innovation, with work spanning many decades across multiple industries. One industry that has not received much attention by researchers is the construction industry. Gambatese and Hallowell (2011a p.554), highlighted that the "body of knowledge of contextual innovation is relatively small and limited in its practical application" and that "few studies address the impacts of contextual factors in project based industries like the construction industry" citing the reasons for this as being "the unique characteristics of the construction industry such as its fragmentation, reliance on multiple firms to produce a product, project-centre focus and traditional separation of design and construction functions."

Classical diffusion studies are often criticised (for example Emmitt 1997, Larsen 2005, Gambatese and Hallowell 2011b) for lacking applicability to specific contexts, as they seek to generalise laws of behaviour across industries and disciplines. It is this lack of contextual focus that provides an opportunity to explore the concept of diffusion within a specific context and will be the main aim of this thesis.

In order to draw a specific context into focus for this research, it was decided that the construction industry social system was too broad for this study, with many different actors with diverse backgrounds, social norms and working practices. Authors such as Larsen (2005) have approached the concept of diffusion across this wide context with some success, but it was the work of Emmitt (1997) who focused his attention to the

architecture profession that inspired the direction of this research. Focusing on a single profession allows a deeper understanding of that particular context, and with shared working practices, ethical standards and common social norms, it was decided to narrow the focus to the QS profession to increase, and therefore contribute to, the knowledge of this particular social system and the role of its actors with regard to the diffusion of innovation. The choice of the QS profession was further supported by the author being a QS and having worked in the industry for over eighteen years, and it was this experience and knowledge that triggered the interest in this research subject in the first instance. In addition, it was decided that in order to facilitate this research a particular innovation was needed to act as a 'hook' for any later discussions with practicing QSs. The New Rules of Measurement (NRM), (RICS 2013d) were launched by the RICS and as they represent a significant change to existing working practices they were considered the perfect vehicle to explore the diffusion concept within the QS profession and allow contextualised exploration of the individual actors' diffusion journeys. This approach therefore focuses this thesis on the diffusion of innovative professional practice among a relatively small social system (QSs), rather than the diffusion of products across the wider population as many of the classical diffusion studies do. It was felt that this narrowing of focus would allow greater depth and richness to be developed in the work, as well as forming a coherent argument for making an original contribution to knowledge.

1.3 Research Aim and Objectives

In order to achieve the desired outcomes of this research, the following aim and objectives have been set, which will allow the exploration of the diffusion concept within a contextual setting.

1.3.1 Research Aim

To further understanding in the context of the diffusion of a professional practice innovation among QSs within the UK construction industry. Not only to ascertain if stages exist in this process, but also to discover if the stages proposed by Rogers (2003) are suitable for this particular context, and if a new model is required to accurately represent diffusion within these particular parameters.

1.3.2 Research Objectives

1. Define the context for the research in terms of actor, social system and innovation under investigation.
2. Identify the current measurement practices utilised by quantity surveyors.
3. Critically appraise and develop existing diffusion literature to suit the research context.
4. Identify barriers to the diffusion and adoption of professional practice innovation.

1.4 Research Approach

The research aim and objectives are initially achieved through the identification of the role of the QS and the professional practices used, in order to set the context for the remainder of the thesis. This is then followed by a critical literature review of the current diffusion literature, both classical and construction management related, to identify the current theories and approaches adopted. The literature is then synthesised to set the direction of the primary data collection.

The research methodology utilised in the work is then discussed and justification for the adoption of a constructivist philosophy supported by a qualitative research approach given. The justification centres around the desire to gather the rich explanatory data that

is lacking in the diffusion research field, which will add to the existing body of knowledge, whilst also helping to develop a deeper understanding of an actor's diffusion journey and therefore address the imbalance towards an overwhelmingly positivist approach to diffusion research in the past. The authors experiences and knowledge of the NRM and its use in practice will be examined to identify any areas of bias and also where this has proved advantageous, especially in the data collection phase where the interviews and their success were a key factor to the outcome of this research.

A comprehensive analysis of the primary data collected is then presented, culminating in the presentation of a contextualised model of the diffusion process. The thesis is then concluded and the contributions to knowledge clearly identified, implications to professional practice discussed, along with limitations that the research faced and areas for further research.

Chapter 2 – Quantity Surveyors and Measurement

2.1 Introduction

This chapter will discuss two key focal points of the research; the quantity surveyor (QS) and the process of measurement of building works. This is necessary as this research is context specific, so a detailed discussion of the main actors concerned and their practices is required to set the scene for the remainder of this thesis. There have been many changes to the ways in which construction is procured and the role of the QS, but both the QS and the process of measurement, in one form or another, are still a fundamental part of the construction industry.

In order to fully understand these two key aspects of this research this chapter will chart the progression of the quantity surveyor as a key member of the construction industry, examine their role and responsibilities, discuss the process of measurement and identify the need for it within the current construction industry. The chapter will conclude with a discussion on the current developments within the measurement field and the implications for the future.

2.2 The Quantity Surveyor

Attempting to define the role of the QS within the construction industry is arguably a difficult task. The role has developed over the years to encompass a wide range of services from the traditional measurement process through to sustainability advice and more recently becoming an integral part of the building information modelling (BIM) process. Several professional bodies in the UK, including the Royal Institution of Chartered Surveyors (RICS), Chartered Institute of Building (CIOB) and the Quantity Surveyors International (QSi), represent quantity surveyors. The RICS, which was founded in 1868, currently has the greatest representation of quantity surveyors with over 35,000 members in the Quantity Surveying and Construction professional group, out of a total membership of approximately 130,000 members (Cartlidge 2013b).

Quantity surveyors can work in various parts of the industry with the main differentiation being the private practice quantity surveyor (PQS) or the contracting

quantity surveyor (CQS). This chapter will now look at the historical development of the quantity surveyor in more detail to provide a rich context for this group in terms of the overall aim of this research.

2.2.1 History

This section locates the role of the quantity surveyor in the wider context of the industry and demonstrates that certain core skills have been, and most likely always will be, of particular importance. Authors such as Ashworth *et al*. (2013 p.1), Ostrowski (2013) and Towey (2011) all identify the history of the quantity surveyor through various RICS reports that have been commissioned over the last 50 years. These reports were published in 1971, 1983, 1991 and 1998 and all feature the common theme of 'the future role of the quantity surveyor'. They all begin with the identification of the key competencies of the quantity surveyor, which mainly consist of measurement and cost management, and then conclude by suggesting that a greater expansion of possible services to be offered would be desirable both inside and outside of the construction industry.

Quantity surveyors have had to keep up to date with emerging trends and changes within the industry and adapt to market conditions to ensure the future of the profession and to offer clients the best possible service. Today the role of the quantity surveyor has expanded to offer a wide range of professional services and whilst measurement is certainly important, it is no longer the driving force behind the profession it once was. New developments in the measurement process such as the New Rules of Measurement (NRM), along with advancements in information technology (IT) and other new initiatives such as BIM will only help to broaden the QS skill base.

2.2.2 Role / Competencies

Towey (2012 p.24) suggests that "The solid foundation of the quantity surveyor's role is based upon an extensive knowledge of construction techniques and competencies to measure works and assess rates that determine costs". Whilst this is correct, he notes that "It would be incorrect to perceive the role of the modern quantity surveyor as one

of a mere measurer of materials and trade works, as quantity surveying has expanded to create different job titles that attract additional responsibilities in the process."

It is important to appreciate that the role of the quantity surveyor has changed over the years and to a large extent this role needs to be defined depending on which type of organisation the quantity surveyor works for, either a private practice or a contracting company, as the overall skill base is similar, but the detailed operations are quite different. The size of the company can also play an important part in defining the role of the quantity surveyor. Skitmore (1994) and Fortune (1994) found that the working practices within smaller building companies, and also quantification skills generally, are quite different to those in larger organisations, which is more recently supported by Ashworth *et al*. (2013 p.37);

> *In some companies, the contractor's surveyor may undertake a specialised range of tasks, but in other firms could be expected to undertake work that is normally outside the periphery of quantity surveying. The size and type of contracting firm is therefore a very important influence on the surveyor's work.*

Seely (1999 p.13) provides a simplistic and useful, if reasonably limited, list of the functions that both the PQS and CQS carries out, and can be summarised as follows:

PQS functions	CQS functions
Preparing approximate estimates and early cost advice	Preparation of BQ
Cost planning and value analysis	Agreeing measures with clients QS
Procurement advice	Variation calculations
BQ production	Details for material orders
Negotiation with contractors	Interim costings for financial management of contracts
Tender examination	Subcontract accounts
Valuing work in progress	Subcontract variations
Valuing variations	Advice on contractual conditions
Preparation of final accounts	Advice on procurement
Advising on claims	
Technical auditing	

Table 2.1 - Functions of the PQS and CQS (Seely 1999 p.13)

Whilst this list only offers a simplistic view of the various roles, it is clear to see that there are similarities and that the general themes focus on measurement, cost advice and cost management. The RICS provide a very detailed set of guidance and competencies that must be met in order to become a chartered quantity surveyor and they attempt to define the role of the quantity surveyor as follows:

> *Quantity surveyors are the cost managers of construction. They are initially involved with the capital expenditure phase of a building or facility, which is the feasibility, design and construction phases, but they can also be involved with the extension, refurbishment, maintenance and demolition of a facility.* (RICS 2013b p.6)

In order to become a member of the RICS, a QS will have to demonstrate a certain level of competency in certain specialist areas. The most relevant area for the purposes of this research is the 'Quantification and costing of construction works' which is a core competency for membership of the QS pathway (RICS 2013b) and is one of the most traditional of roles for a quantity surveyor (Fortune 1994). The RICS (2013b p.24) define this as follows,

> *This competency covers the measurement and definition of construction works in order to value and control costs. Candidates should have an awareness of the various methods of quantifying and pricing construction works used throughout a project. They must have a thorough understanding of the specific methods used on their projects.*

A summary of the expectations at the various levels that need to be achieved can be found in table 2.2 below.

Element	Components	Action
Quantification of works Level 1	Candidates should have an understanding of the reasons for measuring construction work and the rules of measurement commonly used in the industry. They should also understand the different approaches used and their application to measuring work.	Knowing
Quantification of works Level 2	Candidates should have experience of measuring construction work for the purpose of preparing cost estimates, cost plans, tender/ contract pricing documents and valuing change. For example: A candidate might not have been involved with the preparation of a bill of quantities, but they should have been involved with producing some sort of pricing document, whether it is a schedule of works or an elemental analysis.	Doing
Quantification of works Level 3	Ideally candidates should be able to demonstrate that they are capable of explaining approaches to measurement and when they should be used, to clients and project team members.	Advising

Table 2.2 - Identification of Level requirements for RICS APC. (RICS 2013b p.24)

These components demonstrate the importance of the measurement function to the QS, and the wider industry, and also shows that the role of the QS is multifaceted and

dependent upon the specific industry sector. The following discussion will now focus on the measurement function itself, including its history, development and directions for the future.

2.3 Measurement

Following the launch of the NRM by the RICS in 2012 measurement has become a talking point once again for the QS profession. This research will focus on the NRM as the innovation under investigation so it is important to understand the historical development of measurement practices, as well as the need for them in the wider industry.

Lee *et al* (2011 p.1) succinctly describe the need for measurement,

> *There is a need for measurement of a proposed building project at various stages of a project from the feasibility stage through to the final account. This could be in order to establish a budget price, give a pre-tender estimate, provide a contract tender sum or evaluate the amount to be paid to a contractor.*

2.3.1 What is measurement and why do we do it?

In the context of the construction industry the term measurement is used to describe the process of obtaining accurate descriptions and quantities of items of work for the purpose of costing. This can be from drawings or from completed works on site depending on specific requirements.

In the most traditional sense measurement is used to produce a bill of quantities (BQ), which is essentially a detailed list of all items required to construct a building along with their quantities. This document is prepared by the client's private practice quantity surveyor (PQS), based upon completed drawings, and is then sent out to contractors to tender for the works (Kodikara *et al*. 1993). This method supplies all tendering contractors with identical sets of information with which to price the works. In order to provide this consistency and accountability a standard set of measurement rules are used to produce the BQ, which has traditionally been known as the Standard Method of

Measurement (SMM) and the latest edition is the seventh edition (SMM7). In turn, this means that all contractors have priced the same items of work and the same quantities of those items so in theory the only difference between their tender prices should be preliminaries, profitability, overheads and buying power. Following acceptance of the contractors tender the BQ is then used for several purposes as described by the early work of Kodikara *et al*. (1993) and more recently the RICS (2013d):

- Enables all contractors tendering to price on exactly the same information.
- Limits the risk borne by the contractor to the rates that he enters and thereby results in more realistic and competitive tenders.
- Prompts the client and design team to finalise most project particulars before the bill is prepared.
- Provides a satisfactory basis for the valuation of variations and adjustments to the final account.
- Useful basis for the valuation of certified stage payments throughout a contract.
- Gives an itemised list of component parts of a building, with a description and quantities, and can form a checklist for ordering materials, assessing labour requirements and programming the works.
- Provides a good basis for the preparation of future cost analyses.

Towey (2012 p.43) supports the above points and states that "in general, a BQ is a document formatted and worded in accordance with a set of coverage rules provided from a measurement guide, which comprises a measured quantity alongside a description of the works", this, in turn, "permits the contractors estimator to understand the requirement and apply a rate to a given quantity that includes labour, plant and materials in order to determine a price."

Cartlidge (2013b p.95) goes one step further and states that,

> *The BQ remains unsurpassed as a model on which to obtain bids in a format that allows ease of comparison between various contractors, transparency, and aid to the QS in valuing variations, calculating stage payments and the preparation of the final account.*

There is clear support amongst the construction literature for the use of the BQ and as already stated its roots go back many years with many successes. However, the industry is changing at a fast pace and the use of the BQ is in decline due to changing priorities in terms of the procurement of building works and this will be discussed in more detail later in this chapter. Cartlidge (2013 b p.95) supports this trend and states, "during the recent past the BQ has been criticised in some circles, as being outdated and unnecessary in the modern procurement environment. Indeed, the number of contracts based on a BQ has declined sharply over the last 20 years or so."

Lee *at al* (2011) also support this view, but qualify their discussion with the fact that the use of the BQ is only one option available for the procurement of construction contracts and that the skills of measurement are still very much required in some form or other. It is this requirement that has resulted in the responsibility of measurement becoming more widespread.

2.3.2 Who is responsible for measurement?

The decline in the use of the BQ has meant that the measurement process has gone from being the preserve of the private practice quantity surveyor (PQS) and become a necessity for the contractor's quantity surveyor (CQS), or in many cases further down the supply chain to the sub-contractor's quantity surveyor (SCQS). This switch in responsibility is in no small part due to the subject of liability and this view is supported by the RICS (2013d p.19) in their latest measurement guidance. If the PQS produces a BQ then the client is responsible for the accuracy of those quantities. If a BQ is not produced for the client by the PQS then the contractor will have to produce their own quantities to enable them to accurately price the work, and in turn be responsible for their own quantities and therefore pricing.

This is a fundamental point about measurement – it is entirely necessary to accurately measure items of construction work in order to accurately price them. Lee *et al* (2011) stress that substantial errors can lead to increased costs for the responsible party.

They also state that "if, however, the BQ is not a part of the contract, as for example when a contractor prepares a tender from drawings and specification, the risk of errors in the quantities is taken by the contractor" (2011 p.15). Ashworth *et al*. (2013 p.9) suggest that "the wheel may have turned in some respects since instead of preparing bills for clients, quantity surveyors are preparing bills for contractors."

It is this transfer of risk that has had the biggest impact on the production of the BQ and both Lee *et al* (2011) and Towey (2012) support the notion that with the advent of alternative procurement routes, particularly that of Design and Build (D&B), the transference of risk is possible and also very attractive to clients. If the risk is passed to the contractor any mistakes or shortcuts that are taken, which lead to errors, are the sole responsibility of the contractor.

Taking this current state of affairs into account it is clear that the measurement process is still required and is still performed by the PQS, CQS, and QSs working in other parts of the supply chain. However, when this is required depends on the stage in the construction process and also the chosen procurement route.

2.3.3 When is measurement used and how is it influenced by procurement?

As has already been discussed, measurement as a process is used in one form or another throughout the entire construction process, from inception to completion and beyond. For the stages before the preparation of contractual documentation, the PQS has traditionally been responsible for the production of cost estimates and cost plans to assist clients with their decision making. This cost planning process is supported by the Building Cost Information Service (BCIS) who are an independent organisation who collate construction cost data from completed projects for PQS's to use when estimating the cost of projects based on limited information.

Previously, with the exception of the BCIS standard form of cost analysis (SFCA), there was no set of rules used for early cost advice, resulting in many practitioners doing as they wished and often relying on in-house data (Cartlidge 2011). This compounded the inaccuracy of cost advice, and also made comparison between early cost plans and BQ's difficult as different methods had been employed. This problem was also compounded when the early cost plan was used to negotiate contracts instead of a full BQ. (Lee *et al* 2011)

Early cost advice requires a different set of measurement techniques and although there is more interpretation in compiling such an estimate, the basic principles of accuracy and consistency still apply. As stated, this process is ordinarily the reserve of the PQS. What is clear is that the measurement of building works is undertaken at various stages in the broader construction process, and that the measurement process is also influenced by the particular procurement route that is in operation for any given project. It is therefore necessary to outline the two most popular procurement routes and their relationship to the measurement process.

2.4 Procurement Overview

Procurement is one of the most important stages in any development activity as it sets the initial boundaries and relationships that each different party will have with one another. Procurement can take many different forms to suit various projects from one-off house extensions through repetitive supermarkets to one-off mega structures.

The most commonly used procurement methods are the 'Traditional' method and the 'Design and Build' method (RICS 2010) and these two approaches will be discussed in greater detail.

2.4.1 Traditional Procurement

Traditional procurement has strong links with the measurement process, particularly the production of the BQ. The RICS professional guidance (RICS 2013c p.7) gives a good summary of the route as follows:

A commonly adopted UK route, particularly for inexperienced or occasional construction clients. It is seen as the 'least risk' approach, as there is a level of certainty about design, cost and duration inherent in the strategy if it is properly implemented. The sequential nature of the strategy, which is necessary to assure low risk, does mean that it can be relatively slow prior to the commencement of construction.

The sequential nature refers to the need for drawings to be completed first, usually followed by production of the BQ, before they are sent out to various contractors to tender for the work. As has already been discussed, this can provide useful price certainty for the client, but can also leave them exposed to risk if the BQ is inaccurate.

A current popular adaption of this route is to follow the same path, but with the exclusion of the BQ. This, in turn, places the responsibility for producing the quantities on the contractor and is often referred to as 'Spec and Drawings' in reference to the documents that are provided to the contractor. Figure 2.1 shows the relationship of the various parties under a traditional procurement route and it can be seen that there is a clear distinction between the clients 'team' and the contractors 'team'. There is very little overlap between processes, if any, which can lead to an increase in overall project time and also create possible adversarial relationships.

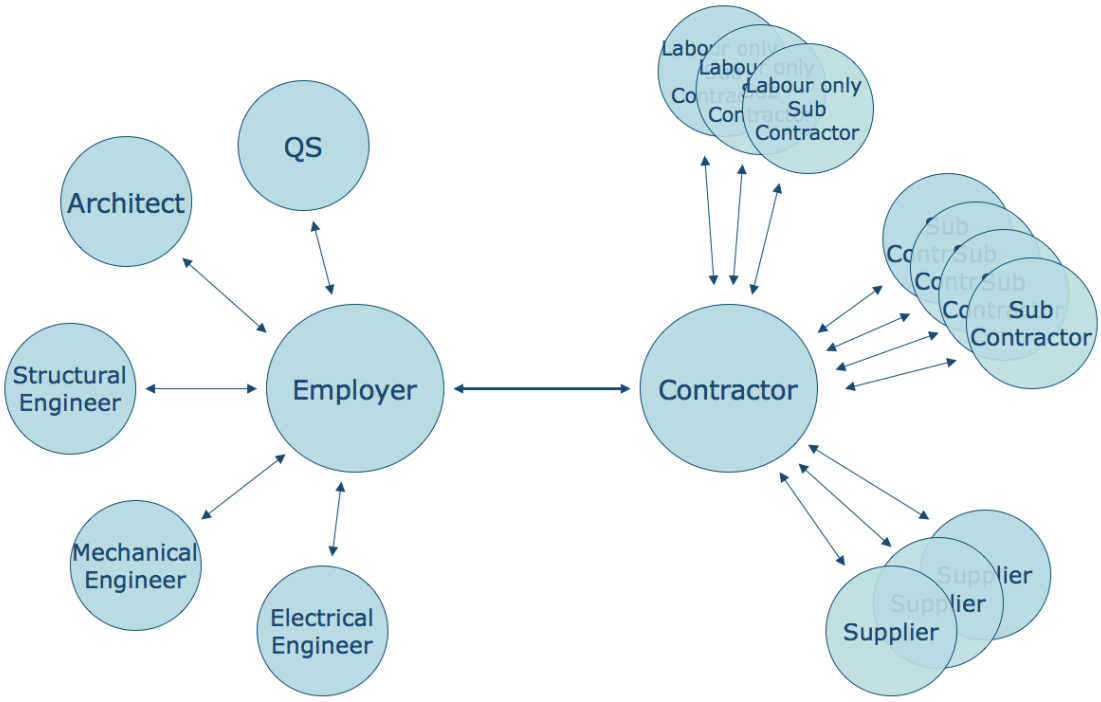


Figure 2.1 - Diagram representing the relationships of the various parties under a traditional procurement arrangement.

2.4.2 Design and Build Procurement

Design and Build (D&B) is an increasingly popular procurement route (RICS 2010) that differs from traditional and can be summarised as follows:

> *Under a 'design and build' route, a single contractor assumes the risk and responsibility for designing and building the project, usually in return for a fixed-price lump sum. Because this approach includes the integration of design, construction can start before all the detailed design is completed and the overall project duration is thus reduced.* (RICS 2013c p.10)

There are many adaptations to the D&B route, for example the novation of design teams, but no matter which path is chosen the principles remain the same. The client will employ a professional to manage their requirements while all other responsibility is passed to a contracting organisation. This results in no requirement for a BQ from the

client, and once again responsibility for the quantification and pricing of the work falls to the contractor. This responsibility for quantification can then in turn be passed down the supply chain to sub-contractors depending on the main contracting organisations desires.

Figure 2.2 shows the relationship of the various parties under a D&B procurement route and it can be seen that there is now an even clearer distinction between the clients 'team' and the contractors 'team'. The contractor is now responsible for all aspects of the design and the build of the project with the client taking advice from his advisors.

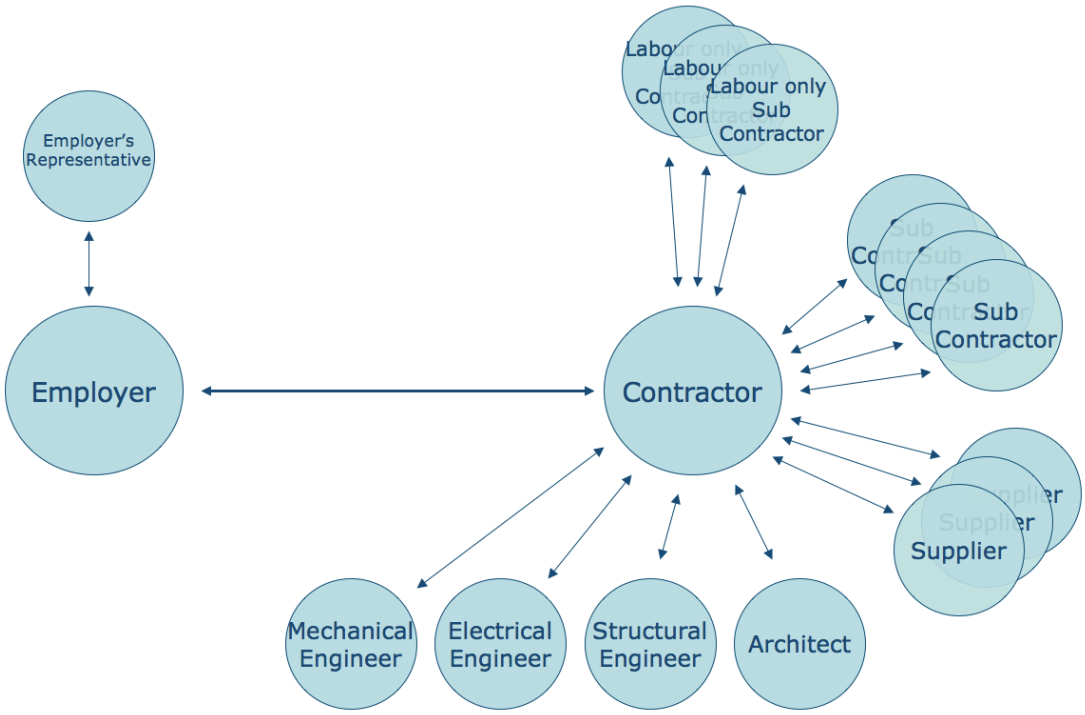


Figure 2.2 - Diagram representing the relationships of the various parties under a D&B procurement arrangement.

2.4.3 Contracts in use survey.

Every three years the RICS undertakes the largest survey of its kind on the current use of procurement in the UK. The 2010 survey (RICS 2013) is of interest as it is the most current survey and shows trends in procurement over the years and also provides a commentary on the current state of procurement in the UK, although the findings need

to be read with consideration of the relatively small sample size of the survey in comparison to the relative size of the industry. Some key facts as follows (RICS 2013):

- *The use of Bills of Quantities increased in 2010 compared to 2007 and BQs are used in 25% of building contracts.*
- *The use of lump sum contracts based on specification and drawings rose in 2010.*

Interesting observations within the survey highlight the increasing use of D&B for larger projects and an increase of use of the BQ compared to the previous survey (RICS 2010). Tables 2.3 and 2.4 below show the trends in procurement over the last twenty years, by number of contracts and by value of contracts. It can be clearly seen that D&B has increased in popularity, with a slight dip by number of contracts in this latest survey, but an increase in the use by value of contract and in turn the nature of the measurement process has been adapted to suit. What is clear is that although the use of the BQ has increased, the majority of projects are procured in such a way that requires the contractors to undertake the measurement process.

	1989 %	1991 %	1993 %	1995 %	1998 %	2001 %	2004 %	2007 %	2010 %
Lump Sum – Firm BQ	39.7	29.0	34.5	39.2	30.8	19.6	30.0	20.0	24.5
Lump Sum – Spec & Drawings	49.7	59.2	45.6	43.7	43.9	62.9	42.7	47.2	52.1
Lump Sum – Design & Build	5.2	9.1	16.0	11.8	20.7	13.9	13.3	21.8	17.5
Target contracts	-	-	-	-	-	-	6.0	4.5	3.7
Re-measurement – Approx. BQ	2.9	1.5	2.3	2.1	1.9	1.7	4.0	1.7	0.3
Prime Cost Plus Fixed Fee	0.9	0.2	0.3	0.7	0.3	0.2	0.2	0.5	0.6
Management Contract	1.4	0.8	0.9	1.2	1.5	0.6	0.2	0.7	0.0
Construction Management	0.2	0.2	0.4	1.3	0.8	0.4	0.9	1.1	0.3
Partnering Agreements	-	-	-	-	-	0.6	2.7	2.3	1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2.3 - Trends in methods of procurement by number of contracts (RICS 2013 p.8)

	1989 %	1991 %	1993 %	1995 %	1998 %	2001 %	2004 %	2007 %	2010 %
Lump Sum – Firm BQ	52.3	48.3	41.6	43.7	28.4	20.3	23.2	13.2	18.8
Lump Sum – Spec & Drawings	10.2	7.0	8.3	12.2	10.0	20.2	10.7	18.2	22.6
Lump Sum – Design & Build	10.9	14.8	35.7	30.1	41.4	42.7	43.2	32.6	39.2
Target contracts	-	-	-	-	-	-	11.6	7.6	17.1
Re-measurement – Approx. BQ	3.6	2.5	4.1	2.4	1.7	2.8	2.9	2.0	0.7
Prime Cost Plus Fixed Fee	1.1	0.1	0.2	0.5	0.3	0.3	<0.1	0.2	0.6
Management Contract	15.0	7.9	6.2	6.9	10.4	2.3	0.8	1.1	0.0
Construction Management	6.9	19.4	3.9	4.2	7.7	9.6	0.9	9.6	0.1
Partnering Agreements	-	-	-	-	-	1.7	6.6	15.6	0.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2.4 - Trends in methods of procurement by value of contracts (RICS 2013 p.8)

2.4.4 Impact of Procurement on Measurement

As has been discussed, procurement choice can have a significant impact on the measurement process in terms of who measures, when they measure and why they measure. There are risks associated with quantification, as those who quantify are liable for their work. Therefore, if a main contractor passes this responsibility down to sub-contractors for example, it is the sub-contractor who becomes responsible for their own quantities.

Due to these developments in procurement the actual process of measurement has had to change to suit the various different requirements. Liability is now being passed to different parties who are now responsible for their own quantities. This is very different to when the PQS was producing a BQ for all tendering contractors to price using a standard set of measurement rules such as SMM7.

Ashworth *et al* (2013), and Cartlidge (2013a) concur that when contractors are required to produce their own quantities, the SMM7 and other guides are not always used as no one else will be relying on the data and therefore the approach to measurement will be very different. One significant impact of this current practice is that instead of one PQS producing the BQ and charging the client a fee, each contractor now has to measure and price their own work. This will in turn result in abortive costs for those contractors whose tenders are unsuccessful, which in turn will be passed onto other clients at a later stage (Ashworth *et al*. 2013). This shift in responsibility also means that contractors will want to take a more pragmatic approach to measurement and produce their quantities as quickly and efficiently as possible to minimise any abortive costs. This has resulted in what are termed 'builders quantities', which are defined by Cartlidge (2013a p.282) as: "quantities measured and described from the builder's viewpoint, rather than in accordance with a set of prescribed rules, such as SMM7 or NRM2."

Towey (2012 p.78) supports this description and states "A builder's bill of trade quantities is flexible and informal, and uses measurement and descriptions to define a scope of works from a builder's perspective. Descriptions include working or operational methods and a number of shortened descriptions that are abbreviated versions of SMM rules or volume 2 of the RICS new rules of measurement."

This suggests that contractors may be using standard methods such as SMM7 as a basis for their measurement but as is often found (Towey 2012), contractors actually develop their own in-house measurement guides with rules to suit their working methods and pricing strategies.

2.5 The Need for Standards

"It is vitally important that measurement practice applied to buildings is both accurate and consistent." (Cartlidge 2013b p.95)

In order for construction work to be accurately priced it needs to be accurately measured. The quantification is only one side of this particular coin as the other, arguably more important side, is the description of work. Descriptions identify the items of work, its exact specification and also encompasses what is specifically included

within that item (Kodikara *et al*. 1993). In order for this description to be workable, consistent and fair standard methods of measurement, such as SMM7, have been published for many years to allow all concerned to see exactly what is measured and how. As can be appreciated, construction contains many processes, some more complex than others, and many specific materials. For example, when measuring brickwork under SMM7 you are deemed to have included the mortar. Those pricing need to be aware of this to ensure they price the mortar into their brickwork item to avoid under-pricing the item.

Originally published in 1922 by the RICS and the Building Employers Confederation SMM has been an industry standard with further editions in 1927, 1935, 1948, 1963, 1968, 1978 and 1988 with the current SMM7 edition being released in 1998 (Seely 1999). Cartlidge (2013b p.101) describes the development of the SMM as "an attempt to bring uniformity to the ways by which quantity surveyors measured and priced building works."

The various revisions were necessary to keep up to date with advances in construction technology and working practices that are constantly changing. That being said, since its update in 1998 there have been no further revisions to SMM7 despite the industry having moved on and changed (Cartlidge 2011). This is in part due to the decline of the BQ and the rise of more independent measurement by contractors and as such many use their own adapted versions of the SMM7.

Seely (1999 p.7) observed that:

> *Although it has been established that a number of measurement approaches are being employed within the construction industry, this does not alter the need to learn initially how to measure using the rules. Once this technique has been mastered, it is a relatively straight forward matter to adapt to other forms of measurement.*

It is this methodical approach to measurement that is an integral part of being a QS and in turn has resulted in SMM7 still being taught in colleges and universities across the

country as the benchmark of good practice, irrespective of what individual companies may do.

2.5.1 The need for current standards

With the last update to SMM7 being in 1998, there has been many developments in the construction industry over this time period and so in 2003 the RICS QS and construction professional group commissioned a report: 'Measurement based procurement of buildings' (Cartlidge 2013b).

Cartlidge (2013b p.103) who himself was a member of the professional group, summarised the findings of the report as follows:

- Low response to the survey.
- 20% of consultants responded.
- 12% of contractors responded.
- Confirmed measurement still had an important role to play.
- Measurement used in a variety of ways by different sectors.
- Rise of D&B has encouraged the use of contractors BQ's where few documents are prepared to a standard format.
- Alleged that SMM7 is out of date.
- SMM7 requires a greater level of detail than is warranted by current procurement practice.

This corroborates the earlier discussion based around current literature and it was these findings that led to further consultation and the development of the New Rules of Measurement (NRM). Cartlidge (2011 p.37), identifying the rationale for the introduction of the NRM believes it provides:

- A standard set of measurement rules that are understandable by all those involved in a construction project, including the employer, thereby aiding communication between the project/design team and the employer.
- Direction on how to describe and deal with cost allowances not reflected in measureable building work.

The intention of the documents being introduced is to have a suite of documents covering all aspects of the measurement and description of a building project – from 'cradle to grave'. Lee *et al* (2011 p.4) describe the NRM project as "arguably one of the most significant developments in quantity surveying practice since the publication of SMM7 in 1988."

Following consultation, the NRM Volume 1 (NRM1) was introduced in March 2009 and an updated version released on 24th April 2012. NRM volume 2 (NRM2) was also released on 24th April 2012 with NRM volume 3 (NRM3) released in March 2014.

2.5.2 NRM1

"One of the factors that has driven NRM1 is the lack of specific cost advice on the measurement of building works solely for the purpose of preparing cost estimates and cost plans." (Cartlidge 2011 p.39)

NRM1 is concerned with the quantification of building works for the purposes of early cost estimates and cost plans. Lee *et al* (2011 p.10) state that "the use of volume 1 is therefore intended primarily to be restricted to the design stages before production or construction drawings are developed and prior to the preparation of detailed tender documents."

The need for NRM1 arose due to the decline in the use of BQ's produced to SMM7 standard. Cost data is no longer contained in BQ's and therefore the BCIS data was becoming increasingly difficult to manage and interpret. The BCIS SFCA was based on SMM7 principles and did not therefore fit easily with the current trend for builder's quantities. In addition, contractors stopped submitting their cost data to the BCIS and as a result the accuracy and use of the BCIS database was quickly becoming a concern (Cartlidge 2013b).

In addition to NRM1 giving current guidance on how to compile early cost advice, it also set out to standardise the way in which certain elements were dealt with, which no other method of measurement had done before. It included items such as preliminaries,

overheads and profit, design fees, project team fees, inflation and risk (Lee *et al* 2011). This was an important step forward for consistency and accuracy of early cost advice as no method had been published for this stage of the process before. The RICS have understandably been promoting the benefits of NRM through various channels such as its own construction journal, Building Magazine and through Continued Professional Development (CPD) roadshows throughout the UK.

In addition to this publicity campaign, the RICS have issued NRM1 as official RICS guidance. This means that the status of the document is not technically for chartered surveyor's compulsory, but as Lee *et al* (2011 p.11) state "this may create problems for any surveyor who does not follow the guidance should any of his methods be called into question. In the extreme, not following the guidance may also invalidate his Professional Indemnity Insurance." The RICS obviously wants its members to utilise its latest publication and to ensure consistency across the profession so this is something that QS's need to be aware of and consider when giving early cost advice.

2.5.3 NRM2

NRM2 was launched three years after NRM1 and is essentially an update to SMM7 concerned with detailed measurement as it quite clearly states in the document itself, "NRM 2 replaces the *Standard Method of Measurement for Building Works* ('SMM'), which was first published by RICS in 1922, with the latest edition being SMM7, published in 1988" (RICS 2013d p.v). It is concerned with the measurement of building works where a BQ is required in the first instance, but it is also intended to represent the various trades better, following detailed consultations, than SMM7 and in turn could be a basis for all construction measurement where accurate pricing is required.

> *Many within the profession waited anxiously for the new rules amidst talk of a revolutionary approach to the measurement of quantities. In the end the new rules are better described as evolutionary, reflecting the changes in the approach to procurement that have gradually been evolving over the last 20 years or so.* (Cartlidge 2013b, preface)

This comment from Duncan Cartlidge summarises the nature of the NRM2 and also the views of those who are involved in its use and education such as Lee *et al* (2011). These comments are also reflective of the consultation for NRM 2, which was focused mainly on sub-contractors as it was trying to reflect the importance of that side of the industry (Cartlidge 2013b) which correlates with the previous findings of this chapter where the liability for quantification accuracy is gradually being pushed down the supply chain.

NRM2 has the same document status as NRM1 and as such is a direct replacement for SMM7. In what appears to be an attempt to encourage the use of NRM1 and NRM2 they are both available free to RICS members, but must be purchased by any non-members, which should assist adoption by RICS members utilising NRM2 for BQ production. It is the intention of this research to discover if such adoption is indeed the case and also to what extent NRM2 has been adopted by contracting organisations in lieu of SMM7, adapted SMM7 or in-house procedures.

Table 2.5 summarises the actors involved in measurement, their function and relationship to the three most popular procurement routes in the UK. The sole inclusion of the NRM forms attempts to simplify matter, but it is acknowledged that under the D&B and Specification and Drawings routes, where the contractor is responsible for the measurement function, any form of measurement may be used and may be unique to each contractor; for example, builder quantities.

		Procurement Route			
Measurement function	**Standard form**	**Traditional**	**D&B**	**Spec & Drawing**	
Cost Plan 1	NRM1	PQS	PQS	PQS	**Responsibility for Measurement**
Cost Plan 2	NRM1	PQS	PQS	PQS	
Cost Plan 3	NRM1	PQS	PQS	PQS	
BQ Production	NRM2	PQS	Contractor	Contractor	
Pricing of works	NRM2 (if available)	Contractor	Contractor	Contractor	
Variations	NRM2 (if available)	PQS	Contractor	Contractor	
Final Account	NRM2 (if available)	PQS	Contractor	Contractor	

Table 2.5 - Measurement function and ownership for the most popular procurement routes.

2.6 Summary

This chapter has identified the evolving role of the QS seeking to remain cost and measurement centred in a changing industry. The core competencies are still alive and well, though modified from what might be termed the 'traditional' approach. Measurement is still undertaken by members of the industry, but now instead of being the preserve of the PQS it is being undertaken by the CQS and even various levels of sub-contractors in the construction supply chain.

Despite the changing nature of procurement practice, one aspect that remains static is that no matter the type of work, someone somewhere has to produce a schedule of works to be able to accurately price the works. The responsibility and liability of this is now often being passed to those responsible for the works themselves and is no longer the preserve of the PQS.

Given the importance of measurement, the use of standards to regulate practice has endured to this day in the SMM7 and even though outdated it is still a valuable set of rules by which to measure quantities and produce descriptions for building work.

However, whilst valuable, owing to the changing nature of the industry many have adapted the rules for their own purpose. This is resulting in an industry with a declining sense of cost certainty and an aversion to risk in terms of quantification.

The introduction of the NRM is an innovation by the RICS that is to be applauded as it attempts to bring much needed consistency to the cost planning stage of the process with NRM1 and also a long awaited update to the measurement rules for building works in the form of NRM2. These documents have had an interesting gestation and introduction and the RICS expects them to be utilised by the QS profession across all sectors of the industry.

As has been discussed, the industry itself is made up of thousands of SME's and the QS profession, whilst represented by such a large organisation as the RICS, is also hugely differentiated with QS's working in every type of organisation within the industry. As such, the diffusion of these new measurement rules amongst the QS profession will be a fascinating journey to follow and it is hoped that along the way not only will the current use of the NRM suite be found, but also the more qualitative aspects of this outcome such as why was NRM adopted? How was the decision to adopt made? What other influencing factors were involved? How do QS's communicate as a social system?

The following chapter will explore the social phenomenon that is the diffusion of innovation, which will be followed by a detailed review of existing diffusion literature within the construction management subject area. Finally, a theoretical framework is delivered by synthesising these three chapters.

Chapter 3 – Literature Review

3.1 Introduction

The previous chapters have identified the apparent lack of innovation in the construction industry, the role of the QS within that industry and current professional practice with regard to the measurement of building works. This chapter will now explore the social phenomenon that is known as the diffusion of innovation in order to gain a better understanding of this research area and assess its applicability, and usefulness, for application in a construction specific context.

Each actor will undertake their own unique journey when considering an innovation for adoption, and it is this journey that will be explored through this research. In order to better understand the actors journey, a review of the current diffusion literature is necessary to appreciate the exiting diffusion research landscape and then discover where this research can coherently add to this existing body of knowledge.

The industry still favours the more adversarial procurement approaches (RICS 2013) and this coupled with the fragmentation, complexity and interdependency of the industry make it more difficult for innovations to diffuse as diffusion is so reliant on the flow of communication amongst a social system. These temporary relationships, and the sheer volume of companies, result in numerous but weaker communication links and the impact that this can have on diffusion cannot be ignored.

The introduction of the NRM to the QS profession is the latest innovation in measurement practice since 1988 when SMM7 was launched for the first time and is an important milestone in the history of the QS. This professional practice innovation has already been introduced to the industry by the RICS and it is for this reason that this research will focus on the diffusion of the NRM among the QS profession. Using the NRM as the main ‘hook’ for this investigation will provide a detailed contextual view of the actors’ journeys through the diffusion process and will help to achieve the main research aim.

Authors such as Sexton *et al* (2001) claim "research regarding innovation diffusion in the UK construction industry is in its infancy and requires further investigation". This statement is still relevant today, as the number and quality of diffusion research within a construction industry context is still low, especially so when restricted to those focused on the UK construction industry. Sexton and Lu (2009) suggest that innovation research tends to focus on large firms in stable supply chains, and very rarely on smaller firms with unstable supply chains, and even less on construction based professional practices. This research attempts to address this shortfall and will focus on the role of the QS within a UK construction industry context. Many researchers focus on innovation creation, such as Blayse (2004), Reichstein *et al* (2005) and Harty (2008), rather than innovation diffusion. This is an important distinction to make as innovative practice within a company is quite different to the adoption of an innovation, both have similarities but the process and therefore research approach are quite different. In addition to this observation, many construction related diffusion studies are focused on the diffusion of new products, as opposed to processes or professional practices, which is not surprising considering that the construction industry is essentially an offsite manufacturing process which brings together numerous products to create finished buildings. While this research will be focusing on professional practice innovation the product diffusion literature will also be examined, as the main principles may still be relevant.

The following will now identify key authors and principles within both the classical diffusion literature and also the construction management specific literature to provide both an overview of the diffusion landscape but also to provide the focal areas for this research.

3.2 Definitions

In order to begin to understand the diffusion of innovation it is necessary to identify some key definitions of the commonly used terms 'innovation' and 'diffusion'.

3.2.1 Innovation

Rogers (2003p.xx) defines innovation as "an idea, practice or object that is perceived as new by an individual or another unit of adoption" while Jones and Saad (2003 P.xv) argue that "Innovation is a new idea that leads to enhanced performance. It is not a single or instantaneous act but a whole sequence of events that occurs over time and involves all the activities of bringing a new product, process or service to the market."

Sexton and Lu (2009) agree with Rogers definition of innovation where the product or service is perceived as new and summarise their point by suggesting that if the idea seems new to the individual, it is an innovation. They also identify that construction literature shares the same approach as other literature and that the common theme across the debate is that 'new ideas' are taken to be the starting point for innovation.

Larsen (2005 p.61) provides a detailed review of the historical development of diffusion research within a sociological context, concluding with his own definition for innovation, derived from Rogers (1995, 2003), Tornatzky *et al* (1990) and influenced by Harkola (1995) yet embedded in a realist perspective.

> *An idea, practice or material artefact perceived as new by an entity based upon the layered perspective of the social system.*

What is quite clear from these definitions is that the common agreement of an innovation is something that is perceived to be new to an individual, be that a new product or a new process. The innovation does not have to be only just released to market to be new, it is the perception to the individual that makes its new, and in turn an innovation to that individual.

This research is not concerned with the generation of innovation and therefore for the purposes of this research Rogers (2003 p.xx) definition suits the research direction perfectly,

> *an idea, practice or object that is perceived as new by an individual or another unit of adoption*

This supports the use of the NRM as an innovation as it is new practice that has been launched by the RICS and will be new to individuals in the construction industry.

3.2.2 Diffusion

Valente (1995 p.xi) states that,

> *The diffusion of innovation occurs among individuals in a social system, and the pattern of communication among these individuals is a social network. The network of communication determines how quickly innovations diffuse and the timing for each individual's adoption.*

While Rogers (2003p.5) defines diffusion as "the process in which an innovation is communicated through certain channels over time among members of a social system" and communication as "a process in which participants create and share information with one another in order to reach a mutual understanding".

Rogers (1962, 1970, 1971, 1981, 1995, 2003) and Valente (1995, 1999) are two of the key authors in the diffusion field with numerous publications to their names that will be discussed in more detail in this chapter. Their definitions as stated look at diffusion from a similar perspective, which is to be expected as the two have previously worked together and clearly have a mutual respect for each other's work. What is clear though is that diffusion is a process whereby an innovation is communicated over time to individuals within a social system.

For the purposes of this research Rogers (2003 p.5) succinct definition is most suitable,

> *the process in which an innovation is communicated through certain channels over time among members of a social system*

In terms of this research the innovation has already been identified as the NRM and with this already being officially launched it is clear that the NRM is already in the diffusion process where the social system being diffused into is that of the QS

profession. Further discussion on the boundaries of the social system in the terms of this research will follow.

3.3 Key Authors and Common Types of Diffusion Research

3.3.1 Key Authors

Larsen (2005 p.93) argues that Rogers is the most published author within the field of innovation diffusion and that his work represents the most complete approach of all diffusion research. This is supported by the more recent work of Rose and Manley (2012) who state that Rogers book '*diffusion of innovations*' has over 39,000 citations according to Google scholar. Rogers' framework encompasses the three main innovation diffusion concepts and Larsen (2005) posits that Rogers' research takes a pluralistic system perspective, searching for laws of behaviour. Katz (1999 p.145) meanwhile states, when discussing the breadth of diffusion research, that "hardly anybody – with the major exception of Everett Rogers – has taken charge of claiming, collecting, and cataloguing these disparate cases for comparison."

In addition, Valente (1995) is a well respected author whose focus is on a network perspective of diffusion and his 1995 book '*Network models of the diffusion on innovations*' is a key text in the understanding of diffusion from a network analysis perspective and also considers all three of the main innovation diffusion concepts.

It is these two key authors, Rogers and Valente, and their work that will form the backbone and structure of this chapter in order to provide a coherent starting point with which to base a critical review of the main diffusion concepts and allow further adaption of these concepts for the suitability of a construction specific diffusion approach for the purposes of this research.

3.3.2 Common Types of Diffusion Research

Before taking a detailed look at the work of Rogers and Valente and their respective diffusion approaches, it is worth considering the different types of diffusion research that has been undertaken and identify any areas of particular importance, strength and indeed weakness.

As can be inferred by his approach to combining the three main theories, Rogers (2003p.xvi) was convinced that "diffusion was a general process not bound by the type of innovation studied, who adopters were or by place or culture". His book (2003p.xvii) is about "regularities in the diffusion of innovations, patterns that have been found across cultures, innovations and the people who adopt them" and identifies that in 2003 there were approximately 6000 publications on diffusion and that "no other field of behavioural science represents more effort by more scholars".

Rogers (2003) argues that the invisible college of diffusion scholars limits the ways in which diffusion was studied and that a standardisation of approach constrained the intellectual progress of diffusion research. Katz (1999 p.145) supports Rogers approach to theorising diffusion and suggests that there is a poverty of theory and states "the number of diffusion studies continues at a high rate while the growth of appropriate theory is at an apparent standstill". This contradicts Larsen (2005) who argued that it was Rogers' general approach to diffusion that was limiting and that a more context specific approach was required.

Larsen's work will be discussed in more detail but it is worth noting that while his criticism of Rogers' work is valid, without Rogers and his tireless and methodical approach to generalising the diffusion process the field of diffusion research would share no common language or indeed even be recognised as being part of the same research landscape. Indeed, it is the intention of this research to contextualise the work of authors such as Rogers and Valente so that the existing body of knowledge in a specialist area, such as construction, can be added to.

In his latest work Rogers (2003 p.96) identified eight types of research that reflected the state of diffusion research to that point in time. These broad categories give a good indication of the type of research that has been published and help to demonstrate the breadth of research possible within the diffusion paradigm. The following is a summary of those areas.

1. Earliness of knowing about innovations.
2. Rate of adoption of different innovations in a social system.

3. Innovativeness of members of a social system.
4. Opinion Leadership in diffusing innovations.
5. Diffusion Networks.
6. Rate of Adoption of innovations in different social systems.
7. Communication channel use.
8. Consequences of innovations.

What can be seen from this is that there are many ways to apply diffusion studies to a given scenario and many variables to consider. These types of study all conform to the Rogers model of diffusion and also use the commonly adopted language also supported by Rogers. In addition to undertaking a diffusion study using methods as above, it is this authors opinion that it is necessary to contextualise the methods and adapt Rogers model to suit a more specific context. This supports the views of Larsen (2005) and Emmitt (1997).

3.3.3 Contributions and Criticisms of diffusion research

Diffusion research is not without its critics and many of these criticisms focus on the method employed when obtaining the primary data. Other critics, such as Larsen (2005) focus on the generalisation of the models proposed by authors such as Rogers (2003).

Rogers (2003 p.103) is quite clear in his work and describes it as a "conceptual paradigm with relevance for many disciplines". By its very nature diffusion research is applicable to many different products and processes across many different scientific fields. Rogers diffusion approach provides a common conceptual ground to help to link these different disciplines and scientific fields. Rogers further supports this approach by stating that without a higher-level diffusion model the "body of complicated research would be a mile wide and an inch deep." (Rogers' 2003p.105)

While there certainly seems to be an element of self justification in his work, it has to be said that even with its critics, such as Larsen (2005), Rogers work has embedded itself into diffusion culture, and as was evidenced earlier, his work is by far the most cited when undertaking a diffusion study of any type. It is therefore this authors opinion that

this represents the most appropriate starting point to develop and add to this body of knowledge and as such will be utilised throughout this study.

Every scientific field makes certain assumptions about the complex reality that it studies. These can give researchers blinkers to certain aspects of their work and the diffusion paradigm is no different. What follows is a short summary of the types of criticisms that are typical in diffusion research and it is intended that by stating these early in this research they can be considered during the primary data collection and analysis phases of this research.

Pro-innovation bias

Rogers (2005 p.106) states that,

> *It is the implication in diffusion research that an innovation should be diffused and adopted by all members of a social system, that it should be diffused more rapidly and that the innovation should be neither re-invented nor rejected.*

This is not something that many authors will state in their research but the implication is real and the lack of recognition of this is potentially troublesome. An example of this is that many diffusion studies focus on the positive side of diffusion in terms of who has adopted and why, but less common are studies that focus on who did not adopt and why.

This research had no predetermined bias in this respect, as the intention was to explore the diffusion of innovation within a particular context, and in particular to undertake the research in a qualitative way that allowed asking 'why?' questions about the diffusion process. This supports the suggestions made by Rogers (2005 p.108) for avoiding the pro-innovation bias, and also his observation that using qualitative methods is rare in diffusion research, which is something that this research addresses.

The individual blame bias.

This relates to diffusion research placing the blame for poor diffusion with the individuals who did not adopt. Rogers (2005) is quite critical of research that doesn't address any issues with the source of the innovation. Essentially this type of study

would blame none adopters for not adopting, as opposed to the innovation for being poor, unsuitable or for the diffusion strategy being weak.

This is avoided during this research, as a more holistic approach to this study has been taken to address these criticisms.

The Recall Problem

Rogers (2005 p.126) describes recall as an "important methodological enemy". What this means is that as diffusion occurs over time, many studies rely upon recall data to track the rate of diffusion. This recall data therefore isn't accurate as it relies upon an individual to remember when they adopted.

When researching rates of adoption, it is therefore desirable to undertake a more longitudinal study to analyse the sequential flow of an innovation as it spreads through a social system. This does not directly impact on this study as it is more exploratory in nature and is not seeking rates of diffusion.

3.4 Diffusion Concepts

It is widely acknowledged (Rogers 2003, Larsen 2005, Valente, 1995) that there are three main diffusion concepts embedded across the diffusion literature. These are Cohesion, Structural Equivalence and Thresholds and all focus on the way in which innovations are communicated amongst actors within a social system, a process often referred to as social contagion. The following provides an overview of these concepts along with the main observations and criticisms of each.

3.4.1 Cohesion

Cohesion is the earliest diffusion model and Katz (1964) observed that it is based around face-to-face contact and communication.

Rogers (2003) argues that communication may flow in various directions, based upon position, title or role, while Albrecht and Ropp (1984) and Tichy *et al* (1979) identify differing types of communication, prescribed and informal. Prescribed communication often has patterned relationships as opposed to informal communication, which Tichy *et*

al (1979) describe as 'organic and emergent.' Larsen (2005) suggests that this type of communication grows naturally and is based upon choice and relationships, and is therefore complex and difficult to visualise.

Albrecht (1984) argues that elements associated with the new message such as uncertainty, risk and trust encourage actors to use informal communication networks more than formal ones.

Harkola's (1995) research, which was embedded within the Japanese construction industry, found that there was a strong reliance on interpersonal communication and that the use of informal opinion leaders could accelerate the diffusion process, as much if not more than, formal opinion leaders and that cohesion played a significant role in the diffusion of knowledge.

Larsen (2005 p.99) identifies that Cohesion explanations use the social science method of sociometry, and that an understanding of the network is built around the number of times an actor is nominated by other actors through survey or interview. Cohesion research established categories for actors depending upon how often they were nominated and their position in the network. This in turn means that Cohesion was essentially viewed as a strong ties concept as it is based around the closeness of actors, linking this to their importance concerning innovation diffusion. A notable addition to this methodology was proposed by Granovetter (1973), with the '*strength of weak ties theory*'. This argued that even loosely connected or even isolated actors play a valuable role in diffusion as these actors move in different social systems and act as bridges between bodies of knowledge. Larsen (2005) provides a detailed review of Cohesion, along with the other concepts, and embeds them throughout his research; however, Larsen doesn't acknowledge that the *'strength of weak ties'* theory could play an important role in the construction industry context due to the unique and fragmented nature of the industry and its supply chains.

From a construction industry perspective, Larsen (2005) found the following with relation to the cohesion concept:

- Cohesion was seen as the most natural explanation of diffusion.
- Respondents preferred face-to-face contact.
- Communication networks can be a useful tool to bring about change.
- Inward looking networks were the main source as communication was primarily with other professionals and partners.
- Cohesion works well with collaborative working arrangements.

There are several critics of the Cohesion concept, such as Burt (1987) and Friedkin (1984). Burt in particular argues that diffusion is better explained by the Structural Equivalence concept than Cohesion.

3.4.2 Structural Equivalence

Burt (1982, 1987) argues that diffusion is better explained by the position an individual occupies within a social system with his early work being based on the combination of strong and weak ties from earlier research from that such as Granovetter (1973).

Larsen (2005 p.100) identifies Structural Equivalence as the middle of the three main concepts and that it accepts that informal communication routes exist. Structural Equivalence argues that another phenomenon is more influential in explaining how diffusion actually occurs and is based around actor's positions, their perception of equivalence and blocks of equivalent actors. In this context 'position' within a social system is defined by an actor's pattern of social relations. The use of structural equivalence was supported by research undertaken by Johnson (1986) in an examination of Burt's (1982) earlier work using a practical empirical examination.

Sailer (1978), argued that actors who share the same pattern are deemed to be equivalent, even if they have never met or hold very different positions in the formal structure of an organisation.

Larsen (2005 p.102) identifies that mapping these patterns forms part of the field of mathematical sociology and uses social network analysis, which will be explored in more detail through the work of Valente (1995) later in this chapter. Structural Equivalence advocates that actors in identical positions use each other as a benchmark,

and can make judgements based upon a standard without face-to-face contact. This could be similar to the of the role of a QS with two different QSs reading the same journal that suggests QSs generally are adopting a new technique. As such the QSs see themselves as needing to act in a manner befitting of a QS. Larsen (2005) argues that this is an informal method of communication but is similar to cohesion without the face-to-face element.

Criticism for Structural Equivalence suggests that it is based on a copycat philosophy and not based upon educated decision making or personal knowledge. Larsen (2005) suggests that this theory is linked to a risk adverse philosophy to innovation as it is driven by a fear of failure and that this shares similar traits to the UK construction industry. Valente (1995) investigated previous diffusion studies, such as Coleman *et al*. (1966) from a theory building perspective and concluded that thresholds were a more suitable explanation in relation to innovation diffusion.

3.4.3 Thresholds

Threshold concepts posit that an actor engages in behaviour based upon the ratio of actors in the social system already engaged in the behaviour (Granovetter, 1978). Granovetter (1978) provides an excellent illustration as follows:

- 100 people in a square – potential riot situation.
- Thresholds distributed 1-100.
- Domino effect.
- Person ‘0’ breaks a window.
- Activates person ‘1’.
- This activates person ‘2’ and so on.
- If person ‘1’ were replaced with another ‘2’ then no riot would take place.

Larsen (2005) suggests that Thresholds are influenced by Cohesion and Structural Equivalence and use similar techniques for analysis, yet adopt a broad perspective whilst sympathetic towards individual actors. He states that innovation is communicated at different rates dependent upon the actor, their communication network and the social system they occupy and argues that this layered view of thresholds is pivotal in

understanding individuals and social systems. he found the following when considering thresholds from a construction industry perspective:

- Can operate at different layers; actor – social system.
- Levels around larger firms can slow the diffusion process.
- Relies on critical mass, which is difficult in the construction industry.
- Construction wants guarantees, so where there is risk or uncertainty people want tried and tested.
- Thresholds are being fuelled by the Industry and its perception of risk and failure.

Rogers (1981) undertook a longitudinal study in Korea and found that adoption of an innovation took place after 62% of an actor's communication network had adopted, while Valente (1995) argues that Thresholds occur at different levels, the collective social system and at a personal level. Larsen (2005) states that this previous research identifies a participatory or pluralistic paradigm and argues that actors cannot be considered solely separate nor solely part of a social system but a combination of both.

This is further complicated by Valente (1995) who argues that actor's individual thresholds will vary because individuals cannot accurately monitor the adoption behaviour of everyone in the social system, while Marsden and Podolny (1990) support this view and conclude that network exposure (the proportion of adopters in an actor's personal communication network) was not related to the rate of adoption of innovations.

3.4.4 Discussion of the three alternative diffusion concepts

Discussion of the three conflicting diffusion concepts of Cohesion, Structural Equivalence and Thresholds remains scarce in current literature with Larsen (2005) being the only author to discuss them in any detail within the construction management field. However, these three concepts have been discussed in detail above and the unique way in which Larsen (2005) utilised these within his research alongside the discussion of Rogers (2003) innovation-decision process was identified as being inspired by the work of Valente (1995). Larsen's (2005) mapping of these concepts along the timeline of the innovation decision process is unique and shows that they are still relevant and

need to be considered within this research. As such these will be addressed within the primary research collection with respect to how relevant they are to the particular context and if they are relevant, consideration will be given to when they are most relevant with respect to the timeline proposed by Larsen (2005).

3.5 Diffusion Networks and Mathematical modelling

3.5.1 Diffusion Networks

Diffusion networks are an important consideration when undertaking a diffusion study as they convey evaluation information about an innovation to an individual in order to decrease uncertainty about a new idea. Understanding and analysing these networks forms a part of many diffusion studies but can also be a specialist area using the various social network analysis (SNA) techniques as championed by Valente (1995), and later by Larsen (2011).

3.5.1.1 Models of communication flow

In order to understand the impact of communication on the diffusion process one must first understand the flow of communication.

One such understanding is the hypodermic needle model (Lazarsfeld *et al* 1968), which postulates that the mass media had a direct immediate and powerful effect on a mass audience. While a more rounded understanding is the two-step flow model (Katz 1964), which is concerned with two simple steps in the flow of communication, step one is the flow of information and step two is the spread of influence. Rogers (2003) argues that this is still a simplified understanding and that sometimes it is purely the one step that encompasses both elements of information and influence. One issue that does appear to have been overlooked with this model is that it doesn't analyse the impact of the different sources of information. For example, is a television advert more likely to initiate the second step than a mass email, or what impact, if any, do these methods of communication have on the innovation-decision process?

3.5.1.2 Homophily and Hetrophily in communication networks.

One important aspect of communication models is who relays messages to whom. Rogers (2003) identifies the concepts of homophily and hetrophily, which were originally conceptualised by Lazarsfeld (1964p.23).

Homophily is the degree to which a pair of individuals who communicate are similar, which could be with respect to certain beliefs, religion, education or socioeconomic status, whereas hetrophily is the degree to which pairs of individuals who interact are different in certain attributes.

Homophilious communication is more likely to be effective for the diffusion of innovation, as the individuals will share a common understanding on what they may consider to be important issues.

Hetrophily, however, still plays an important role as it can connect two cliques, which supports the work of Granovetter (1973) who identified the strength of weak ties in communication networks.

The idea of strong and weak ties is something that will be discussed throughout this research, as their importance cannot be underestimated. Homophily can actually act as a barrier to diffusion as strong homophilious communication would limit the spread of an innovation, or discussion about a particular innovation, to that particular clique. For an innovation to diffuse throughout a social system these messages need to flow around the entire system, not just in localised pockets. Hetrophilious communication therefore allows these messages to enter into other cliques and areas of the system and therefore aids the spread of information. An example of this can be found in the work of Coleman *et al* (1966) who studied the diffusion of a new medical drug amongst medical professionals and found that for an innovation with high uncertainty friendship aided initial diffusion through face-to-face communication and that isolated individuals did not adopt until much later. Coleman *et al's* (1966) work has been the subject of much scrutiny over the years, such as Burt (1982, 1986) and Valente (1995), and provides a good understanding of the role of communication on the diffusion of innovation.

3.5.1.3 Communication network analysis

The analysis of communication networks is complex. Although networks have a certain degree of structure or stability, they consist of numerous interconnected individuals who are linked by patterned flows of information. Rogers (2003) identifies the complexity of analysis with the example of 100 members of a system that can mean 4950 possible links. 200 members would be 19,900 links….

Rogers' work on communication network analysis was clearly influenced by Thomas Valente and as such this research will now be discussed in more detail. Valente's work on diffusion focuses on a more quantitative and predictive approach than that of Rogers. While Rogers sought generalisations of individual's behaviour in order to develop his diffusion model, Valente seeks to understand the relationships between individuals and utilise these relationships to estimate the speed in which innovations may diffuse among a social system.

Valente (1995 p.xi) states that,

> *The diffusion of innovation occurs among individuals in a social system, and the pattern of communication among these individuals is a social network. The network of communication determines how quickly innovations diffuse and the timing for each individual's adoption.*

Two key aspects of Valente's work are that of thresholds and critical mass. Valente sees thresholds as an individual characteristic with critical mass models focusing on the entire social system. The differentiation between these will be discussed shortly.

Valente (1995 p.2) is very enthused by network analysis and the use within a diffusion context as diffusion allows a real world application to compare network models. On the subject of network models, he states that,

> *Network analysis is a technique used to analyse the pattern of interpersonal communication in a social system by determining who talks to whom. Network analysis can be used to understand the flow of personal influence by enabling researchers to define who influences whom in a social system.*

Valente (1995 p.4) states that very few diffusion studies investigate social networks and how the flow of communication influences diffusion. In fact, when selecting previous studies for his work Valente found that he was limited by the quality and extent of the previous research.

The history of network models of diffusion can be traced from Coleman *et al* (1966) and Menzel and Katz (1955). Also Rogers (1962) discussion on opinion leadership through to Granovetter's (1973, 1982) strength of weak ties, through to Rogers and Kincaid's (1981) communication networks and finally Burt's (1987) structural equivalence model.

Valente (1995 p.5) argues that,

> *Network models allow the specification of whom and to what degree individuals monitor others in the social system, based on the systems social structure. Thus, network models capture the structure of communication and incorporate this structure into predications of individual behaviour.*

As was identified by Rogers, it is the uncertainty of an innovation that leads an individual to find out more to minimise their risk and increase the adoption potential. This means that individuals are more likely to rely on the behaviour of immediate peers rather than mass media or a perception of what the social norm is.

Data Sets Analysed

Before identifying Valente's concepts, it is important to identify the data sets with which he worked. In order to fulfil Valente's requirements for network analysis he required both time of adoption data and also network data. This is extremely difficult data to obtain and as such is quite rare. At the time of writing Valente could only identify five studies, which had previously collected the relevant data, and of those five only three had data that existed in the public domain. The three studies used were:

- Medical innovation (Coleman *et al*. 1966)
    - 4 communities.
    - 125 respondents.
    - 18 months.
- Korean family planning (Rogers and Kincaid 1981)
    - 25 communities.
    - 1047 respondents.
    - 11 years.
- Brazilian farmers (Rogers *et al*. 1970)
    - 11 communities.
    - 692 respondents.
    - 20 years.

Rather unsurprisingly Rogers, who has already been identified as having a long history in the diffusion research domain, compiled two of these studies.

As one of the most famous studies, some further consideration will now be given to the medical study to provide a clear context and setting for the work of Valente. The Coleman *et al* (1966) study is used as an example in numerous diffusion publications as it contained elements of good practice and was one of the first to consider network analysis. In addition, the time of adoption was accurately recorded as the prescription records were used rather than relying on a respondent's recall, which has already been identified as an important methodological enemy (Rogers 2003). However, the data can still be seen as skewed as the prescription records were only analysed on three consecutive days each month, therefore any other prescriptions would have been missed thereby altering the actual date of adoption. In addition to this Valente (1995) suggests that the prescriptions were in fact only the first trial and that this may not constitute adoption in the Rogers sense of the word where it implies continued use.

The social network data was obtained by asking doctors to name three doctors with whom they most frequently sought for discussion, friendship and advice. The friendship element of this study formed an important aspect as it showed that even though the

doctors had extensive networks those who were friends adopted within a short time of each other.

The Coleman *et al* (1966) study was therefore not without its limitations, and the other two studies were also flawed as they relied upon recall for time of adoption and in addition they were carried out in rural communities in developing countries and as such have limited parallels to modern developed countries. However, as Valente (1995) identified, they were the only three studies that combined the necessary data with which to undertake a network analysis.

3.5.1.4 Contagion

Rogers (1983) refers to contagion as the diffusion effect. This is where individuals are exposed to innovations through their peer network and this exposure has a cumulatively increasing influence on adoption. This is essentially referring to peer pressure.

Valente (1995 p.12) states "contagion refers to how individuals monitor others and imitate their behaviour to adopt or not adopt innovations."

Once again the main diffusion concepts are of interest as it is these communication channels and influence that affect the rate of diffusion. Valente (1995) argues that contagion is modelling the behaviour of those in direct contact, which is similar to the principles of cohesion. Burt (1987) however argues that contagion is more likely to occur through structural equivalence. Valente counters this by suggesting that structural equivalence is the imitation of others in a similar position within the social system, but not necessarily others with whom the adopter communicates. This is an important distinction as network models are focused on communication, and not on people's perceptions and therefore structural equivalence does not have a role to play in network analysis.

3.5.1.5 Prior research on threshold and critical mass effects

Thresholds and critical mass form an important part of Valentes work, and diffusion generally, so it is necessary to briefly consider them before any further discussion. Threshold models of collective behaviour have already been discussed using

Granovetter's (1978) example of a riot situation. Valente (1995 p.17) defines an individual's threshold as "the proportion of a group needed to engage in a behaviour before the individual is willing to do so". This is reasonably simple to comprehend but poses interesting questions when attempting to apply this logic to different contexts. For example, how applicable is this to the construction industry where many individuals work as part of closely connected teams? This is something that will be considered during the primary data collection and analysis.

If a threshold is an individual's tipping point, then critical mass is the social systems equivalent. Valente (1995 p.18) suggests that,

> *Critical mass is thought to occur early in the diffusion process when about 10-20% of the population has adopted an innovation. The critical mass occurs here as it is believed that this is the number of individuals needed to spread the innovation to the rest of the social system.*

Critical mass is a concept that receives significant attention in Valentes work as it forms an important aspect of any network approach to diffusion. As will be seen, the critical mass can occur at many different stages dependent upon many different variables. One of the important aspects of understanding the critical mass and its relationship to diffusion is that the benefits of an innovation increase with each adoption, and in turn the perceived risks and uncertainties decrease, both of which aid diffusion.

Valente (1995 p.22) uses a simple example to demonstrate this as follows,

> *For example, the first person to use a spreadsheet in an office may do so because he or she used it in a prior office or due to a sales campaign or due to contact with another user. Once this first individual adopts this spreadsheet in an organisation he or she lowers the risk for others to adopt it because they now have someone to turn to as an example and to gain support.*

Valente (1995) summarises his thoughts on thresholds by suggesting that it is often the percentage of relevant others that have adopted that determines the threshold level for an individual, not the absolute number or percentage within the social system. This is

interesting as it links back to the idea of close networks having more influence than system wide influence, or personal communication having more influence than mass media. All of these observations point to the individual relationships being of paramount importance in the diffusion of innovation.

3.5.1.6 Relational Diffusion Networks

Relational diffusion network analysis focuses on individuals and their networks. Some of the key aspects are considered below although this is in no way a comprehensive account. The purpose of this exposition is to identify key terminology and theories that will aid the overall research aim.

An individual's network can only be constructed by asking them to name others with which they communicate. This has obvious complications for researchers but does then allow a graph of the communication structure to be produced, which is called a sociogram.

As was found in the Coleman *et al* (1966) study, uncertainty and risk about the new drug forced doctors to turn to their peers for advice, information, and reassurance about the new drug. As the drug diffused, uncertainty and perceived risk decreased, and thus diffusion occurred through the more social network of friendship. It is these more qualitative observations that are of interest for this research, rather than the complexities of sociograms and SNA.

Personal network density

The study of an individual's personal network density shows the degree to which an individual's personal network is interconnected. This means that an individual with a dense network is unlikely to receive information from outside their personal network. As has already been discussed, receiving information along the 'weak ties' is as important to diffusion as those strong ties, so it is desirable for an individual to have a more radial personal network density, that is one which is characterised by communication outside of the individual's personal network.

What can be seen from the analysis of Valente's work is that while the terminology differs from that of Rogers, the main principles remain unchallenged.

Personal Network Exposure

Personal network exposure is simply the degree to which an individual is exposed to an innovation though their personal network (Valente 1995). The measure of this network exposure is called 'connectedness' which measures how much exposure to an innovation an individual receives. The impact of this exposure in terms of adoption depends upon an individual's threshold.

Although thresholds have been discussed, it is worthy of note that Valente (1995) defines an individual's threshold as the exposure to one's personal network at the time of adoption.

This approach to analyse and interpret an individual's network shows obvious benefits when attempting to predict adoption behaviour, and also has interesting ramifications if used retrospectively as Valente has with the previous three diffusion studies. What is clear is that Valente's empirical work supports the earlier work of Rogers but with added depth to aid further quantitative studies.

3.5.1.7 Structural Diffusion Networks

As identified earlier, it is not only the individuals who can influence the diffusion process, the social structure that surrounds those individuals can also have an influence upon those individuals and their adoption decisions. Valente (1995 p.47) states that, "Structural models try to determine how the structure of the social system influences diffusion of innovations. If, for example, diffusion occurred within groups how did innovations spread between groups?"

Structural models differ to relational models as they suggest that the rate and character of diffusion are determined by structural characteristics of the social system within which diffusion occurs (Valente 1995). One of the earliest advocates of this was Granovetter (1979) and his discussion on *'weak ties'* that has already been identified in

earlier discussions. Valente (1995) suggests that this was perhaps the most influential network model to date and that is wasn't really a diffusion theory but a network theory.

Granovetter (1979 p.1366) states that "Intuitively speaking, this means that whatever is to be diffused can reach a larger number of people, and traverse greater social distance, when passed through weak ties rather than strong." This shows a clear and logical explanation and while Valente (1995 p.50) agrees with this conclusion he finds that "a clear empirical analysis of the role of weak ties on diffusion has not been conducted." The complexity of identifying these 'weak ties' could be one reason for the lack of empirical evidence, as one would have to compare identical networks with and without weak ties. The practicalities of this are realistically unachievable, but the theory remains sound. Sheffer and Levitt (2010) found that this relational model plays an important role in the construction industry and they posit that a more stable network will aid the diffusion process. The opposite is true of an unstable network that has fragmented and one-off relationships, such as the construction industry. It is suggested that low relational stability affects the rate of diffusion along with other factors such as the culture of competitive bidding, the lack of a truly multidisciplinary life cycle perspective on the finished project, demand fluctuation, technological risk aversion due to the long life cycles expected from a building and finally possible interventions such as legislation.

Structural Equivalence

Structural equivalence has already been discussed with the main author supporting it being Burt (1987). Valente (1995) identifies that it is the degree to which two individuals occupy the same position in a social system and that a structural equivalence model of diffusion postulates that individuals are influenced to adopt by imitating the behaviour of others.

Burt (1987) also reanalysed the Coleman *et al* (1966) study when proposing the case for structural equivalence, in lieu of the more favoured, at the time, cohesion concept. Burt (1987) preferred a model that did not require direct contact between individuals.

Valente (1995) highlights the importance of Burt's (1987) analysis of structural equivalence effects on diffusion as an extremely important piece of research that led to

the realisation of the different ways contagion can operate, while another medical study by Anderson and Jay (1985) also supports the role of structural equivalence.

Summary of Relational and Structural

What can be seen from this initial discussion on a network approach to diffusion is that structural models exist and show that the structure of a social system can determine the rate of adoption. One of Valente's main criticisms of earlier diffusion studies is focused on the collection of data that doesn't help to identify network structure or influence. While this may be true, it is only a criticism if you are attempting to study relational and structural network data. As has been identified, many diffusion studies are only concerned with limited aspects such as the rate of adoption, which have no requirements for a network analysis.

What is interesting though is that the network approach is returning the same principles that the traditional descriptive approach has already identified. Although they are showing these correlations, what existing models do not show is who influences whom or provide an integrated framework with which to compare relational and structural influences. This is an area where Valente (1995) takes his research further into threshold and critical mass models of diffusion.

3.5.1.8 Threshold Models of Diffusion

Although thresholds have been discussed it is here that Valente (1995) surmises his empirical work and the impact of thresholds on diffusion. He identifies that individuals differ in the degree they are influenced by the behaviour of others in their social system, which is essentially what the threshold concept is based upon. A low threshold is equivalent to low resistance, which in turn results in an early adopter, the opposite is true of a late adopter who is perceived to have a high threshold.

Valente's work is influenced by Granovetter as already identified, but for completeness Granovetter (1978 p.1422) defined an individual's threshold as "the proportion of the group he would have to see join before he would do so".

Valente (1995) identifies that early threshold analysis considered thresholds to be the proportion of influence of the whole group, while current threshold analysis constructed from network information creates thresholds based on influence from one's personal network.

Network Thresholds

In order to apply network thresholds to a network analysis one must consider the roles of observability and uncertainty. Observability is the degree individuals may witness the adoption experiences of others (Valente 1995), which is not to be confused with the Rogers definition of observability in relation to an innovations attributes.

It would be impossible for an individual to know the adoption decision of everyone in the social system and therefore only receive his or her information on other adoption decisions based on direct communication. Therefore, Valente (1995) suggests that diffusion thresholds are the proportion of prior adopters in an individual's personal network when the individual adopts. This is narrowing down the definition of thresholds to a more specific application in the diffusion process.

Personal Network Exposure

Following the discussion on thresholds Valente (1995) identifies that they are essentially the exposure level necessary for an individual to adopt. Exposure differs to an individual's threshold as exposure can be measured at a point in time using network techniques. Once exposure has reached threshold level the individual may now adopt. The social network determines individual exposure and the threshold determines the time of adoption.

In addition to identifying thresholds for individuals, further information can be gathered from these datasets and Valente (1995 p.74) states that,

> *The threshold concept enables us to determine innovativeness relative to the social system and relative to personal networks. The degree of overlap between system and personal network innovativeness measures true innovativeness.*

This helps to provide further methods to identify innovativeness as a concept originally suggested by Rogers (2003) who posited that innovativeness is measured by the time of adoption relative to the social system.

Threshold Lags

Although an individual may reach their threshold and be ready to adopt, not all individuals will adopt at that point for various reasons, such as a lack of resource. Therefore, a threshold lag is suggested by Valente (1995), which is the number of time periods between the time an individual's exposure reaches his or her threshold and his or her time of adoption.

This discussion is limited in the work of both Valente and Rogers but available resources to pay for a given innovation is a serious consideration, especially in the current market place, and is something that requires further investigation.

Valente (1995) accepts that a type of lag that cannot be measured in the current framework is one where an individual reaches their threshold, but does not adopt the innovation, and their network exposure continues to increase. This is another demonstration of the depth of research possible within the diffusion paradigm and is something for others to consider in the future.

3.5.1.9 Critical Mass Models of Diffusion

Valente (1995 p.79) defines the critical mass as "a system level measure of the minimum number of participants needed to sustain a diffusion process." The keyword here is *sustain*, as it is at that point where diffusion becomes self-perpetuating and no further external influence is necessary.

The quantitative approach to calculating and identifying critical mass is too complex to discuss within this study, but essentially the critical mass is deemed to have occurred at the inflection points on a typical logistic diffusion curve. At the system level the rate of diffusion can be influenced by either external influence, such as mass media, or by mixed influence which would be a combination of external influence and also interpersonal communication and both are responsible for the rate of diffusion.

As already identified, mass media can help with an individual's awareness, but this does not automatically translate into an adoption decision and it is here where thresholds and critical mass may have a role.

The rate of critical mass is dependent upon many variables such as the shape of the social system, network density or the presence of weak ties, so the character of early adopters and their connections to later adopters can move the critical mass inflection point depending on the innovation and the system it is trying to diffuse into.

As the shape of the system can influence critical mass, it is important to consider what impact a differentiated network can have on diffusion. Valente (1995) argues that the existence of numerous sub-groups within a network slows diffusion and impedes critical mass. This has important implications for the construction industry and needs further consideration. When a network is divided into many small groups there will be fewer connections between them, which may not allow critical mass to occur and emphasises the importance of weak ties.

3.5.1.10 Empirical Analyses of Threshold Models

In order to substantiate his network models of innovation Valente undertakes a quantitative empirical analysis of the three case studies already identified.

In undertaking this work Valente (1995 p.92) attempts to combine both agency and structure components and identify their influence. He states that,

> *Micro level processes occur at the individual level of analysis. Personal efficacy, attitudes and behaviour are examples of variables involved in micro level processes. Macro level processes occur at a system level of analysis. Societal efficacy, norms, and group behaviour are examples of variables involved in macro level processes. Few research efforts have systematically analysed the relationship between micro and macro level processes.*

It is at this stage in his work that Valente begins to identify the relationship between the concepts already discussed. As already stated, some of the key aspects of a network diffusion model are thresholds, exposure and critical mass. Valente refers to this as the 'threshold/critical mass theory (T/CM) and it essentially suggests that over time as more individuals adopt, more individuals will reach their threshold. Therefore, exposure levels will increase, thus aiding diffusion. In addition, over time, early adopters are able to experience the innovation and communicate their experiences to others, thus allowing thresholds to be met.

This relationship between the various elements essentially follows Rogers innovation-decision process but with less discursive points and narrative. The principles remain though, and that is that with time as more people adopt an innovation this adoption reduces risk and uncertainty and the innovation becomes more visible to others (exposure), which in turn can aid diffusion and ultimately achieve critical mass. It is therefore important to acknowledge that the micro level measures can influence the macro level measure. It is also important to realise that it is not the level of exposure to an innovation that leads to adoption; it is the individual's threshold. An early adopter will have low exposure but will still adopt due to their low individual threshold.

The datasets analysed provided differing results. For example, innovativeness is associated with opinion leadership for the Korean data, but not the medical doctor's data. Valente acknowledged that while the datasets assisted him in developing his model one needs to consider the specific system to appreciate the application of any model and any analysis of data, and that one size does not fit all.

3.5.2 Mathematical Modelling

The mathematical modelling of consumer behaviour is traditionally performed from a marketing perspective (Bass 1969), with a focus on predictions of adoption to assist in marketing campaigns and is an entirely quantitative approach. While some use a common language to that proposed by Rogers (2003), the modelling approach is complex and formulates differential equations to specify the flow between mutually exclusive and collectively exhaustive sub-groups (Chatterjee and Eliashberg, 1990). Advocates of this approach include Mahajan and Peterson (1985), Bass (1994) and

Yucel and Daalen (2011). However, Rogers and Kincaid (1981 p.xii) go as far as to say that much of the network literature is "over-mathematised, confusing in terminology and concepts, and devoid of much application that would aid the understanding of human behaviour".

The work of Kale and Arditi (2010) is a construction industry specific investigation on the diffusion of CAD and ISO9000 but using a new modelling approach, namely the non-uniform influence model. This work is entirely focused on the applicability of the various mathematical diffusion models, such as the Bass (1969) model. This particular piece of research used a modelling approach to assess influence on the diffusion process and concludes that internal influence, rather than external influence, plays a predominant role. This shows that construction companies are more influenced by their own internal operations and workload than that of other companies within the same social system. This research shows that there are many alternatives to the diffusion modelling process and that some are more suitable to specific scenarios than others. This particular research is certainly valid in its chosen field, but does not provide any advancement to this current research direction.

The use of mathematical models is an area of diffusion research that while interesting is beyond the scope of this research as it is a purely qualitative study of the diffusion of innovation within a particular social system. The work of Valente sits between the two approaches as it is based in the traditional sociological work of Rogers (1962-2003), Burt (1982, 1987) and Granovetter (1973, 1978), but takes a network approach to help explain social phenomena.

3.5.3 Social Network Analysis

Social Network Analysis (SNA) can be used to chart communication networks, from aspects such as direction and influence to distance and regularity. As can be seen from the work of Valente (1995) it can be a useful tool for analysis of a complex phenomenon such as communication. Within a construction management focus, the main author that has explored the use of SNA for the purposes of a diffusion study is Larsen (2005, 2011).

Communication networks are an active part of any contextual setting and Larsen (2011) identifies the difficulties in empirically assessing this type of data such as the nature of networks and their constant state of flux. As part of this discussion Larsen argues that awareness and influence are underrepresented in the literature and that the work of Rogers (2003), which states that actors can choose to avoid awareness of innovations, is more difficult than Rogers suggests. In addition, it is argued that the counter arguments supporting a more structurally equivalent approach from authors such as Burt (1982) are more representative due to the amount of information that is received via the Internet and email.

Larsen's (2011) research in this instance is focused on the applicability of SNA as a tool to better understand how actors become aware of an innovation and how they may be influenced related to that innovation. Larsen's work is quite refreshing, as he doesn't provide pages of calculations and measures of centrality from his SNA as he suggests that such social constructs cannot be measured with any real meaning and argues that what is offered is an improved understanding and a discussion of how SNA may be utilised in the future.

It was concluded that actors experience awareness and influence differently and that researchers need to be aware of this when undertaking diffusion studies. Sociograms and the data obtained can quickly become very complex and difficult to understand yet provides information that can be observed that is often overlooked in diffusion literature. Larsen concludes by stating that SNA often raises more questions than it answers, but does provide a better understanding than qualitative interview data could alone and posits that in future research follow up interviews should be undertaken to gain a greater understanding of the sociograms and their meanings.

Although this is outside of the scope of this research and its methodological approach, SNA is an important methodological aspect to consider in the future as its findings could prove valuable to the diffusion research landscape.

3.5.4 Summary

Valente's work introduces a new and interesting way of studying the diffusion process. It offers a more predictive approach to diffusion rather than the classical Rogers approach which is classed as descriptive as it can only occur after an innovation has started to diffuse. In addition, Valente's work considers the micro and macro level analysis in a way that the classical methods cannot. Valente has sought to understand the diffusion effect within a social system, something that not many others have attempted to understand in any depth, and has provided diffusion scholars a new and interesting way in which to study diffusion away from the classical Rogers approach. Valente's work is not without its critics, such as Iacobucci (1996), but these criticisms are focused on the lack of detail from a marketing modelling perspective, and as already discussed these predictive models are a very specific area of research and Valente is quite clear in his work as it tries to bridge the sociological and mathematical approaches to diffusion.

In addition, Valente has made some interesting observations on the roles of the main diffusion concepts. Indeed, the threshold concept features heavily in his work, but it is his comments on the roles of cohesion and structural equivalence that warrant further consideration. Valente posits that instead of the theories being competing, they could in fact be complimentary, and rather than being exclusive interpersonal forces actually act simultaneously to influence adoption behaviour. Valente (1995 p.122) goes onto state that "It may be that awareness of innovations flows through cohesive ties, as individuals talk to one another, but adoption is more likely to occur through modelling the behaviour of near peers" and that "It may be that the two processes operate during different stages of the diffusion process".

This final suggestion of Valente is something that Larsen (2005) has attempted to identify within a construction industry context and will form a major consideration for this research.

3.6 The Diffusion Journey

As already identified, Rogers (2003p.xvi) was convinced that "diffusion was a general process not bound by the type of innovation studied, who adopters were or by place or

culture". His book (2003p.xvii) is about "regularities in the diffusion of innovations, patterns that have been found across cultures, innovations and the people who adopt them" and identifies that in 2003 there were approximately 6000 publications on diffusion and that "no other field of behavioural science represents more effort by more scholars".

This research is concerned with the actors' journey through the diffusion process and seeks an improved contextualised understanding of the classical Rogers diffusion studies. Sheffer and Levitt (2010) argue that there is a shortage of literature available on the implementation phase of Rogers' innovation-decision process and that most diffusion literature is concerned with an individual's or a firm's willingness to adopt, rather than their ability to adopt. This section will now identify each of Rogers stages in his diffusion research in order to allow development and contextualisation through the primary research.

Rogers (2003p.xx) defines innovation as "an idea, practice or object that is perceived as new by an individual or another unit of adoption" and that the diffusion of innovation is "essentially a social process in which subjectively perceived information about a new idea is communicated from person to person".

This social process is complex and has many variables that will be identified through the following discussion. The main principle to consider is that any new idea has many uncertainties and individuals are unsure about the new ideas superiority to existing ideas. This then motivates individuals to seek further information to cope with this feeling of uncertainty. It is this process that forms the main backbone of diffusion research.

The following is broken down into key stages in the diffusion process and will be summarised with diagrams where appropriate.

3.6.1 Generation of Innovation

Before diffusion can take place there needs to be an innovation to diffuse. The events occurring before the diffusion process can have serious implications on the relative

success of diffusion as decisions will be made on target audiences, advertising, commercialisation and the eventual role out of the innovation.

Figure 3.1 highlights a basic six-stage lifecycle of an innovation:

Figure 3.1 - Lifecycle of an innovation. Adapted from Rogers (2003)

As identified, the focus of this research is on the diffusion and adoption phase of this process although due consideration will be given to the other phases throughout. In particular, the early phases of this process have been the subject of particular focus in the construction industry with authors such as Dubois and Gadde (2002), Jones and Saad (2003) and Sexton and Lu (2009) all contributing to this area of research.

3.6.2 The Innovation – Decision Journey

The innovation-decision process forms the cornerstone of Rogers diffusion model. Rogers (2003 p.168) describes it as:

> *The process through which an individual (or other decision making unit) passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making a decision to adopt or reject, to the implementation of the new idea and to confirmation of this decision.*

The model quite clearly shows that diffusion occurs over time and that an individual can pass through several stages before fully adopting an innovation. It is the perceived newness and any uncertainty associated with this that drives an individual through the

innovation-decision making process. The key point at this stage is that the focus is now wholly on the individual and their experiences through the diffusion process. Prior to this stage it could be an individual or indeed an organisation that identified the need and developed the innovation ready for the diffusion process to commence. Figure 3.2 shows the innovation-decision process.

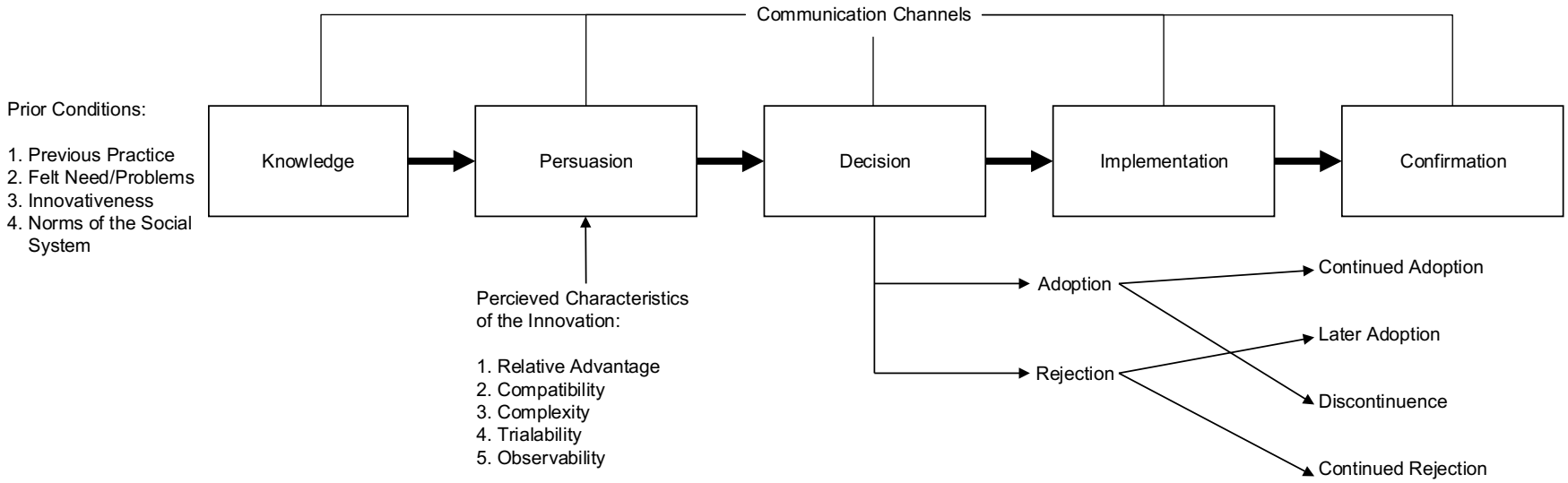


Figure 3.2 - Rogers (2003) Innovation-decision process

As can be seen in Figure 3.2, there are five key stages to the Roger (2003) innovation-decision process and these will be discussed in more detail.

The innovation – decision process is a key aspect of Rogers (2003) work and is found in many diffusion studies (Emmitt 1997, Larsen 2005, Harkola 1995). Rogers proposition is that the innovation-decision process is the journey an individual goes through from initial exposure to an innovation to confirmed acceptance of that innovation. As such this process forms the backbone of the Rogers' diffusion research and is a process most often cited within diffusion literature (Harkola 1995, Rose and Manley 2012, Songip *et al* 2013). Within the construction management literature, Emmitt (1997) proposed some contextual changes to the process, but these were minor and limited to the work of an architectural practice. Larsen's (2005) work was much more comprehensive, though it didn't challenge the model of the process but rather included it within a wider theoretical framework.

The five stages are preceded by what Rogers (2003) refers to as *prior conditions* that comprise of previous practice, felt needs, innovativeness and the norms of the social system. The impact that these have on the diffusion process vary dependent upon individual actor and this research will attempt to discover this impact within the context of the defined boundaries identified later in this chapter.

This research seeks to further the understanding of an actors' diffusion journey in the context of the diffusion of a professional practice innovation diffusing amongst QSs within the UK construction industry. Not only to ascertain if stages exist in this process, but also to discover if the stages proposed by Rogers are suitable for this particular context, and if a new model is required to accurately represent diffusion within these particular parameters.

The majority of this will be achieved through primary research, but consideration of the stages here is necessary to identify initial thoughts and to justify further research into the suitability of this process which was proposed by one of the most authoritative diffusion scholars.

3.6.2.1 Knowledge Stage

Knowledge occurs when an individual (or other decision making unit) is exposed to an innovations existence and gains an understanding of how it functions (Rogers 2003, p.169)

The first stage in the innovation-decision process is the knowledge stage. This is the means by which an individual first acquires knowledge of an innovation.

Rogers (2003 p.172) identifies three types of knowledge about an innovation

1. Awareness-knowledge
2. How-to-knowledge
3. Principles-knowledge

The application of these types of knowledge will depend upon the type of innovation and the individual who may adopt. Some observers claim an individual plays a relatively passive role when being exposed to awareness-knowledge about an innovation. An example of this is when being exposed to an innovation through mass media channels such as advertising. Other individuals may initiate the process by actively seeking information about specific innovations, as there is a felt need for an innovation to address a current concern or problem.

Hasinger (1959) argued that individuals seldom expose themselves to messages about an innovation unless they first feel a need for the innovation, and that even if they are exposed to the messages, such exposure will have little effect unless it is perceived as relevant to the individual's needs, and is consistent with the individual's attitudes and beliefs.

Rogers (2003p.172) agrees with Hassinger (1959) and states, "there is much to support Hassinger's view that the need for an innovation usually precedes the awareness-knowledge of the innovation."

However, these discussions seem to miss an important position in that an individual may develop a need when they learn that an innovation exists and current research does not provide a clear answer to which comes first.

The knowledge stage of the process has significant importance in the overall innovation-decision making process as first impressions count and whether that initial knowledge is gained through mass media or by word of mouth it has an important role to play. Although it is important it is only the first stage and as Rogers (2003 p.174) states "knowing about an innovation is quite different from using it".

Awareness-knowledge is concerned with the actor being aware that the innovation exists, how-to-knowledge is concerned with information necessary for an actor to use an innovation properly and principles-knowledge is information dealing with the functioning principles underlying how an innovation works.

It is not clear why Rogers (2003) has split this stage into three sections under the umbrella term *knowledge* other than the suggestion that this stage is about information seeking and answers to questions such as "what is it?", "how does it work?" and "why does it work?". These are logical questions when faced with an innovation, and in the context of the NRM they initially seem to have relevance. For example, initial awareness-knowledge could come from a direct mail from the RICS making you aware of NRM. If you had been working as a QS for several years then you would have had some previous experience of standard methods of measurement, so the principles-knowledge would also be in place. The missing piece of this jigsaw is the how-to-knowledge, as you would not have used the new rules if you had only just become aware of them.

What seems odd here is that the awareness part of the process is attached to the knowledge part. The study of the nature of knowledge and how we acquire it is referred to as epistemology (Pritchard 2006, Schwandt 2007), which is an entire subject in its own right. This research will be discussing epistemology in terms of positioning itself within the current field of research in the methodology chapter. For the purposes of this discussion though, it is proposed that the awareness stage is a stage in its own right to clear the lines between awareness and knowledge which in turn will allow a clearer

understanding of the intricacies of these two aspects when the primary data collection is undertaken.

Larsen (2005, 2011) identified that there was a lack of literature regarding the awareness stage and developed his own framework incorporating the concept of awareness. He didn't directly challenge Rogers' (2003) innovation-decision process and so his contribution here is limited. Emmitt (1997) did discuss the concept of awareness but only in terms of how one may become aware of an innovation and his work was focused on architectural practices in a time before the internet and therefore his findings are also limited.

Considering the above it is this authors belief that awareness of an innovation should be a stage in its own right, as without this initial awareness then there is no diffusion process. This initial awareness is the trigger that starts the innovation-decision process and its importance should not be underestimated. How an actor becomes aware of an innovation is an important consideration as this can come from many different communication channels such as the internet, email, direct mail or word of mouth. Once this initial awareness is achieved, then the journey of diffusion can begin. As such, it is this initial awareness that is a gateway to the diffusion process and one that every actor must pass through before any further stages are possible. It is accepted that awareness is a form of propositional knowledge, in so much that once you are aware that something exists you can state that this is the case i.e. the innovation exists. Any further knowledge about the innovation in terms of how it works or why it works are aspects of further investigation and not the result of a chance reading of an email for example.

It is therefore proposed that awareness is the first stage in the innovation-decision process and constitutes the first proposed amendment to the model as proposed by Rogers (2003).

This still leaves the *knowledge* stage, which is further complicated by the name having such a broad definition and historical debate. Knowledge from a philosophical perspective is often defined as a *justified true belief* (Pritchard 2006). This is where an actor needs to not only have a belief in what they know but it must be justified and true. This argument is one that has occupied academics for many years with some strong

counter arguments such as those from Gettier (1963). It is not the intention of this research to enter this debate but to highlight the problem of a *knowledge* stage in this process.

The two aspects that remain in Rogers (2003) proposition are the how-to-knowledge and the principles-knowledge. So understanding how the innovation works and why it works in that way. If the innovation truly is new to the actor, then they will only have an understanding of these aspects if they were involved in the innovations development. If the innovation is a development of an existing product/process/practice, then there may be some understanding of the how and why aspects. In the case of NRM it has already been stated that the principles will be understood but the application would not. Where this starts to become difficult to discuss is that the following persuasion stage is concerned with forming an attitude towards the innovation. This attitude could be influenced by this earlier stage, especially if the innovation is a development of something that the actor already uses or has adopted in the past.

3.6.2.2 Persuasion Stage

Persuasion occurs when an individual (or other decision making unit) forms a favourable or unfavourable attitude towards the innovation (Rogers 2003, p.169)

It is at this stage where an individual forms a favourable or unfavourable attitude towards the innovation. The terminology used is not to be confused with the individual being persuaded to adopt the innovation by a third party. The previous knowledge stage was mainly a cognitive function (knowing), whereas the persuasion stage is mainly affective (feeling).

Once an individual has knowledge about an innovation they can actively seek new information and thereby decide which messages are credible and interpret the incoming information. Attitudes are important at this stage and Rogers proposes five key considerations:

- Relative advantage.
- Compatibility.

- Complexity.
- Trialability.
- Observability.

These are all important factors to consider as they are essentially innovation attributes and can all influence the innovation-decision process. As such these will be discussed in more detail when innovation attributes are specifically identified.

It is at this stage that an actor forms an attitude, so more of a feeling towards an innovation rather than knowing about the innovation. As previously discussed this stage is not concerned with being persuaded by other parties, it is about informing one's self to form an attitude that will either encourage or discourage further progression towards adoption. Initially this terminology is quite confusing and Larsen (2005) renamed this stage the *opinion forming* stage, although he provides no rationale for this, or even any discussion but it does have a clearer meaning and as such will be considered when undertaking the primary research.

This is also the stage where an actor considers innovations attributes, which are discussed in detail later, that can help to form either positive or negative attitudes towards an innovation. Rogers (2003) suggests that an actor will mentally apply the innovation to their situation before deciding to progress with the adoption decision so how this is undertaken by QSs within the construction industry is unknown.

3.6.2.3 Decision Stage

Decision takes place when an individual (or other decision making unit) engages in activities that lead to a choice to adopt or reject the innovation (Rogers 2003, p.169)

The decision stage is when an individual engages in activities that lead to a choice to adopt or reject an innovation. Activities could be such as trialling an innovation or by observing peers using an innovation. As already identified, the rejection of innovations is an under explored area, with Rogers (2003) stating that investigations into rejection behaviour have not received much attention. Rogers (2003) suggests that rejection could be passive or active, but does not expand on this, or have any research to support this

suggestion. This stage is where the type of innovation will play an important role as with product innovations such as a new mobile phone an actor can touch, feel and even try the innovation but with professional practice this is not possible. One cannot trial professional practice with any meaning without a live project to use it on so how this works within the construction industry will be unique and will be an important discussion point during the primary research collection.

3.6.2.4 Implementation Stage

Implementation occurs when an individual (or other decision making unit) puts a new idea into use (Rogers 2003, p.169)

Following the decision to adopt an innovation an individual then has to implement the innovation into their daily lives. Up until this point the process has been a mental exercise of thinking and deciding. The implementation cannot always be immediately following the decision to adopt depending on the innovation and any lead times or operational barriers.

This stage also has individuals seeking more information such as how to use it and what problems might be encountered. These are relatively simple questions on an individual basis but this stage can be more protracted if in an organisational setting as some structures may resist change.

Over time a point will be reached where the innovation becomes a regular part of adopters ongoing operations and given more time there is the possibility of re-invention where new ideas can change and evolve. In terms of the context of this research it is felt that this is the most important stage as professional practice innovations are very difficult, if not impossible, to trial and therefore the initial use will be very revealing in terms of suitability for continued adoption and use.

3.6.2.5 Confirmation Stage

Confirmation takes place when an individual seeks reinforcement of an innovation-decision already made, but he or she may reverse this precious decision if exposed to conflicting messages about the innovation (Rogers 2003 p.169)

Once implementation is underway then over time, confirmation of the decision is required. Does an actor continue to use the innovation or discontinue its use? Discontinuance can be for many reasons but it is usually due to a new and better innovation taking its place or disenchantment with the original innovation after prolonged use. From a construction perspective, this may occur after one use, or many as it will be dependent upon the types of projects encountered and other parties involved. As discussed in chapter two, the construction industry is quite unique and many projects are one off with each having many unique variables. This means that successful utilisation of an innovation on one project does not guarantee success on others. This aspect will be considered during the primary research collection.

3.6.2.6 Are there stages in the innovation-decision process?

One clear distinction that Rogers makes about the innovation-decision process is that there are not any defined stages and that one should not expect sharp distinctions between stages as individuals see them differently.

Rogers states that most diffusion research is variance research using highly structured quantitative methods and is concerned with determining the correlations between sets of data variables but not time order. He goes onto say that "The scarcity of process research on the innovation-decision process is a basic reason why we lack definitive understanding of the degree to which stages exist" (Rogers 2003p.197)

Rogers (2003) showed empirical evidence of stages in his Iowa study and concludes that stages do exist and that this is most clear cut at the 'knowledge' and 'decision' stages, with less evidence on the 'persuasion' stage and little evidence of 'implementation'/'confirmation' stages.

3.7 Developments of the Rogers Innovation – Decision process

It has already been expressed how Rogers work spans many decades and is regularly cited within diffusion studies, so it is not surprising that many authors have challenged and adapted his work, and this research is no different. It is important then, to consider where other research has made modifications to the work of Rogers to see how they can be utilised or influence this research. For the purposes of this study only scholars in the construction management field will be considered both for reasons of context and also practicality.

The innovation-decision process has been the subject of several studies in the construction management literature with the main authors being Emmitt (1997) and Larsen (2005), so their work, alongside others, will now be considered.

Emmitt's (1997) research was focused on the relationship between architectural practices and product suppliers, and specifically the way in which new products are specified by architectural practices. Emmitt does provide some good contextual observations using Rogers innovation-decision process as a framework for the discussion. He identifies the trade representatives as change agents and emphasises the importance of this role, in line with Rogers' earlier work.

Emmitt does suggest that the situation under investigation was more complex than what Rogers' model was able to adequately cover, but complex is not necessarily the correct term here. Rogers' model, as already discussed, is a general model and as such attempting to contextualise it is for the individual researcher. As it stands Emmitt provided a comprehensive analysis and development of Rogers' model, but failed to address the more complex sociological issues involved in the diffusion process. In his development he introduces two new stages to the process namely stage 3a – external influence and stage 4a – contractors influence on site. It is this part of his work that leaves more questions than answers. The two additional stages are purely external influence, which Rogers quite clearly discusses and suggests are inherent in any adoption decision. Emmitt's external influence are specifically named and timed in terms of their position in the innovation-decision process but they seem like limited

additions given the possibilities for adapting Rogers' model. Also, does the fact that a product is changed on site negate the original adoption decision? The product has been chosen, but not used, so it is this that would require more discussion which unfortunately was not provided.

Larsen (2005) took Rogers (2003) innovation decision process and combines the sociological and construction specific diffusion literature to produce a theoretical framework with which to understand an actor's journey through the diffusion process and considers the agency-structure debate in detail. He identified that diffusion is an iterative process that means innovation can occur at any time, essentially a form of evolution, and that context can influence the rate of diffusion. Factoring in the possible evolution of an innovation context can also influence possible alterations to the innovation to suit the beliefs, rules and language of that particular context. This could result in adoption of an innovation that is very different to the one that commenced the diffusion process.

One of the key criticisms that Larsen (2005) cites of the work of Rogers (2003) is the lack of consideration for the awareness stage of the diffusion process. Rogers (2003) highlights this as a key stage in the process but Larsen (2005 p.106) identifies a lack of focus on this particular stage stating that Valente (1995) does not consider or apply the Threshold theory to this stage of the process, only the adoption stage. This is an acute observation and one that Larsen addresses through his research, and an area that has been identified already in this chapter as being a significant stage in an actors' diffusion journey.

Lessons can be learnt from the work of Larsen (2005) particularly with regard to the use of the sample and approach to questioning respondents. In response to his pilot study Larsen received responses suggesting that the request for names and addresses of respondents contacts and colleagues was too intrusive and uncomfortable when searching for communication networks. His sample, although stated to be from the main professional bodies, appears to be only from architectural practices when looking at details of the respondent's responses. This research will attempt to address this criticism by being clear about the bounded sample and nature of the research, and will make no claims to wider generalisations. The most significant part of Larsens (2005) work was

where the main study utilised a weighted scale to identify the appropriateness of the main diffusion concepts to the UK Construction Industry. A dispersion calculation was undertaken to gain a numerical appreciation of the range of responses, which was then converted to a percentage fit calculation. The results showed that Cohesion and Thresholds were predominantly a good fit, while Structural Equivalence was predominantly a poor fit.

This was followed by an analysis of where the diffusion concepts were related to Rogers (2003) stages of the diffusion process. The stages are identified as Awareness, Opinion Forming, Decision Making, Adoption, Use and Promote/Retract. This was undertaken in the same manner of best fit for each stage and the results can be seen in figure 3.3 below.

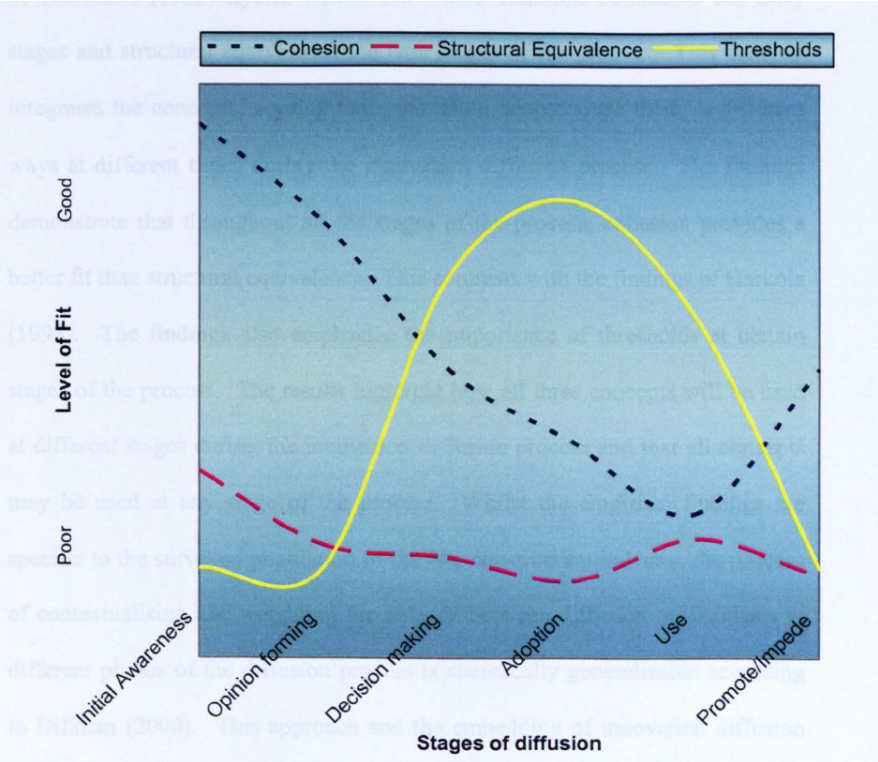


Figure 3.3 - Relevance of diffusion concepts to the innovation-decision process. Larsen (2005 p.189)

Larsen (2005 p.189) states that the shape of the curves and their relation to each other is fundamental in interpreting how innovation diffusion occurs. This analysis integrates

the concepts and shows that adopters use the concepts in different ways at different times during the diffusion process. Larsen's identification of Cohesion as the best fit is in contrast with Harkola's (1995) findings as Harkola is a proponent of Structural Equivalence, but it should be noted here that her research is based on the Japanese construction industry which operates in a very different manner to that in the UK. Larsen's work on the diffusion concepts at this stage is certainly very interesting and helps to embed those concepts into Rogers' (2003) innovation-decision process. This provides future researchers with a clear idea on the impact these concepts can have on diffusion and that they do not have to be competing concepts at all and may in fact be complementary to diffusion overall.

Other authors that have addressed the diffusion process include Jones and Saad (2003), Peansupap and Walker (2006) and Sheffer and Levitt (2010). The work of Jones and Saad (2003) is more focused on innovation creation than diffusion in the earlier stages of their work, but there are important considerations.

Their proposed model off diffusion from the user's perspective is as follows:

1. Identification of the need to innovate.
2. Developing awareness – gain a greater understanding of the new idea with a view to minimising difficulties of implementation and ensuring success.
3. Selecting the innovation – collect data on strengths and weaknesses.
4. Planning – anticipate events likely to occur.
5. Implementation – the heart of successful innovation.

This model follows Rogers (2003) stages very closely and the authors cite Rogers in their third stage of selecting the innovation and refer to innovation attributes. As can also be identified there is an emphasis on the awareness stage of the process, but no real further discussion on this. Further discussion focuses on implementation within an organisation of an innovation, but this is on development of an innovation within the organisation, rather than the diffusion of an innovation to an organisation. They do state that it is not as simple as adopting an innovation as advocated by the classical diffusion literature, with reference to Rogers (1971), which in turn questions the suitability of their findings for this research.

Peansupap and Walker (2006) provide a diffusion framework specifically for IT within a construction context. The literature reviewed is as one would expect with clear identification of the work of Rogers (2003), along with discussion of the main diffusion concepts of cohesion, structural equivalence and thresholds. While these concepts are briefly identified they do not form a part of any further discussion or have any clear influence over the development of their diffusion framework.

The case studies undertaken were based on three large organisations that were in the process of implementing data sharing IT to their workforce. Following the case studies and drawing on the work of Rogers (2003) along with more IT specific literature a frame work of IT innovation diffusion is proposed. The framework identifies relationship categories such as,

- Management.
- Individual.
- Technology.
- Environment.

These four areas focus on the varying characteristics that may influence the diffusion process and sit alongside a six stage diffusion process, again adapted from Rogers (2003), which consists of the following stages,

1. Developing new business practices/processes.
2. Organisational adoption of the IT decision.
3. Preparing for the initial use of IT applications.
4. Reinforcing the actual use of IT applications.
5. Clarifying the benefits of IT application use.
6. Developing a positive perception towards IT and IT diffusion.

What is clear from this research is that it is entirely embedded in the general diffusion of IT and that the construction industry context provided has little to no influence over this diffusion. The construction industry is barely mentioned and no influence on the

diffusion process is stated or implied by being set in this context. The framework proposed draws little on the diffusion literature and although other authors, such as Rogers (2003), are discussed the six stages are quite clearly adapted from the general management literature such as Wolfe (1994) and simply describe the process of implementing a new technology *within* an organisation, rather than the diffusion of the new technology *to* the organisation and it is this important distinction that is missing from this research.

3.8 Attributes of Innovations

Rogers (2003) identifies five characteristics that an innovation can have and each is important in its own right, as each can be perceived by potential adopters and influence the adoption decision process in different ways.

Most research focuses on *people* differences and diffusion rather than *innovation* differences and diffusion and it is important to realise that not all innovations are the same, an issue identified by Fliegel and Kilvin (1966) as far back as the mid-sixties, but which was still an under researched area in the early noughties as identified by Rogers (2003). Where research in this area is undertaken, it commonly follows the definitions provided by Rogers (2003) in various contexts with the most recent example of this being Makse and Volden (2011) who applied this typology to numerous criminal justice policy innovations in the US where each policy was rated against each attribute, having either high or low scores for each where for example the death penalty policy was seen as having low Complexity, but high Observability with perhaps unsurprisingly low Trialability.

The focus of this study is on one particular innovation, the NRM, but the attributes of that innovation are still important considerations with regard to the influence on the diffusion process, and therefore they are identified in more detail here. Wolfe (1994 p.415) highlighted the need to incorporate innovation attributes within any research concerned with innovation as it allows "systematic and meaningful comparison to other innovations" which would "be impossible without knowledge of an innovations attributes".

Rogers (2003) suggests very little research has been undertaken to determine the relative contribution of each of these variables. This supports his earlier findings that many diffusion studies are concerned with the rate and extent of adoption. Moore and Benbasat (1991) provide a good example of a piece of research that has explicitly attempted to determine the contribution of these variables and after a thorough review of previous literature they undertook a quantitative study of user's perceptions of personal work stations. Their approach was well thought out with carefully considered questions relating to each of the characteristics and results in an instrument that can be used to investigate how perceptions affect individual's actual use of innovations.

The study of innovation attributes could be considered as a separate individual study e.g. Songip *et al* (2013), but it was felt that this would be too limited for this research. However, these characteristics proposed by Rogers need further consideration within a construction management context with particular regard to professional practice innovations as they were developed based on product or process innovation studies. It is also felt that these characteristics are closely linked to the innovation-decision process and that one should not be considered without the other. The five characteristics as proposed by Rogers (2003) are:

1. Relative advantage.
2. Compatibility.
3. Complexity.
4. Trialability.
5. Observability.

This research seeks to further the understanding of these characteristics with particular reference to a professional practice innovation, in this case NRM. This is to ascertain if these characteristics are suitable for a professional practice innovation and if so how they may influence the diffusion process.

The majority of this will be achieved through primary research, but consideration of these characteristics is necessary to identify initial thoughts and to justify further research into their suitability.

3.8.1 Relative Advantage

Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. (Rogers 2003. P.229)

The degree variable depends upon the particular innovation and what it is trying to achieve, for example cost savings, time savings or quality of life. Rogers (2003) considers relative advantage as one of the strongest predictors of an innovations rate of adoption.

This particular attribute is one of the most encompassing as it can mean many things to many different actors. As an example, Fliegel and Kilvin (1966) cited several more attributes in their early study such as initial cost, rate of cost recovery, payoff, social approval, saving of time and regularity of reward, all of which could be categorised under the heading of relative advantage. This is a particularly good example of where Roger's work in the diffusion field is so well refined over many years of research, but also very broad and generalised. Pries and Janszen (1995) also identified relative advantage as being important to the diffusion process when concerned with manufacturing and product innovations, particularly with reference to improvements in productivity on site, and this was later supported by Arditi et al (1997) who found that although the relative advantage could gain a manufacturer competitive advantage, this advantage was not sustainable for long periods of time as their product innovation is easily copied. This period of competitive advantage was identified as being in the order of one year.

Does NRM offer any advantages over its predecessors? The official literature suggests so and this is the message that the RICS have communicated so this particular attribute may be suitable for professional practice innovations. The term 'better' as used by Rogers is open to interpretation but does allow this particular attribute to be considered across many different types of innovation. The implication here is that if an innovation offers an advantage over previous practice then it will aid the adoption decision. How this fits with the construction industry and the NRM will be considered during the primary research but it is felt that this attribute is of particular importance as if an innovation has a high relative advantage then an actor may be more willing to overlook

other less desirable attributes such as increased complexity; however, the opposite is also true in that if an innovation offers little relative advantage then a compatible and simple innovation may be overlooked in favour of the status quo.

3.8.2 Compatibility

Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences and need of potential adopters. (Rogers 2003. P.240)

If an innovation is compatible with an individual's existing values, past experiences and fulfils their current needs, then this will reduce uncertainty and lead to a higher chance of adoption. Rogers (2003) claims that individuals cannot deal with an innovation except on the basis of the familiar, where previous practice provides a standard against which an innovation can be interpreted, thus decreasing its uncertainty.

Rogers (2003) also suggests that a strong belief in the relative advantage of a new idea often leads technocrats to assume that existing practices are so inferior that they can be completely dismissed. This is a dangerous position to find oneself and is something that needs careful consideration given the current state of measurement practice within the UK construction industry.

New professional practice is often linked to previous practice, just as the NRM is a standard method of measurement that is essentially a new method developed over many years and based on previous practice. The implication here is that if an innovation is compatible with current practices and past experiences this will lower the perceived risk and increase the possibility of adoption. This introduces an interesting point for this research as the existing practice is so embedded within the industry it may be this similarity that hinders the adoption of NRM rather than help it as actors may see no benefit (relative advantage). The NRM is similar and compatible to exiting practices but different enough for an actor to have to undertake additional training and utilise new software so the subject of compatibility in this context is quite complex.

3.8.3 Complexity

Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use. (Rogers 2003. P.257)

Rogers (2003) claims that this is not as important as relative advantage or compatibility; although the majority of his research was based on agricultural innovations. This attribute is important with regard to professional practice as if the innovation is seen as complex this will increase the perceived risk for an actor and may lead to rejection. This is especially true if current practice is seen as adequate and the innovation does not offer enough of an advantage to warrant the additional complexity of use. The NRM is a good example to consider this as it is very similar to existing practice but as described earlier it is different enough to require additional training and specialist software. In addition, as NRM is new practice replacing an existing practice then many actors will be competent in the previous practice which dependent upon the individual will make the new practice appear more or less complex based on their experience and knowledge.

3.8.4 Trialability

Trialability is the degree to which an innovation may be experimented with on a limited basis. (Rogers 2003. P.258)

Early adopters in particular value trialability as they have no frame of reference, unlike late adopters who have the benefit of having seen the innovation in use.

Where an innovation is ground breaking and has never been seen then trialling the innovation can be a desirable attribute for a prospective adopter. This is possibly less important where the innovation is a progression of existing practice, such as the NRM. Another consideration is how applicable this attribute is to the construction industry as each project is unique and one off there is little or no possibility of trialling an innovation be it a product, process or professional practice. Emmitt (1997) found that with products this was impossible as they had to be specified and the building built with no clients being prepared to try out new products in case they needed removing at a later date, which mirrors the earlier findings of Pries and Janszen (1995). The only option was to trial build but this idea of prototyping buildings is not commonplace in

the UK construction industry. With regard to professional practice innovation this is more achievable as mock projects could be used or a form of role play employed to trial the innovation. For NRM the only possibility is for an actor to use the method on an old project and get a feel for it, there would be no possibility of trialling the accuracy of the NRM or competence of the actor without a live project.

3.8.5 Observability

Observability is the degree to which the results of an innovation are visible to others. (Rogers 2003. P.258)

This is more suitable for later adopters as they can observe the innovation in use prior to adoption. This attribute is more difficult for early adopters to utilise unless they can observe some form of demonstration for example.

Similar in concept to Trialability this is for an actor to observe the innovation in action or use where a trial may not be possible. This is even more difficult for an actor to achieve with regard to NRM or any professional practice within the UK construction industry as projects are mostly confidential between interested parties and outside observation is impossible, especially with regard to the professional practice elements. Some observation of product or process is possible, even if only from observing the finished building but the paperwork and documentation remains confidential. Therefore, the suitability of this attribute for professional practice innovations is doubtful.

3.9 Developments of the Rogers Innovation Attributes

As already identified, numerous authors have used and adapted the work of Rogers to their own ends. One area that has not received as much attention as the innovation-decision process is that of the innovation attributes. It is important then, to consider where other research has discussed the attributes of an innovation to see how they can be utilised or influence this research. As before, for the purposes of this study only scholars in the construction management field will be considered both for reasons of context and also practicality.

Slaughter (1998) doesn't address the Rogers (2003) attributes directly, but does state that there are many theoretical models of innovation in existence, but then fails to identify or discuss any, which feels like a serious oversight when proposing a new model for consideration. Slaughter argues that innovations needs to be considered in relation to their innovativeness and proposed a sliding scale from *incremental* to *radical*. She also considers the activities needed to implement innovations and aims to provide a guide for future reference. The focus is on product and manufacturing process innovations, rather than any discussion around professional services, and is of little value to the direction of this research.

The work of Mitropoulous and Tatum (2000) aims to identify a model of diffusion of new technologies for the construction industry. Through their literature review they identify the work of Rogers (1983), in particular the concept of innovation attributes, but very quickly dismiss the work, as it doesn't offer sets of consistent characteristics for adoption behaviour. They also briefly mention various other areas of diffusion literature but without any real depth or with any consistency to their statements. For example, they critique Rogers (1983) five innovation characteristics, but only actually discuss four of them. Through the use of eight case studies they identify four forces that motivate an adopter to adopt a new information technology. The case studies all focused on the adoption of 3D CAD technology with a specific target of mechanical and electrical companies, both consultants and contractors. The four forces identified were,

- Competitive advantage.
- Process problem.
- Technological opportunity.
- External requirements.

These forces are then influenced by organisations characteristics, such as management's attitudes towards an innovation or the existence of an in house champion for the innovation and each force operates at different levels and in different directions over time. Their findings on competitive advantage support those by Arditi (1997).

While their work contradicts the more classical diffusion literature, such as Bresnen and Marshall (2001), Koskela (2001) and Harkola (1995), there are similarities throughout that are not specifically identified. For example, their external requirements force states that competitors create pressure for adoption and that several of their case studies identified the need for equal footing between contractors to remain competitive. This shares a strong sociological context with the diffusion concept of structural equivalence but there is no reference to any diffusion concepts within their work.

Kramer *et al* (2009) produced an interesting piece of longitudinal research focused on the health and safety sector of the construction industry in Canada. Their research was based on the adoption of a new ladder lift system that is used to prevent the workforce from having to lift heavy ladders onto the top of their work vans. In terms of the influences that assisted diffusion it was determined that four particular elements were dominant,

- The relevance and usefulness of the innovation.
- The characteristics of the adopting companies.
- The credibility of opinion leaders as promoters of the innovation.
- The barriers and facilitators facing the innovation.

These findings were specific to the ladder lift system and align with the findings presented in this chapter. The concept of barriers and facilitators will be discussed in more detail.

Gambatese and Hallowell (2011a) focused on product innovation in the USA, where some were construction related innovations while the majority were computer related. They identify that reduced costs, reduced task durations and improved quality are enablers to the diffusion process, all of which map back to the Rogers (2003) concept of relative advantage and are supported by the work of Songip *et al* (2013) whose work focused on innovation attributes within the Malaysian construction industry, but whose work does not specify the type of innovation under investigation.

3.10 Innovativeness

Individuals can be classified into adopter categories on the basis of when they first begin using a new idea with categories having individuals with similar degrees of innovativeness. Rogers (2003) defines Innovativeness as the degree to which an individual is relatively earlier in adopting new ideas than other members of a system. This is one of the main dependant variables in diffusion research with categorisation of adopters not becoming the norm until the 1960's.

Rogers (2003) shows that adoption of an innovation usually follows a normal, bell shaped curve when plotted over time on a frequency basis, whereas if a cumulative number of adopters is plotted the result is an S shaped curve.

As more individuals adopt, word of mouth, observability, etc. increase, therefore increasing factors that aid adoption and in turn an increase in the number of adopters.

Innovativeness is used as a criterion for categorisation and as Rogers (2003) reasons, partitioning into discrete categories is a conceptual device that aids understanding. Rogers (2003 p.282) identifies five descriptors but excludes the 'non-adopter' and Rogers argues that these descriptors are now the "most used descriptors in innovation research"

The descriptors listed below relate to an individual and do not apply to organisations.

- Innovators.
- Early Adopters.
- Early Majority.
- Late Majority.
- Laggards.

Emmitt (1997) discussed innovativeness from an architectural practice perspective and is quite critical of Rogers' adopter categories and suggests that when specifying products, they will not apply as there are too many external influences such as budget, client's requirement etc. He also suggests that the category that Architects fall into may

be different for each product, for example an early adopter for a type of roof tile but a laggard for brickwork. This is a good example of where a specific context doesn't fit with a more general concept such as Rogers work on diffusion. Emmitt does suggest that the adopter categorisation of architects could be achieved through the careful examination of particular specification habits and that categorisation could be attempted from this data, although he does not attempt this in his research.

The identification of an actor's innovativeness is outside the scope of this research, but is an interesting area for further consideration.

3.11 Social System

A social system can take many different meanings although Rogers (2003 p.23) defines it as "a set of interrelated units that are engaged in joint problem solving to accomplish a common goal". The interrelated units are individuals, or actors, or possibly groups or even organisations. The main criterion is that each unit can be distinguished from the others.

Rogers' definition is embedded in the diffusion paradigm and as such doesn't necessarily work in a more general society where joint problem solving and common goals do not really feature in day-to-day existence between actors.

This continued generalisation throughout Rogers work is something that does start to limit the applicability to other contexts, indeed, the construction industry has a very unique social system that would not conform to Rogers definition as stated and is something that will be considered through the primary data collection and analysis. This was identified by Sheffer and Levitt (2010) who discussed the relational stability of the industry where a more stable network will aid the diffusion process. The opposite is true of an unstable network that has fragmented and one-off relationships, such as the construction industry.

Social structure and diffusion

Rogers (2003) argues that not all units in a social system are identical, and that the structure in a system is the patterned arrangements of the units. An example of this could be a hierarchy in an organisation.

As has been discussed, one of the key elements of diffusion is communication and it is these communication structures that predict, in part, the behaviour of individual members of the social system including when they adopt an innovation.

Katz (1961) as cited in Rogers (2003p.25) remarked "it is unthinkable to study diffusion without some knowledge of the social structures in which potential adopters are located as it is to study blood circulation without adequate knowledge of veins or arteries." While this may be true, Rogers claims that there have been relatively few studies of how the social or communication structure affects the diffusion and adoption of innovations in a system.

Rogers (2003 p.25) attempts to justify this position and states "It is a rather complicated matter to untangle the effects of a systems structure on diffusion, independent from the effects of the characteristics of individuals that make up the system."

While this research will not attempt to identify the effect of the social system upon individuals, there will be due consideration throughout as the two can be considered as both sides of the same coin (Ritzer 2000).

3.12 Barriers to the diffusion of innovation

Any social process, such as diffusion, will have certain enablers and barrier to the progress and success of the process. Each actors' diffusion journey is unique, as a direct result of numerous variables including social setting, communication channels and the innovation in question. Several authors have attempted to identify the barriers to the diffusion process, but none have made a distinction between barriers to the diffusion process and barriers to adoption. It is this authors opinion that this is an important distinction to make and as will be seen in the primary data analysis each has quite different barriers.

Larsen (2005) offers a compressive review of the possible barriers and identifies complexity, cost, regulations, risk, skills, time, opposing interests, threat and insult, uncertainty. These mirror the findings of Slaughter (1998) and also the later research of Gambatese and Hallowell (2011b). Jones and Saad (2003) make some good observations around the construction industry in their research and identify barriers to the development of long term and more stable innovative relationships between clients and the supply side of the industry. These barriers include its bespoke product nature, that work is produced at the point of consumption and that many projects are large and complex. In addition, they discuss complexities of the supply chain and the weaknesses that this can cause and also the irregularity of clients and their demands on price and time.

Blayse and Manley (2004) set out to identify the main factors driving or hindering construction innovation. Following a comprehensive literature review they identify six main factors that influence innovation in construction:

1. Clients and Manufacturers.
2. The structure of production.
3. Relationships between individuals and firms.
4. Procurement systems.
5. Regulations / standards.
6. Nature and quality of organisational resources.

These factors are discussed within the context of the construction industry but no attempt is made to make comprehensive recommendations on how to improve or maximise these factors. No primary research is undertaken but this is acknowledged as a starting point for further research. No references are made to the diffusion of innovation literature but of the factors identified, number three suggests that the relationship between individuals and firms is important. This concept is well represented in diffusion literature so this is an important oversight, although it is appreciated that diffusion literature is vast in quantity and as such the research undertaken had to limit its reach. Although the research was undertaken in Australia the

nature of the research being literature based means that sources from around the globe were included. As such their research is not limited to a single country.

On a larger and more empirical basis Rose and Manley (2014) undertook an investigation into the diffusion of product innovations in the road infrastructure industry in Australia. They found several contextual determinants that can have an impact on the diffusion process and these were identified as follows:

- Structure of production.
- Industry relationships.
- Procurement systems.
- Regulatory conditions.
- Organisational resources.

These determinants were based on their comprehensive literature review and are valid findings that support many other authors in their work, particularly Blayse and Manley (2004), Hartmann (2006) and Gambatese and Hallowell (2011a). In addition they identified twenty-two specific obstacles which were then ranked through a large scale quantitative study.

Of the twenty-two identified obstacles to innovation diffusion, the top five as identified by the survey are summarised as follows:

1. Restrictive tender assessment criteria (e.g. price only).
2. Disagreement over who takes the risk on any new products.
3. Adversarial contract relations.
4. Contractor time pressure inhibits ability to consider new products.
5. Time pressure from clients to complete works.

As can be seen from this section, there is some strong correlation between authors, but none that have specifically identified the specific area that the barriers are impacting. Is it the diffusion journey or the adoption itself? This distinction will form a more detailed discussion through the primary data collection and subsequent conclusions.

3.13 Narrowing the Research Focus

The preceding chapters have provided the building blocks for this research and can be summarised as follows.

Chapter two identified the role of the quantity surveyor and the measurement process that is central to that role. It also showed where this process occurs within a project timeline and discussed the shift in responsibility for measurement from the private sector to contracting organisations.

This chapter has introduced the diffusion concept and identified the key authors in this field with a critical review of their work. It also highlighted the differing approaches to diffusion that can be taken such as the mathematical predictive approach and the post adoption descriptive approach. Few authors have attempted to fully grasp the complexities of the diffusion paradigm and develop satisfactory advancements to the work of Rogers (2003). As is demonstrated though the above review it can be clearly seen that the closest we have experienced in the construction industry context is the work of Larsen (2005). Larsen's work shows a real depth and insight into the complexities of the subject area and proposes a well considered framework that actors may travel on their individual diffusion journeys. While comprehensive and of high quality, the work of Larsen does have weaknesses and is also very abstract. It is hoped that the findings of this research can help to bridge the gap of theory and practice.

Generally, authors have focused on diffusion studies associated with either new products, or new processes with which products may be constructed, or put together. Mitropoulous and Tatum (2000 p. 340) provide the most suitable definition of a process innovation when they state that a process innovation is "a technology that contractors use to plan, execute and control construction operations". The focus of this research is on the diffusion of professional practice procedures and in particular the use of the NRM. In addition, it can be seen from the literature that no author has yet undertaken a diffusion study where the focus is on the QS, with most being on organisations or architectural practices. The majority of literature is also based outside of the UK and as

such has very different social systems and working practices, both of which influence the diffusion process.

This chapter will now identify and synthesise the main ideas, theories and concepts identified. The intention of this is to provide definitions of specific terms and a narrowing of the main focal area of this research that in turn develops a clear direction for the primary research to ensure that the main research aim is met.

3.13.1 The Social System

Rogers (2003p.5) defines diffusion as "the process in which an innovation is communicated through certain channels over time among members of a social system" so in order to undertake any form of diffusion research the first step is to identify the social system under investigation.

Chapter two discussed the UK construction industry and its fragmented nature (RICS 2013a, Cartlidge 2013b) and also identified the role of the QS within this industry. Previous diffusion literature within the construction management field have identified the entire construction industry as their social system for the purposes of their research, for example Harkola (1995) in Japan and Kramer *et al* (2009) in Canada. This is important as it frames the research and provides context for the diffusion process that is so reliant on communication channels through these social systems.

From a UK construction industry perspective, the most comprehensive discussion on the role of the social system and its relationship with the actors within it was from Larsen (2005) who identified the interplay between the actor and their social system and how the two can influence each other. This was all framed in the wider industry with discussion of immediate surroundings, but no attempt was made to narrow the focus to a specific smaller system.

Emmitt (1997), on the other hand, undertook a successful narrowing of the field in his diffusion study of architects and their adoption process. Emmitt (1997) identified that the architectural profession was a social system in its own right, which was not isolated but rather part of a larger social system; the construction industry. Emmitt (1997) made

this distinction to narrow the research focus and this is the approach that this research will take.

For the purposes of this research, the social system is defined as the QS profession, encompassing anyone who works as a QS as defined in chapter two. It is acknowledged that this system forms a part of a larger social system, the construction industry, and that therefore an actor's diffusion journey may be influenced by factors within the immediate social system, the QS profession, or by factors external to it. This definition is deemed necessary due to the actors under scrutiny and also the nature of the innovation being investigated.

Further justification for this decision comes from the complete lack of any diffusion research where the QS profession is considered and it is the use of the QS profession for this research and the outcomes from it that help form one of the proposed contributions to knowledge, as the investigation of this profession and the findings presented can then coherently sit alongside the existing body of knowledge in this area.

3.13.2 The Actor

Having defined the social system in which diffusion will take place, it is necessary to identify the actor that takes the key role in the diffusion process within that social system. With the social system in question being the QS profession it is logical that the actor at the heart of this research is to be the QS, as discussed in chapter two and as already identified, there are no previous diffusion studies where the QS is considered which is an omission that this research aims to amend. This is also relevant owing to the authors background as a QS, as described in the personal reflexive statement, and it allowed a closeness to the subject area under investigation and as will be seen in the methodology chapter, it also allowed a more in depth conversation with the respondents about their individual diffusion journeys. This combination has allowed for the research to become unique and will be a contributing factor towards any claims for knowledge.

The key roles and responsibilities of the QS have been identified and also the diversity of the role depending upon the type of organisation the QS works for, either the PQS or CQS. For the purposes of this research both types will be included in the primary data collection as the individuals concerned belong to the same profession, have similar skill

sets and both use measurement in their roles, but happen to operate on two sides of the same coin. Both types of QS also regularly converse and can move from one type to the other depending on their employment so it is felt that the broader picture is required to be able to draw any meaningful conclusions. Care will be taken when undertaking the data analysis and observations on the divergences between QS types will be considered if relevant.

3.13.3 The Innovation

In order to consider the diffusion process one must have an innovation that can diffuse among a particular social system, in this case the QS profession.

As previously stated this research is not concerned with the generation of innovation and therefore for the purposes of this research Rogers (2003 p.xx) definition suits the research direction perfectly,

an idea, practice or object that is perceived as new by an individual or another unit of adoption

This chapter has identified that the majority of diffusion studies within the construction sector focus on the diffusion of new products, for example Emmitt (1997) who was concerned with how specifiers adopt new products for inclusion in their designs. Where the focus is not on new products it is on new processes that are essentially ways in which to combine existing products. Mitropoulous and Tatum (2000 p. 340) define a process innovation as "a technology that contractors use to plan, execute and control construction operations". This definition fits with how other authors such as Slaughter (1998, 2000) view process innovation and will be adopted for this research.

This highlights that within the construction management literature, the two main innovation focuses are either new products or processes. This research is concerned with neither of these types of innovation and instead will be focused on professional practice innovation.

Chapter two identified the importance of the measurement function for the QS and how it is used within the construction industry. Although some argue that its use is in decline

(Cartlidge 2013), this is only really referring to the use of the formal BQ within a traditional procurement setting and not the wider use of measurement techniques for the basis of forming building costs. This research considers the measurement process as professional practice that is informed, but not governed by, appropriate industry standards. As such, the development and release of the NRM is considered to be a professional practice innovation and will be the focus of this research.

To frame this using Rogers (2003) definition of an innovation the NRM is professional practice that is perceived as new by quantity surveyors.

The use of the NRM is important to provide a 'hook' with which to frame the research questions that will allow a less abstract view of the actors' individual diffusion journeys. This in turn will allow an inductive data analysis process to discover the actors' journeys without forcing the data into predetermined pockets.

In addition to their being no previous diffusion research where the QS is either the focal actor or the predominant social system, there is also no diffusion research within the construction management field that focuses on professional practice, and this is another area that will allow the findings to sit among the existing body of knowledge while adding to it.

3.13.4 Research Focus

Having identified the actor, social system and innovation under investigation, it is necessary to narrow the research focus in terms of the specific aspects of diffusion that will be considered.

This chapter has shown that there are many aspects available when studying diffusion of innovation from mathematical modelling (Bass 1969), through network analysis (Valente 1995) and descriptive analysis of the diffusion process (Rogers 2003). Rogers' work through his many publications (1962 – 2003) advocated the more descriptive analytical view where the diffusion of an innovation is studied either alongside the diffusion process or even after diffusion has reached critical mass, but this method relies

heavily upon quantitative analysis of data to ascertain trends, for example the rate of diffusion.

The popularity of the use of quantitative data for diffusion studies is not surprising as a key objective of the study of diffusion of innovation is to understand the diffusion process which in turn can help to inform future innovations and their diffusion. While this is desirable within certain markets and with certain innovations the aim of this study is not to chart the diffusion of the NRM, but rather gain a deeper understanding of the diffusion process with regard to QSs working within the UK construction industry. As such, existing diffusion theory will not be applied to the diffusion of NRM and no attempt will be made to ascertain the rate or spread of diffusion.

From the myriad of options available to study in terms of diffusion theory this research will focus on what this author considers four key aspects, firstly Rogers (2003) innovation – decision process, the role of prior conditions, innovation attributes, and the applicability and/or dominance of the three alternative diffusion concepts of cohesion, structural equivalence and thresholds.

Figure 3.4 shows a Venn diagram that positions this research within the diffusion of innovation research field. Only key authors have been identified in terms of relevance to this research with the mathematical modelling research being shown generically for completeness.

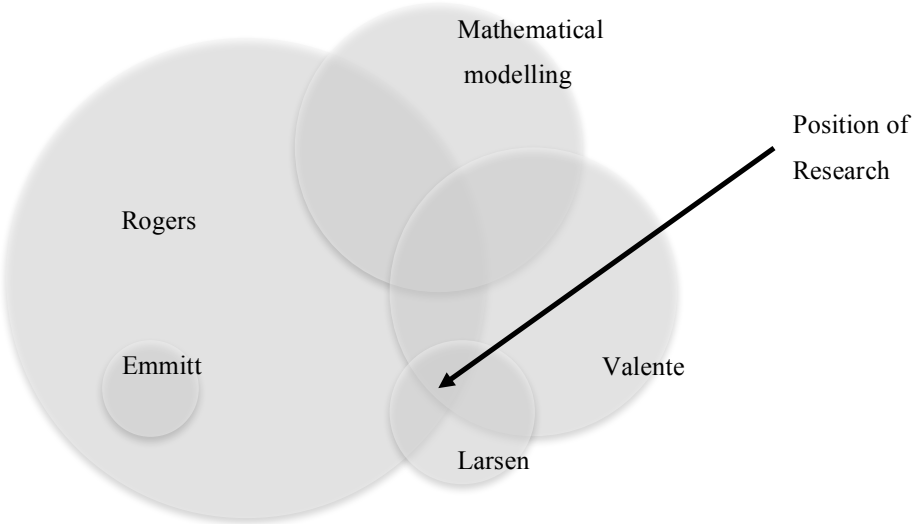


Figure 3.4 - Position of research within diffusion of innovation research field

3.14 Summary

The concepts and theories identified depict the main body of classical diffusion literature. As has been discussed there is an increasing trend towards a predictive mathematical modelling approach, but this approach is embedded more in the marketing strategy research area than on a more general sociological discussion around particular social groups and systems. Rogers' work provides a comprehensive framework with which to understand and describe the diffusion process from this sociological perspective and as such will be the main focus for discussion and development for a construction industry context.

The work of Valente and the network approach to diffusion also has its place in this research as it provides some clearer understanding of the roles of the actor and system, their influence upon each other, and on the diffusion of innovation. This understanding will allow a more detailed review and adaption of the classical diffusion model for a construction context.

This chapter has sought to define some key terms and lines of enquiry for this research. Firstly, the social system, actor and innovation have all been identified and defined

within the context of this research which provides a clear benchmark with which all further investigations are set against.

Secondly the main research focus has been identified in terms of the key aspects of diffusion theory that will be investigated through the primary research and are summarised as follows:

1. Rogers (2003) concept of prior conditions.
2. Rogers (2003) innovation-decision process.
3. Three diffusion concepts of Cohesion, Structural Equivalence and Thresholds.
4. Rogers (2003) innovation attributes.

This will be achieved using a qualitative methodology which is discussed, rationalised and justified in the next chapter and supports the research aim and objectives which are as follows:

Aim

To further understanding in the context of the diffusion of a professional practice innovation among QSs within the UK construction industry. Not only to ascertain if stages exist in this process, but also to discover if the stages proposed by Rogers (2003) are suitable for this particular context, and if a new model is required to accurately represent diffusion within these particular parameters.

Objectives

1. Define the context for the research in terms of actor, social system and innovation under investigation.
2. Identify the current measurement practices utilised by quantity surveyors.
3. Critically appraise and develop existing diffusion literature to suit the research context.
4. Identify barriers to the diffusion and adoption of professional practice innovation.

Chapter 4 – Methodology

4.1 Introduction

The aim of this chapter is to identify the ontological and epistemological stance of the research and to outline the overall research strategy and approach adopted for the primary research which is considered in the following chapters. In addition, consideration will be given to the data collection method and analysis techniques. Finally, details are provided on the chosen research methods, sampling technique, limitations and suitability in terms of the research aim and objectives.

4.1.1 Diffusion and methodology

Diffusion research poses numerous methodological challenges. The previous chapter has shown that the majority of diffusion research is concerned with searching for laws of behaviour, quantitative data and statistical methods of analysis, and almost exclusively uses the relationships between actors as the unit of analysis (Larsen (2005), Rogers (2003) and Emmitt (1997)). This is mainly owing to the majority of diffusion research being focused on utilisation of existing theory within the marketing and manufacturing sectors, where the focus is on searching for trends such as the rate of diffusion, tipping points or adopter categories. As Rogers (2003) identified, most diffusion studies are of a quantitative nature owing to the ability to set variables and analyse them with confidence and repeatability, which can then lead to generalisations across a wider population. What these studies fail to comprehend or even consider is the rich data that relates to the journey that each actor takes through a diffusion process. It is this journey that is the focus of this research and not the laws of behaviour for the entire social system.

In the broadest sense, diffusion is a macro-theory that consists of several, but no less significant, micro-theories. At the macro-theory level, the most significant consideration, which is often overlooked, is the interplay between the agent and their social system. This is not generally considered in the current literature, with the exception of Larsen (2005) who developed his own framework of diffusion to allow for this relationship. However, it is not the intention of this research to discuss the agency-

structure debate at length, but its inclusion is necessary to provide the research with focus and validity.

As identified in chapter three, the research focus is on the innovation-decision process as proposed by Rogers (2003). This is a micro-theory within the diffusion body of knowledge with a focus on the actor and their journey through the diffusion process, with consideration of external influence from the social system. In isolation, this micro-theory brings its own epistemological and methodological considerations that will be addressed.

4.1.2 Research Aim and Objectives

Before discussing philosophical assumptions, research strategy and techniques, it is important to reconsider the research aim and objectives to provide context for the following discussion.

Aim

To further understanding in the context of the diffusion of a professional practice innovation among QSs within the UK construction industry. Not only to ascertain if stages exist in this process, but also to discover if the stages proposed by Rogers (2003) are suitable for this particular context, and if a new model is required to accurately represent diffusion within these particular parameters.

Objectives

1. Define the context for the research in terms of actor, social system and innovation under investigation.
2. Identify the current measurement practices utilised by quantity surveyors.
3. Critically appraise and develop existing diffusion literature to suit the research context.
4. Identify barriers to the diffusion and adoption of professional practice innovation.

4.2 Ontology

In order to position this research within the diffusion body of knowledge, ontological assumptions need to be clearly defined and this section attempts to provide a settled resolution for the purposes of this study. Knight and Turnbull (2008 p.64) argue that without a clear ontological and epistemological stance, the researcher cannot strongly defend their contribution to knowledge.

Knight and Turnbull (2008 p.64) state that ontology is "concerned with existence or being and what we assume to exist clearly has implications for what we claim to know, and vice versa". Hughes and Sharrock (1997) summarise this by suggesting that ontology is concerned with what kinds of things really exist in the world.

As this research has a social science base, Dainty (2008 p.7) provides the most appropriate definition as follows:

> *Questions of social ontology are concerned with whether social entities are objective realities or social constructions built up from the actions and perspectives of social actors.*

So this brings the question of whether society exists independently of its actors and can therefore influence them, or whether society is a social construct of the actors themselves. These two positions generally fall into the following terms, objectivism or constructivism, although there are terms such as 'constructionism' that are used interchangeably, which does not help the researcher. For the purposes of this research, the term constructivist will be used.

Bryman and Bell (2011 p.21) provide a succinct definition for objectivism, which agrees with that provided by Silverman (2013) as follows:

> *An ontological position that asserts that social phenomena and their meanings have an existence that is independent of social actors*

While they define constructivism in line with authors such as Silverman (2013) and 6 and Bellamy (2013) as:

> *An ontological position that asserts that social phenomena and their meanings are continually being accomplished by social actors. This implies that social phenomena and categories are not only produced through social interaction but are in a constant state of revision*

This follows the earlier work of Kant (1724 - 1804) who held that knowledge of the world is mediated by cognitive structures, with the belief that as an agent we construct or make knowledge and invent concepts, models and schemas to make sense of our experiences and continually test and adapt them when new experiences occur (Guyer 2004). Schwandt (2007) is quite clear in this respect and suggests that we do not construct our interpretations in isolation but against shared understandings, language and practices for example.

Moses and Knutsen (2012) argue that constructivists are not looking for a true account of a phenomenon, but rather seek to capture and understand the meaning of social action for the actor performing it and seek to explain the nature of social patterns, rather than predict the outcomes. This approach aligns with the research aim which seeks to further understanding of the diffusion of innovation where the actors in question are part of the QS profession.

Moses and Knutsen (2012) also suggest that a constructivist approach has other implications to consider as through the investigation of these social constructs, the observations and experience depend upon the perspective of the investigator as they are not neutral and would not necessarily be consistent across investigators. This leads to a discussion on reflexivity and will be discussed later in this chapter.

This research takes a constructivist view supported by a qualitative research strategy that follows Bryman (2008 p.366) who states that qualitative research strategies adopt,

An ontological position described as constructivist, which implies that social properties are outcomes of the interactions between individuals, rather than phenomena 'out there' and separate from those involved in its construction.

The research aim sought to further understanding of the diffusion phenomenon among the social system comprised of the QS profession, and not to discover any tangible objective meanings. A constructivist position allowed for the exploration of this phenomenon through the journeys of the actors themselves and allowed development of the existing body of knowledge in this subject area that leads into the epistemological stance of the research and how the justification for knowledge is positioned.

4.3 Epistemology

Now that an ontological stance has been taken, it is important to consider the epistemological stance of the research. Epistemologies provide much of the justification for particular methodologies within social science, for example the aim, function, and assumptions of method.

Knight and Turnbull (2008) identify two main traditions of epistemology, the normative tradition and the naturalistic tradition. Within these traditions the normative is associated with foundationalism or coherentism, with the naturalistic tradition associated with positivism.

The naturalistic tradition, advocated by positivists, a term originally coined by Auguste Comte (1798 – 1857), owes a lot to empiricism (Knight and Turnbull (2008)), but instead of using sense experience, positivists attempt to found knowledge on ordered experiences such as those associated with scientific experimentation (Bourdeau 2014). Positivists can be split in terms of two approaches to the founding of knowledge, the empirical and the logical, where empirical knowledge is gained through natural science and logical knowledge by logic itself and by mathematics (Hughes and Sharrock (1997)). Denscombe (2010, p.324) shares the empirical view and states that positivism is "An approach to social research which seeks to apply the natural science model of research to investigations of the social world" and that "for positivists, the aim of social

research is to discover the patterns and regularities of the social world by using the kind of scientific methods used to such good effect in the natural sciences."

Within the normative tradition foundationalists make the assumption that all knowledge has some foundational belief, and that these beliefs act as the substructure for all other inferred beliefs. Foundationalists fall into two distinct categories the empiricists with philosophers such as Locke (1632-1704) and Hume (1711-1776) being most notable, and the rationalists, which is commonly associated with Descartes (1596-1650). Schwandt (2007) claims that the empiricist considers knowledge to be derived from sense experience where beliefs can be justified by observation, while the rationalist claims that reason is the sure path to knowledge.

The normative tradition is where this research positions itself, but not within the foundationalist tradition but rather the coherentist tradition. Knight and Turnbull (2008) suggest that the coherentist holds no foundational beliefs, and that beliefs support each other where the *justification* for the belief centres around the match between it and others. This research makes no attempt to discover any new foundational knowledge but rather to see how new understandings within a particular context map against existing theory.

This research therefore takes an inductive approach to knowledge acquisition that builds evidence towards inductive inference. Pritchard (2006 p.175) states that "an inductive argument is any argument where the premises, while offering support for the conclusion, do not *entail* the conclusion" and suggests that lots of scientific knowledge is gained inductively whereby scientists make a series of observations and then draw conclusions based on these observations that go beyond what has been observed. While Hawthorne (2014) suggests that an inductive argument accumulates evidence to a degree where it supports a conclusion, but does not guarantee it. As such, an inductive argument is concerned with probable conclusions. The inductive approach is suitable for this research as it is concerned with an actors' individual journey through the diffusion process where multiple actors' journeys will be analysed and synthesised to draw probable conclusions to inform the development of a contextualised model of diffusion, which is coherent with the existing body of knowledge surrounding the diffusion phenomenon.

Given the research aim and objectives it was decided that a coherentist epistemological position, informed by a constructivist ontological stance and supported by a qualitative research approach should be undertaken to gather the rich explanatory data that seems to be lacking in the diffusion research field, and that this approach will help to develop a deeper understanding of an actor's diffusion journey and to address the overwhelmingly positivist approach to diffusion research in the past (Rogers (2003), Larsen (2005)). This approach will support the development of the Rogers (2003) model and propose context specific findings which will demonstrate how these new understandings within a particular context map against existing diffusion theory, thereby supporting the coherentist position.

4.4 Qualitative Research

Moses and Knutsen (2012 p.201) state that constructivists "realise that the world is filled with repetitions and regularities, but they insist that these patterns are socially constructed" and therefore to support the constructivist stance adopted the research needs to approach the data collection and analysis with tools and approaches that can identify the socially constructed patterns in the world, and understand them in the light of the contexts that give them meaning.

Rogers (2003) suggests that nearly all diffusion research has used statistical analysis of some form, with the exception of those embedded in anthropology. This is both a concern and an opportunity as it results in a field of research that fails to understand *why* things occur from an actor's perspective. As has been discussed above, this research seeks to gain a deeper understanding of an actor's diffusion journey by utilising existing theories and developing those within a specific context that adds to the coherence of the existing body of knowledge. A qualitative research approach will support this and allow the successful achievement of the research aim.

Qualitative research is "subjective in nature" and relies on people's experiences, views and understanding (Naoum 2007 p.40) and seeks to "gain insights and understand people's perceptions of the world" (Fellows and Liu 2008 p.27). Fellows and Liu (2008) acknowledge that qualitative research is criticised by people with a traditional

quantitative background, but that within the built environment research field there has been a clear move to adopt a more qualitative approach, regardless of the difficulties and biases. A qualitative approach also places the research in a social context which supports the constructivist ontology.

Creswell (2014 p.4) defines qualitative research as "An approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" that is a good fit for the consideration of an actor's journey through the diffusion process, which is a human problem, and also as this research aimed to explore and understand this journey where previously only quantitative approaches had been undertaken. Creswell (2014) also discusses the use of qualitative approaches being particularly relevant where existing theories do not apply with the particular group of actors being studied, so again, this supports a qualitative approach to this research, as existing diffusion studies are generalised across wide populations and this research seeks to contextualise this diffusion journey with respect to the QS profession.

Creswell (2014), Marshal and Rossman (2011), Denscombe (2010), Hatch (2002) and Miles and Huberman (2002), identify various qualitative research *characteristics*. These are worth considering within the context of this research and can be summarised as follows:

Natural setting

This refers to data being collected in the field. This study comprised exclusively interview data collected in the field from QSs who are the actors being investigated. All data was collected from the actors place of work to avoid any disruption and also to ensure that all actors were comfortable in their surroundings.

Researcher as a key instrument

Data should be collected by the researcher to allow more comprehensive observation of behaviour. This was a crucial element of this research as the author has over 18 years' experience working as a QS. This was expressed in the reflexive statement at the start of this thesis, but the importance should not be under estimated. By having this experience and knowledge of the practice under investigation it allowed for a more detailed discussion that could really explore the actor's journey, as opposed to being a simple

question and answer approach. This also allowed the author to reflect and write memos following each interview to allow more holistic and detailed analysis of the actors journeys.

Multiple sources of data

It is suggested that alternative data collection techniques are utilised, such as observations, in addition to conducting interviews. For this research this was deemed unviable due to the nature of the diffusion process.

Participants meanings

The focus is to be on learning the meanings participants hold, not the researchers meaning or that from the literature. This is true of this research as it is the actors individual journey that is the focus of the research. Care was taken with the research design to not impose too much meaning to the interview questions and to let respondents speak with relative freedom. This was aided by using the NRM as the 'hook' to base the interview questions on, and this also allowed a more realistic representation of their journey to be uncovered as opposed to if direct questions were utilised about the theory itself.

Emergent design

This study evolved iteratively from a sound literature based theoretical framework through to a more inductive approach that evolved following each respondents interview.

Reflexivity

Cresswell (2014) suggests that the distanced and objective writer is no longer an acceptable position to adopt, and therefore the researcher needs to position themselves within the research process. This statement also supports the constructivist approach adopted as "constructivists recognise that people may look at the same thing and perceive it differently" (Moses and Knutsen 2014). In addition to the reflexive statement, located at the beginning of this thesis, and consideration of the researcher being a key instrument, constant reflection of the research process was undertaken using memos following the interviews and regular revision to the interview guide. Furthermore, the impact of the authors experience was considered during the analysis

phase where it is important to examine the data openly to allow alternative interpretations of the data. This was aided through the continued use of memos and diary writing which allowed the author to look back on decisions and reflect on the data analysis process as it occurred. Further discussion on the role of the researcher and the impact on the interview process can be found later in this chapter.

Holistic account

Signifies the need for multiple perspectives, and to consider the many factors that allow one to look at the larger picture that emerges. Given the limits of this research this is constrained somewhat, but consideration has been given to the wider QS profession as far as practicable and as such multiple perspectives have been taken into account.

As can be seen from the above, a key aspect of qualitative research is the richness of knowledge that can be gained through the use of appropriate methods. This richness needs to be offset against the main criticisms of qualitative research, and they are the question of generalisation, subjectivity, replication of results and a lack of transparency. (Fellows and Liu, 2008 and Bryman, 2008).

These criticisms are regularly cited by positivist scholars when referring to the quantitative criteria of validity, reliability, generlisability and objectivity (Denscombe 2010). Denscombe (2010), Schwandt (2007) and Bryman (2008) suggest that a more pragmatic approach is required when considering qualitative research, as the data is not easily judged using these criteria. They propose a revised set of more appropriate criteria that are part of the orthodoxy of assessing the quality of qualitative research.

Credibility

Consideration needs to be given to the extent that qualitative research can demonstrate the use of accurate and appropriate data, and where used has the data been produced and checked in accordance with good practice. For this research credibility can be attributed to the data collection by considering the sample of respondents and their diversity but also relevance to the UK construction industry. The sample is discussed later in this chapter but was chosen purposively with an element of snowballing where deemed appropriate. In addition, the use of the NRM as a ‘hook’ with which to base the interview guide on allows a contextual investigation of diffusion theory and provides

the framework to allow the interview to revolve around a naturally occurring diffusion scenario, rather than directing questions at respondents about diffusion itself. This adds to the credibility of the research as it removes the abstract element from the interviews and increases the respondent's ability to engage with and answer the questions based on their personal diffusion journey. As a further measure to increase credibility, the proposed model of an actor's diffusion journey will be internally validated through the demonstration of the actors journeys and the mapping of these to the proposed model.

Dependability

This refers to the demonstration that the research reflects best practice and that any decisions undertaken can be clearly seen by others who can then evaluate the extent that they constitute "reputable procedures and reasonable decisions" (Denscombe 2010 p.281). This requires a comprehensive and explanatory account of methods used, analysis of data and any decision making. This research provides this auditable account through discussion in this chapter, for example the use of interview guides, and also the results chapters through careful and systematic use of proven tools and techniques such as NVivo, and also the use of memos, as well as the reflexive account at the start of this thesis and commentary throughout.

Transferability

One area that attracts criticism when undertaking qualitative research is that of generlisability. Punch (2014 p.122) states that "Generalisation should not necessarily be the objective of all research projects" while Creswell (2014 p.203) discusses the idea of qualitative generalisation, where the intent of qualitative enquiry is not to generalise findings to individuals, sites or places outside of those under study. Denscombe (2010) identifies the same principles and argues that it is not our business to make such generalisations and that we should use a judgement about how far the research findings would apply to other comparable instances, or in other words what extent 'could' the findings be transferred, rather then what extent 'are' they transferable. With regard to this research, the aim is to further understanding and develop existing theory from a constructivist position, which as already discussed seeks to interpret and explain the nature of social patterns, not predict the outcomes. The findings will then add to the existing diffusion research landscape in line with a coherentist approach to epistemological justification.

Confirmability

The research aim is supported by the qualitative approach adopted and the influence of the researcher has been discussed above. The author has a unique background in the QS profession and as such it would be impossible for another researcher to gain identical findings. However, it is clear that the author took the necessary steps to provide a consistent approach to the data collection and the interview guide used can be found in the appendix. As has been discussed above, the main influence that the author had on this research is associated with the previous experience of the professional practice used as the 'hook' in the interview questions. This allowed a more conversational approach to the interviews and garnered trust from the respondents as they were dealing with an equivalent professional.

4.5 Interviews

Having considered the methodological approach adopted for the research it was decided to utilise interviews for the data collection.

As has been identified, interviews are a key method for collecting primary data under a qualitative research strategy. As this research adopts an inductive approach to knowledge acquisition the use of interviews is wholly appropriate to gain the insights into people's opinions, feelings, emotions and experiences (Denscombe 2010) and to allow the investigation into actors' diffusion journeys. Interviews are the most prominent data collection tool in qualitative research and are a very good way of accessing people's perceptions, meanings, definitions of situations and constructions of reality (Punch 2014). Although a popular tool, interviewing should not be considered an easy option, as it can fail as a research method unless there is good planning, proper preparation and sensitivity to the complex nature of interaction during the interview itself (Denscombe 2010).

In order to sufficiently discuss the interview as a method and the approach taken for this research the following will be considered:

- Interview techniques, tools and processes

- Question design and application
- Sampling

4.5.1 Techniques, tools and processes

Interviews can be undertaken using one of three main approaches, either structured, semi-structured or unstructured where the approach adopted is aligned with the overall research aim and strategy (Punch 2014).

Denscombe (2010) describes structured interviews as being tightly controlled, almost like a questionnaire where questions are predetermined, in careful order and an expectation of limited response. This brings the advantage of standardisation to proceedings and also the ability to pre-code answers. Haigh (2008) describes additional characteristics of this approach and suggests that the standardisation assists with the reliability of results and conclusions, but that the interviewer cannot deviate or inject any extra remarks, or share their beliefs or opinions.

Semi-structured interviews start with a clear list of issues to address, but there is flexibility and the interview can develop through the use of open-ended questions that allow elaboration on points of interest (Denscombe 2010). This style of interview therefore lets concepts emerge in a freer flowing, conversational manner, and allows the interviewer to adjust questions or inject ideas to stimulate the discussion (Haigh 2008).

Unstructured interviews are focused on the interviewee's thoughts, and the interviewer is to only start the ball rolling with a theme or topic, where the aim is discovery rather than checking (Denscombe 2010). This is a more in depth approach that proceeds without priori categorisation and one that requires more skill and ultimately more complex analysis (Punch 2014).

This research adopted a semi-structured interview approach as it offers the benefits of the unstructured approach in terms of flexibility, but also allows the control of the discussion though the use of an interview guide, without being so rigid as a structured approach. Haigh (2008) advocates the use of an interview guide to assist this approach and suggests that it is intended to ensure that the same general areas of information are

collected from each interviewee, but also allow a degree of freedom and adaptability. The design of the interview guide is discussed separately.

Once a suitable approach was adopted, the next stages to consider were the sampling of respondents, design of the interview guide (both of which will be discussed separately), and the interview as a data collection technique in terms of conduct during the interview and any other considerations of this type.

Haigh (2008) states that a good interview is the art and science of exploring the subjective knowledge, opinions and beliefs of an individual. As such, consideration needs to be given to the interview process that goes beyond what questions are to be asked. Denscombe (2010) suggests that interviews are easier to control when they are one to one, as this provides only one flow of information, is easier to arrange and easier to transcribe. As will be seen from the later discussion on sampling, the majority of interviews undertaken were one to one, but where opportunities arose to interview multiple respondents who can offer different but complementary perspectives, this was taken irrespective of the increased difficulty. For consistency, the same interview guide was used, but rather than work around each respondent in turn the respondents were encouraged to interact with each other. This follows the protocol for group interviews as proposed by Silverman (2014). This resulted in a more cohesive interview where all respondents could contribute to the discussion.

Denscombe (2010) also raises the question of the effect the interviewer can have on proceedings. He suggests that the interviewer's identity can have an impact on the amount of information people are willing to share. This has been considered in the discussion earlier in this chapter, but it is worth noting that it is the opinion of the author that his experience and position in the industry helped to improve the quality of the conversation in the interviews as both the author and respondents are from the same profession and share many of the same professional ethical standards and practices. This commonality between the author and respondents resulted in extended conversations about the minutiae of the measurement process and this also helped to explore the respondent's diffusion journey in more detail than would have been possible otherwise.

Haigh (2008) cites a different issue with regard to the influence that the interviewer can have over the interviewee, and suggests that care needs to be taken and consideration needs to be given to tact, phrasing, clarity, bias, accuracy and confidentiality. These aspects were considered as part of the interview guide design and also through the use of a checklist of items that were discussed before each interview. This checklist consisted of permission to record and also discussion on interviewees wishes in terms of confidentiality and remaining anonymous in the research.

In terms of conduct during the interview, authors such as Denscmobe (2010), Haigh (2008), Punch (2014) and Bryman (2008) are in agreement with the main points. Firstly, conduct should be of a professional manner and good preparation is needed in terms of the interview guide, recording equipment and appearance. Recording equipment used was an Apple iPhone 6 which not only provided excellent recordings in terms of audio clarity, but also allowed hassle free transfer of files to computer for playback and transcription. The iPhone was set to 'airplane' mode to prevent any interruptions during the interview.

In addition, certain skills are identified as being crucial to the success of the interview and these can be summarised as follows:

- Attentiveness.
- Sensitivity to feelings.
- Tolerate silences.
- Adept at using prompts.
- Adept at using probes.
- Adept at using checks.
- Non-judgemental.

Bryman (2008) also suggests that making notes after the interview is of great importance and can help with analysis at a later date. These notes should contain thoughts on how the interview went, where it took place, any feelings about it, any initial thoughts on key themes and any amendments to the guide that are required. This was undertaken in the form of memos that were written in a journal immediately after

each interview and these were used to aid the data analysis and to support the transcribed interviews. Items considered in the memos included suitability of location, observations on interviewees and their reactions to questions, key themes that were emerging and any comments on specific questions that needed revision or reconsideration. The memos were also used to make early charts of the respondent's diffusion journey which would later be useful when considering the development of the contextualised diffusion model.

4.5.2 Question design and application

Having adopted a semi-structured approach for the interviews, the design of the interview guide is crucial to extract the most relevant and appropriate depth of data. Punch (2014) recommends that good questions are clear, specific, empirical, interconnected and substantive. This was all achieved through the careful drafting of the interview guide in line with both the research aim and objectives but also the existing body of literature.

Kvale (1996) suggests nine types of interview questions:

1. Introducing questions.
2. Follow up questions (what do you mean?).
3. Probing questions (could you say more?).
4. Specifying questions (What did you do then? How did you react?).
5. Direct questions.
6. Indirect questions (Broad questions on a topic).
7. Structuring questions (Moving topics).
8. Silence.
9. Interpreting questions (where you interpret a response and then ask a new question).

These criteria were considered when designing the interview guide as they are logical and allow the interview to provide the additional depth and richness of data that is associated with this type of research method.

The structure of the interview was designed to discover an actor's journey through the diffusion process in accordance with the research aim and objectives. Therefore, the first line of questioning was focused on the actors existing conditions to ascertain a benchmark position. These questions considered items such as the type and size of the company, the most commonly encountered procurement routes and most importantly the actor's current measurement practices.

From this initial stage the questions were composed around Rogers (2003) innovation-decision process, as the development of this is part of the main research aim. Questions were segregated into the various stages and unique questions were written for adopters *and* non-adopters of the NRM. This was necessary for two reasons, firstly it was not known how the NRM was diffusing amongst the construction industry and therefore one had to be prepared to explore both adoption and rejection, and secondly, research into rejection decisions was unusual (Rogers 2003) and therefore this was seen as an essential contribution to this research. Questions were structured in accordance with the guidance provided by Kvale (1996) and commenced with a key point which was then followed up with more probing questions to unearth the required detail of the actor's diffusion journey. No direct questions were asked about the innovation-decision process itself, neither were respondents alerted to the various stages of the innovation-decision process. The intention was to identify the actor's journey without influencing their response and in turn allow later assessment of the relevance of the process to QSs within the construction industry through a more inductive approach. Rogers (2003) existing model purely provided a logical sequence of questioning to provide consistency and flow to the interview proceedings. The use of the NRM as the main 'hook' for the line of questioning was important, as it was critical to avoid direct questions around existing diffusion theory. Although these questions are not as explicit as those posed by Larsen (2005) the subtler embedded approach to these questions provided a greater response rate and also, as they are contextualised with regard to a specific innovation, a less abstract final result.

Larsen (2005) received several responses to his line of questioning that suggested that the work was too complicated, too abstract, too intrusive and of little use. These can be judged as harsh responses but maybe not unexpected when approaching abstract theoretical concepts to members of the construction industry. The use of a particular

innovation, the NRM, added some much needed context to this research and in turn avoided the problems experienced by Larsen (2005). The use of the NRM allowed consistent and relevant questioning and also encouraged deeper and more meaningful conversations with all respondents owing to their interest and previous experiences with the subject at hand, which aided the development of the contextual diffusion model presented at the end of this thesis.

In addition to the five stages of the innovation-decision process it was also necessary to address the Rogers (2003) concept of innovation attributes. This line of research is quite common in product innovation studies (Kale and Arditi 2010) but is more complex when considering a professional practice innovation. Although analysis of innovation attributes is not the sole focus of this study it was felt that a line of enquiry was necessary to add data to the persuasion stage of the innovation-decision process and also to ascertain if this type of innovation has any specific attributes that may influence the analysis of the data relating to the innovation-decision process, and in turn if any further research is required in this area. Once again, no specific mention was made of the attributes identified by Rogers (2003) but rather more open-ended questions were posed to allow later analysis of both the suitability of those suggested by Rogers (2003) but also any additional factors.

Questions within specific stages were written to both identify that stages suitability in the process and also to allow further comparison with the work of Larsen (2005) where he identified the positioning of the three main diffusion concepts of cohesion, structural equivalence and cohesion along the innovation-decision process timeline.

The interview guide was developed as the data collection progressed to fine tune the guide and maximise the usefulness of the interviews in achieving the research aim and objectives. One area that this was particularly important was where a respondent to the initial request for interview admitted that they were not aware of the NRM. This in turn required a new line of questioning that focused on their existing practices, and the felt need for a new method of measurement. In addition, it was decided that this would also be a good opportunity to explore in more detail why the respondent felt that they were unaware of such a significant innovation within the industry. Full discussion of this can

be found in the analysis chapter. A final version of the interview guide can be found in Appendix A.

4.5.3 Sampling

Miles *et al* (2013) suggest that specific questions are asked when considering a sample and these have been addressed as follows.

Is the sampling relevant to your conceptual frame and research questions?

The sampling was undertaken purposively with a focus on senior QSs in a position of influence. This was necessary as the respondents needed to have been through the diffusion process themselves, and not just be at the receiving end of an authoritative decision. This would allow the interviews to explore the respondent's diffusion journey and the various factors that influence this in line with the researches conceptual frame.

A mixed sample was undertaken with regard to private practice QSs and contractors QSs. This was necessary as it was identified in chapter two that these two differing sectors are part of the wider construction industry, but actually have different approaches to professional practice, and in particular measurement of building works. In addition to this, it was also deemed necessary to gain a wider sample that included respondents from all parts of the industry from regionalised SME level up to internationally active consultants and contractors.

A full list of the respondents, their respective professions and company size can be found in Table 4.1, the coding of which is explained in full detail in the next chapter. As can be seen, nineteen codes are shown from a sample of twenty-six respondents. This is a result of the use of multiple actor interviews as discussed earlier in this chapter, which are broken down as follows:

1 x 4 respondent interview.
4 x 2 respondent interview.
14 x 1 respondent interview.

This provides a sample that covers the four main extremes of the QS profession namely the large PQS and CQS actors and the SME level PQS and CQS actors. The QS profession is a large and diverse group, so no attempt is made to suggest that this is representative of the profession, only that the sample is deemed suitable given the research philosophy and aim, and is as broad and pragmatic as it could be given the research constraints.

No.	Initials	Position	RICS?	Sector	Turnover (£)	No. of Employees	CODE
1	DM	CE	N	C	M	M	DM – CE-C-£M-M
2	PR	QS	N	C	S	S	PR – QS-C-£S-S
3	SB	SQS	Y	P	S	M	SB – SQS-RICS-P-£S-M
4	SD	Dir	Y	P	M	L	SD – Dir-RICS-P-£M-L
5	WC	Dir	N	C	S	S	WC – Dir-C-£S-S
6	CG	SQS	Y	P	M	L	CG – SQS-RICS-P-£M-L
7	JC	CE	N	C	M	L	JC – CE-C-£M-L
8	JP	Part	N	P	S	S	JP – Part-P-£S-S
9	CB	Dir	Y	C	S	S	CB – Dir-RICS-C-£S-S
10	MR	Dir	Y	C	S	S	MR – Dir-RICS-C-£S-S
11	SW	CM	Y	C	M	M	SW – CM-RICS-C-£M-M
12	SB	SQS	N	C	M	L	SB – SQS-C-£M-L
13	LF	SQS	N	C	M	L	LF - SQS-C-£M-L
14	SS	SQS	N	C	S	M	SS – SQS-C-£S-M
15	JB	Part	Y	P	S	M	JB – Part-RICS-P-£S-M
16	AG	SQS	Y	P	L	L	AG – SQS-RICS-P-£L-L
17	GS	CM	N	C	M	M	GS – CM-C-£M-M
18	VR	CM	Y	C	M	L	VR – CM-RICS-C-£M-L
19	SH	SA	Y	P	L	L	SH – SA-RICS-P-£L-L

Table 4.1 - List of respondents and codes

Will the phenomena appear?

By selecting such a wide sample in terms of profession and size of company it was hoped that the phenomena under investigation would appear. As it transpired there were many more rejecting the NRM than adopting which was initially surprising, but not a concern as all but one respondent was aware of the NRM and could therefore discuss their journey through the diffusion process. This diffusion journey discussion was the

key aspect of the interview process, so the fact that all respondents could contribute towards this discussion was a welcome relief. The interviews were conducted across twenty-six actors and it was at this stage where a decision was taken to stop collecting any more data. The interviews had covered the main extremes of the QS profession as discussed earlier, and the data being collected was starting to reach a saturation point. The author would not be as bold as to suggest that a 'theoretical saturation' point had been reached as this research has not adopted a grounded theory methodology, however, the responses were starting to repeat and it was felt that at this stage there had been sufficient data collected to begin the analysis process.

Can believable descriptions and explanations be produced?

From the sample identified it shows that a broad spectrum of the QS profession has been considered and as such the sample would provide the relevant data to be able to address the research aim and objectives. The focus of this research is on an actors' diffusion journey and the sample had provided twenty-six accounts of the diffusion journey from the various parts of the industry. This was deemed suitable to provide the basis of an inductive analysis of the data and allow the development of the contextualised diffusion model.

Is the plan feasible?

Access to respondents was gained through a variety of sources. Initially the main focus was on industry contacts from the author's previous professional practice experiences, then utilising current colleagues professional contacts. Once these were exhausted respondents were contacted through formal contracts that Nottingham Trent University (NTU) has with various industry related companies. Finally, assistance was sought from the current cohort of part time QS students studying at NTU. This purposive approach was supplemented by a snowballing process where each respondent was asked if they knew any other QS practitioners that would be willing to partake in this research. Once again, care was taken not to influence this process and no respondents were known to the author to avoid any bias in the interview proceedings. This approach yielded all of the required respondents to satisfy the sample criteria identified here. The author did utilise his available contacts as described above from a purely pragmatic perspective, but he had not met any of the respondents before the interview and had not discussed the details of the interview either to avoid any preparation on behalf of the respondent.

All potential respondents were contacted via email in the first instance with a brief description of the research and a request that they partake in an interview. Once responded to this was followed up with more information if requested and a suitable date/time arranged.

Time was a big factor in the collection of the interview data, and this was conducted around current work commitments. This restricted the speed in which interviews could be undertaken, but overall all of the interviews were conducted within a twelve-month period. Financial considerations did not prevent the undertaking of any of the interviews, and all were conducted at the respondents work place to minimise disruption to them and also to allow them to be in familiar surroundings to minimise any discomfort during the interview process. The various locations of the sample have not been disclosed on the grounds of confidentiality, but all respondents were interviewed in England as far north as Newcastle and as far south as Exeter, with some respondents working for international consultancies or contractors but based in the UK.

Is the plan ethical?

This research follows the guidelines for the ethical conduct of research set by the NTU Graduate School. All respondents were asked to approve the use of audio recording equipment and the use of their names, organisation names and any other data before interviews began. Some respondents reserved the rights to have their data remain anonymous subject to inspection of the finished research. This was undertaken and the result of this can clearly be seen. All interview recordings and transcripts were kept on secure, password protected, computers and backed up on individual password protected cloud storage.

4.6 Data Analysis

Having undertaken the interviews, the next stage was to analyse the data. As already discussed, all interviews were transcribed, where possible, into Microsoft Word format to allow further use in specialist qualitative analysis software.

The purpose of analysing something is to gain a better understanding of it
(Denscombe 2010 p.235)

The above quotation holds true for this research as the interviews and transcriptions are only data collection, not analysis, and in order to fully understand an actor's journey through the diffusion process and to address this research aim and objectives, a detailed analysis of the data is required.

Creswell (2014) suggests following a series of steps to provide a comprehensive approach to the data analysis which are shown in table 4.2 below.

Step	Description
1	Organise and prepare the data. Transcribe interviews, write up notes.
2	Read the data. What are the general ideas? What is being said?
3	Start coding the data. Obvious codes, surprising codes, codes of conceptual interest. Consider if the codes are predetermined, or if they emerge from the data. Possibly a combination approach?
4	Allow the codes to generate a description of the setting and the individuals, in addition to the categories or themes for analysis. Use to develop into a theoretical model (if applicable) and to form complex theme connections.
5	Consider how to represent the themes.
6	Interpretation of findings. What were the lessons learned?

Table 4.2 - Steps for analysing qualitative data. Adapted from Creswell (2014)

These steps introduce the technique of coding, and this will be discussed in more detail later in this chapter, as this was the approach adopted for analysing the interview data, but the key aspect to take from the above is having the data is only the first stage in a lengthy and complex process. Denscombe (2010 p.283) provides a similar series of steps, but suggests that no single approach covers all situations and states "the ultimate goal of analysis is to derive concepts and theories that capture the meaning contained within the data".

Denscombe (2010 p.279) goes on to say that one must be considerate of how one moves from raw data to findings, and that this process needs to be detailed and rigorous, and that it can be a "messy process". In addition, one must consider how much data is presented to the reader, as not all data can be shown. This is a key consideration as extracts from transcripts can be taken out of context and require careful judgement from the author who ideally should only use extracts to illustrate a point or as supporting evidence, not proof of a point in discussion.

The analysis needs to show detail, scholarly rigour and discipline (Punch 2014, Silverman (2011), Denscombe (2010)), in order to meet the criteria previously proposed consisting of credibility, dependability, transferability and confirmability, but above all it needs to treat the data carefully and bear in mind the overall research aim and objectives. The actors diffusion journey is central to this research and as such this needs to be analysed with care to ensure that the findings are accurately represented. To address these criteria and demonstrate the necessary scholarly rigour Computer Assisted Qualitative Data Analysis Software (CAQDAS) was utilised for the analysis of data.

4.6.1 Coding using QSR NVivo

King (2008) highlights that historically qualitative researchers undertook the coding and analysis of their data manually, but that in more recent times there has been a shift as more researchers are utilising CAQDAS. Having considered the various software packages available, this research will utilise the QSR NVivo software as it is widely recognised and has substantial supportive literature.

When utilising software for assistance with analysis of qualitative data care needs to be taken so that one does not follow a strict mechanistic approach, and that one takes the time to think and reflect upon the data, therefore avoiding an overly descriptive prosaic project (Johnston 2006). This was considered when undertaking the coding process, which will now be discussed in more detail, and the results can be seen in later chapters.

When undertaking the coding process Bringer *et al* (2004) recommend that researchers provide a transparent account of the process so that readers can decide if the software

utilised was used in such a way that was appropriate to the overall methodology. This approach was followed and evidence of this can also be found in the next chapter. This was achieved through the use of screen shots and associated narrative to provide an audit trail of the coding process.

The art of coding is discussed in all current methodological texts that concern themselves with qualitative data and its analysis, though many (Punch (2014), Miles *et al* (2013), Bryman (2008)) focus on and describe the approach to be taken if following a grounded theory methodology, where specific details are given on open coding, axial coding and selective coding. These terms can be traced back to Strauss and Corbin (1990) who distinguished between these three types of coding practice and can be summarised as follows:

Open Coding: breaking down, examining, comparing, conceptualising and categorising data. Yield concepts, which are later to be grouped and turned into categories.

Axial Coding: Set of procedures where data are put back together in new ways after open coding making connections between categories. Linking codes to contexts, to consequences to patterns of interaction and to causes.

Selective coding: Selecting the core category, systematically relating it to other categories, validating those relationships and filling in categories that need further refinement and development. A core category is the central issue or focus around which all other categories are integrated.

As previously discussed, this research has not adopted a grounded theory approach, and therefore these techniques, while interesting, will not be followed verbatim. At the other end of the scale is the work of Saldana (2009) who identifies a comprehensive list of what he terms first cycle and second cycle coding methods, which cover all manner of qualitative enquiry approaches. This, admittedly comprehensive, work overcomplicates what should be a more fluid and inductive process, and as such was deemed unsuitable for this study. Having said that, his work is supportive of the more general tools and techniques already discussed such as memo writing, reflection and transparency of approach.

Of more interest to this research is the work of Bazeley and Jackson (2013) and Richards (2015) where a more pragmatic and holistic approach to coding and qualitative data analysis in general is taken. Richards (2015) identifies three main types of coding;

1. Descriptive.
2. Topic.
3. Analytical.

Descriptive coding

This is essentially just storing information about the cases under analysis. This was undertaken using the attribute feature within NVivo where known data about each case is entered before the analysis process begins. For this study the data consists of the sector of the industry (PQS, CQS), professional qualifications (e.g. RICS), turnover and number of employees. It was also decided to identify who had adopted the NRM and who had rejected at this stage. This attributes data allows convenient cross case analysis at a later stage when for example you can interrogate which RICS members have adopted NRM and in turn what reasons were behind that adoption.

Topic Coding

Topic coding allocates passages of text to topics. This generally involves little interpretation but is essential to put all like data together for further analysis. for example, procurement plays an important role in the chosen method of measurement used so identifying each occurrence of a respondent who primarily procures using D&B is essential as this can then be quickly identified and analysed in the wider context of the study.

Analytical coding

Richards (2015) identifies this as any coding that requires interpretation and reflection on meaning. This is quite different to the previous techniques and is one where you consider the meanings of the text in context and create new categories that express new ideas about the data. Richards (2015) suggests a three step approach to the analytical process which can be summarised as follows:

1. Identify what's interesting in the data.
2. Ask: *Why* is it interesting?
3. Then ask: Why am I interested in *that*?

This approach is also adopted by Bazeley and Jackson (2013) who suggest that in addition to the coding alongside should be a regular process of annotating, memoing, linking and modelling. This process is simplified in NVivo as you can create memos to any document, case or node as your work progresses and this is the process that was undertaken as part of the data analysis. Bazeley and Jackson (2013) provide the most comprehensive insight into using NVivo for any research project and as NVivo was used for this research it is important to identify some of the particular terminology used within the software for clarity when reading the later analysis chapters of this study.

Coding in NVivo is stored in nodes. Nodes become points at which concepts potentially branch out into a network of sub-concepts or dimensions. You initially make a node for each topic or concept to be stored, where at first they are simply dropping off points for data about ideas you want to hang onto (Bazeley and Jackson (2013)). As the research progresses these are likely to be organised and moved into a branching structure, which are called trees. A tree is a hierarchy in which nodes representing sub-categories (child) are placed under higer-level (parent) nodes (Bazeley and Jackson (2013)). This process mirrors the coding approach described by Richards (2015) and was the approach adopted for this study. Further details on this process will be discussed in the next chapter through the analysis of the data and presentation of findings.

4.7 Limitations

This chapter has sought to clearly identify and justify all decisions made around research methodology, but this research is not without its limitations. This research has been undertaken within a limited time frame and with limited resources, both of which have had some implications on the research sample. As already discussed, the sample was deemed appropriate, but given the luxury of infinite resources this could have been expanded. This research adopts an exploratory approach in that it seeks an improved understanding of an actor's diffusion journey, and the sample obtained is able to provide the data for this exploration.

The nature of the diffusion process itself is such that a longitudinal study of some kind would have been an interesting alternative to the chosen approach, but not one that was felt necessary to achieve the research aim. This is a possible area of further research to conduct in the future.

One of the main concerns associated with this research was the vast amount of current literature within the diffusion field. This clearly influences discussions with respondents as it is very difficult to forget that accrued knowledge and this then has influenced the data collection and subsequent analysis.

4.8 Summary

In summary this research has adopted a coherentist philosophy supported by a qualitative research approach to gather the rich explanatory data that is lacking in the diffusion research field, and this approach will help to develop a deeper understanding of an actor's diffusion journey and therefore address the overwhelmingly positivist approach to diffusion research in the past, which in turn will add to the existing diffusion research landscape. As such no claim is made as to the replicability of this research and all findings will be temporary, local and situationally specific (Denzin and Lincoln 2005).

The qualitative research approach was achieved through the use of semi-structured interviews with various sectors of the QS profession using purposive sampling and an evolving interview guide. Care has been taken to ensure that the parameters of credibility, dependability, transferability and confirmability are addressed in the research design, collection of data and subsequent analysis.

Chapter 5 – Data Analysis

5.1 Introduction

The previous chapter identified the research ontological, epistemological and methodological position. It also discussed the methods employed to collect the primary interview data, the rationale for doing so and the proposed method of analysing the data.

This chapter follows logically from that discussion and will now identify the author's analysis journey using the NVivo software and then proceed to highlight and discuss each of the various key aspects that emerged from the interview data.

Before the analysis begins, attention needs to be drawn the authors role in the data analysis process and the structure of the analysis itself. As has already been discussed in both the personal reflexive statement and the methodology, the author has many years' experience working as a QS and while this has aided the data collection process it could also be argued that it has influenced the analysis of the data. It is the authors opinion that it has influenced the analysis, but in a positive way, in that the author is perfectly positioned to understand both the innovation under investigation, the NRM, but also the social system in question, the actors within this system and the impact that these all have on the QS profession.

The structure of this chapter will follow the logical sequencing that links back to the research aim and objectives as well as the key aspects of the diffusion journey under investigation and as outlined in chapter three. For clarity the research aim and objectives are:

Aim

To further understanding in the context of the diffusion of a professional practice innovation among QSs within the UK construction industry. Not only to ascertain if stages exist in this process, but also to discover if the stages proposed by Rogers (2003) are suitable for this particular context, and if a new model is required to accurately represent diffusion within these particular parameters.

Objectives

5. Define the context for the research in terms of actor, social system and innovation under investigation.
6. Identify the current measurement practices utilised by quantity surveyors.
7. Critically appraise and develop existing diffusion literature to suit the research context.
8. Identify barriers to the diffusion and adoption of professional practice innovation.

The key aspects of the diffusion journey, which link to objective three, are:

5. Rogers (2003) concept of prior conditions.
6. Rogers (2003) innovation-decision process.
7. Three diffusion concepts of Cohesion, Structural Equivalence and Thresholds.
8. Rogers (2003) innovation attributes.

This chapter will now consider each of these aspects and seek to further the understanding of the diffusion journey in the context of the QS and the introduction of the NRM.

5.2 Managing and Analysing the Qualitative Data

NVivo was used to code the interview transcripts and for managing the data overall. This provided rigour to the analysis process, which supports the discussion in chapter four with regard to analysing qualitative data, namely credibility, dependability, transferability and confirmability. A sample of two fully transcribed interviews can be found in Appendix B.

5.2.1 Confidentiality of Respondents

Before discussing the analysis process, one needs to consider the respondents and their identities. Most of the respondents to this research wished to remain anonymous in any publications, which results in a need for a simple, yet comprehensive way, of

identifying each of them without divulging names or companies. It was decided that ‘Respondent 1’, ‘Respondent 2’, etc. would be unsuitable as this does not provide the reader with any context about the respondent, and even with the use of a reference table it would provide an incoherent reading experience.

A full table of the respondents was presented in chapter four, and this table will now be explained with the rationale for the coding of respondents for this analysis chapter. Where more than one individual was interviewed at once, the lead individual is used for coding purposes and attribute data during analysis. This was done to simplify the coding and also streamline the data analysis. For clarity it is worth noting that all multiple party interviews contained individuals with equivalent qualifications, but not positions within their respective companies.

As of July 2015 a total number of individuals involved in the interview process is 26.

1 x 4 respondent interview.
4 x 2 respondent interview.
14 x 1 respondent interview.

In order to codify the respondents, it was decided that the key contextual data for each respondent should be utilised. This was obtained through the interview process, and links back to the attribute data that will be discussed further. The main categories considered were turnover, number of employees, sector of industry, RICS membership and finally job title.

For the analysis of the cases from a company perspective, the number of employees and turnover will be shown in categories in line with the definitions as detailed in the companies act 2006 (ICAEW 2016), but also in line with the Department for Business, Innovation and Skills (HM Government 2012) growth review reports that recognised ‘mid’ size business between the traditional SME cut off points and the large businesses. This suggests a turnover point of £25-£500 million per year for medium sized businesses. Therefore, the following categories have been adopted for this research:

Turnover (£ millions):

Small (£S) = £0-24

Medium (£M) = £25-499

Large (£L) = £500 +

No. of Employees:

Small (S) = 0-49

Medium (M) = 50-249

Large (L) = 250 +

Sector

P = Consultant/private practice QS company (PQS)

C = Contracting organisation (CQS)

RICS qualified

RICS = Yes

Blank = No

Job Title/Position

Part = Partner

Dir = Director

SA = Senior Associate

SQS = Senior Quantity Surveyor

QS = Quantity Surveyor

CM = Commercial Manager

CE = Chief Estimator

Following the commencement of this process it was discovered that some of the respondents had the same codes, so to aid the distinction, and also to aid the authors analysis process it was decided to include the respondent's initials. This results in the codes shown in table 5.1.

No.	Initials	Position	RICS?	Sector	Turnover (£)	No. of Employees	CODE
1	DM	CE	N	C	M	M	DM – CE-C-£M-M
2	PR	QS	N	C	S	S	PR – QS-C-£S-S
3	SB	SQS	Y	P	S	M	SB – SQS-RICS-P-£S-M
4	SD	Dir	Y	P	M	L	SD – Dir-RICS-P-£M-L
5	WC	Dir	N	C	S	S	WC – Dir-C-£S-S
6	CG	SQS	Y	P	M	L	CG – SQS-RICS-P-£M-L
7	JC	CE	N	C	M	L	JC – CE-C-£M-L
8	JP	Part	N	P	S	S	JP – Part-P-£S-S
9	CB	Dir	Y	C	S	S	CB – Dir-RICS-C-£S-S
10	MR	Dir	Y	C	S	S	MR – Dir-RICS-C-£S-S
11	SW	CM	Y	C	M	M	SW – CM-RICS-C-£M-M
12	SB	SQS	N	C	M	L	SB – SQS-C-£M-L
13	LF	SQS	N	C	M	L	LF - SQS-C-£M-L
14	SS	SQS	N	C	S	M	SS – SQS-C-£S-M
15	JB	Part	Y	P	S	M	JB – Part-RICS-P-£S-M
16	AG	SQS	Y	P	L	L	AG – SQS-RICS-P-£L-L
17	GS	CM	N	C	M	M	GS – CM-C-£M-M
18	VR	CM	Y	C	M	L	VR – CM-RICS-C-£M-L
19	SH	SA	Y	P	L	L	SH – SA-RICS-P-£L-L

Table 5.1 - Coding of respondents for analysis.

So for clarity, **VR – CM-RICS-C-£M-L** is a Commercial Manager, RICS member and works for a contracting organisation who turns over between £25-499 million and employs over 500 staff.

5.2.2 Setting up the data in NVivo

In order to provide a logical and useful dataset in NVivo, all respondents' transcripts were imported into the database. In order to utilise the software for analysis purposes NVivo requires that one select a unit of analysis or 'case'. For this research the unit of analysis is the individual actors, so each transcript provides a case for NVivo to work with. Following this it is good practice to assign each case their own attributes. This was briefly discussed in the previous chapter, but for clarity any known data around each case can be entered to allow for later in case, and across case, analysis. For the

purposes of this study the attributes assigned initially were as follows, where all data was acquired through the interviews:

Sector of the industry	-	either CQS or PQS
Membership of professional bodies	-	RICS, CIOB etc.
Turnover category	-	£0-24, 25-499 or 500+ million
Number of employee's category	-	0-49, 50-249, 250+
Adopted NRM	-	Yes or No.

As can be seen above, each attribute is then assigned several variables to allow cross case analysis. These were kept as simple as possible for clarity and to maximise their impact on the subsequent analysis.

5.2.3 Observations on attribute data

It is important to look across the attribute data to identify any key aspects, and also set the context for the following discursive analysis. The attribute data was derived from the interview process and was removed from the node data as it is of a quantitative nature. This can be seen in figure 5.1 below.

Name	Professional Qu...	industry Sector	Turnover	No of Employees	Adopted NRM	Knowledge of NRM	Decision Type
WC - Dir-C-£S-S	None	CQS	£0-25 Million	0-49	No	None	Passive
MR - Dir-RICS-C-£S-S	RICS	CQS	£0-25 Million	0-49	No	Excellent	Active
GS - CM-C-£M-M	None	CQS	£25-500 Mil...	50-249	No	None	Passive
SB - SQS-C-£M-L	None	CQS	£25-500 Mil...	250+	No	None	Passive
DM - CE-C-£M-M	None	CQS	£25-500 Mil...	50-249	No	Poor	Active
PR - QS-C-£S-S	CIOB	CQS	£0-25 Million	0-49	No	None	Passive
SS - SQS-C-£S-M	None	CQS	£0-25 Million	0-49	No	Poor	Passive
LF - SQS-C-£M-L	None	CQS	£25-500 Mil...	250+	No	Poor	Passive
JC - CE-C-£M-L	None	CQS	£25-500 Mil...	250+	No	None	Passive
VR - CM-RICS-C-£M-L	RICS	CQS	£25-500 Mil...	250+	No	Poor	Passive
SW - CM-RICS-C-£M-M	RICS	CQS	£25-500 Mil...	0-49	No	Poor	Active
CB - Dir-RICS-C-£S-S	RICS	CQS	£0-25 Million	0-49	No	None	Active
CG - SQS-RICS-P-£M-L	RICS	PQS	£25-500 Mil...	250+	Yes	Excellent	Active
SH - SA-RICS-P-£L-L	RICS	PQS	£500 Million +	250+	Yes	Excellent	Active
JP - Part-P-£S-S	RICS	PQS	£0-25 Million	0-49	No	Good	Passive
SB - SQS-RICS-P-£S-M	RICS	PQS	£0-25 Million	50-249	Yes	Good	Active
JB - Part-RICS-P-£S-M	RICS	PQS	£0-25 Million	0-49	Not formally	Good	Active
SD - Dir-RICS-P-£M-L	RICS	PQS	£25-500 Mil...	250+	Yes	Excellent	Active
AG - SQS-RICS-P-£L-L	RICS	PQS	£500 Million +	250+	Not formally	Good	Passive

Figure 5.1 - Respondent attribute data, sorted by industry sector.

Of the respondents who have adopted NRM, all cases were members of the RICS and all are PQS's. Two of these have not formally adopted NRM, but claim to be compliant with the rules and have a good working knowledge of it. This is not surprising as the RICS list the NRM as professional guidance and as such members are encouraged to utilise it where necessary.

Of the none adopters, all are CQSs with the exception of one respondent who although categorised as a PQS, only work for Contractors producing quantities for their estimating departments.

Half of the none adopters are RICS members, while turnover and number of employees has no direct discernable influence over the adoption of NRM.

All cases with poor or none categories of knowledge have rejected the NRM, while those with good or excellent knowledge all but two have adopted. These two respondents are **MR – Dir-RICS-C-£S-S** who was involved in the early development of NRM but sees no need for it in his current business practices and **JP – Part-P-£S-S** who works exclusively with contractors providing quantities and has had no demand from his clients for the use of NRM.

This attribute data just provides and overview of the sample from a different perspective to allow the reader a more holistic account of the nature of the sample and this is to be considered when reviewing the detailed data analysis.

5.2.4 Coding process

Once the attribute data was entered and considered, coding began on the first interview transcript. Coding was not undertaken in any particular order, as each case was thoroughly analysed allowing the node structure to emerge in a fluid but iterative way, while constantly being conscious of the key themes and terminology that were discovered during the literature review. As identified in chapter four, coding is stored in Nodes in NVivo. Nodes can be 'parent' or 'child' containers and their relationship is represented in a 'tree' structure of nodes, the development of which will now be discussed.

Following the first wave of coding of two cases, the node structure appeared as follows:

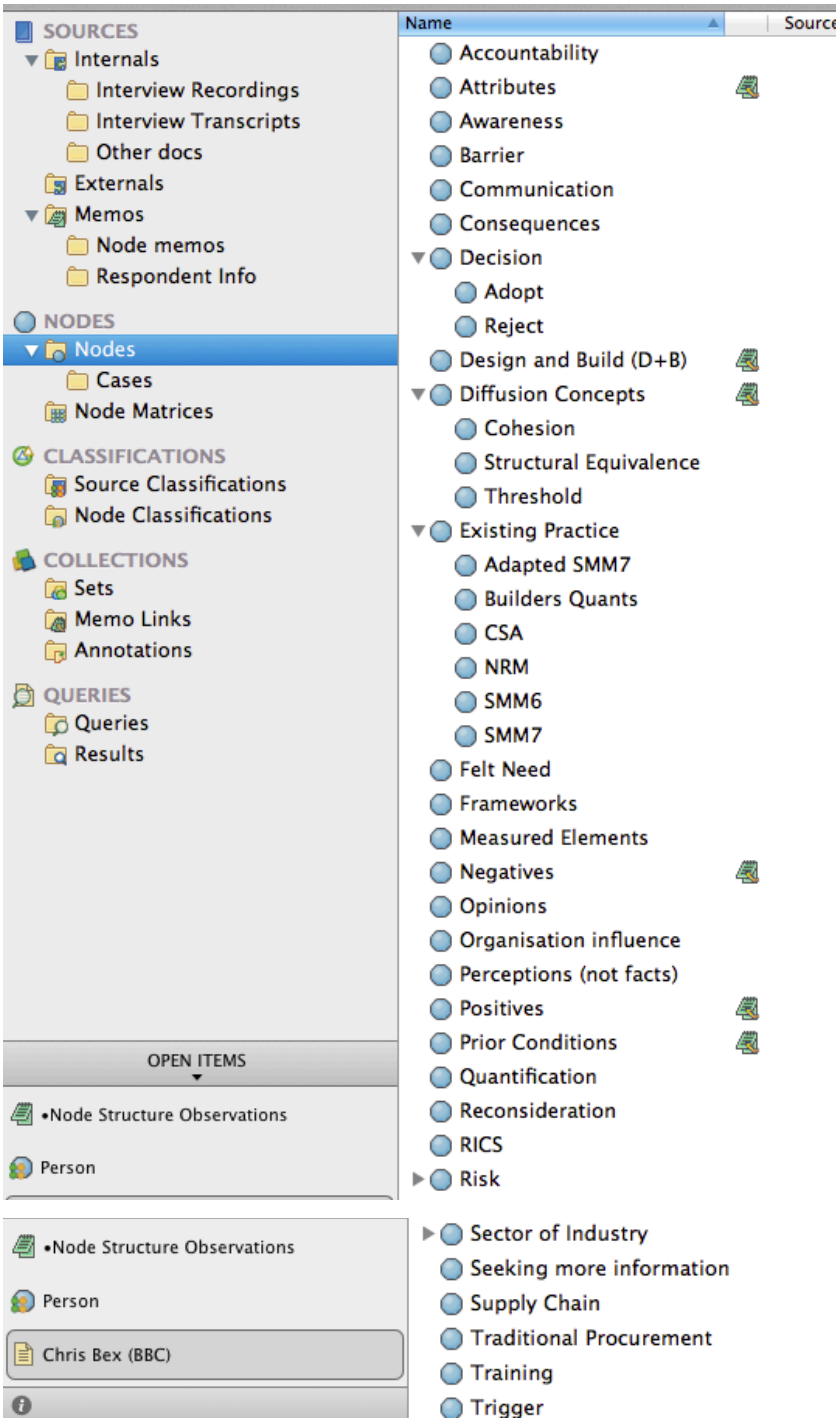


Figure 5.2 - Screen shot showing initial node structure

As can be seen, these are predominantly parent nodes, with very little structure. What was reassuring, was that looking through the nodes highlighted some key terminology already starting to stand out, some as found in the existing literature and also some more familiar terms used regularly within the construction industry, such as design and build and SMM7.

What followed was an iterative coding process where each case was read carefully and coded appropriately. As this process continued the node structure developed as more ideas and concepts came to light, and more questions were emerging about the data and how it might be utilised for the more detailed analysis later on. In order to facilitate and record these thoughts memos were kept within NVivo using the memo tool.

Memos were kept on each node – why it was created and what it was created for. This was deemed important to keep abreast of any developments, and to allow reflection on the coding process. Each node needs to earn its position, and later during the analysis process some nodes may be merged, some may be split into further categories, but either way an audit trail of their development was essential. Figure 5.3 shows the node memos as they appeared in NVivo. These memos will later form an important part of the detailed discussion and analysis.

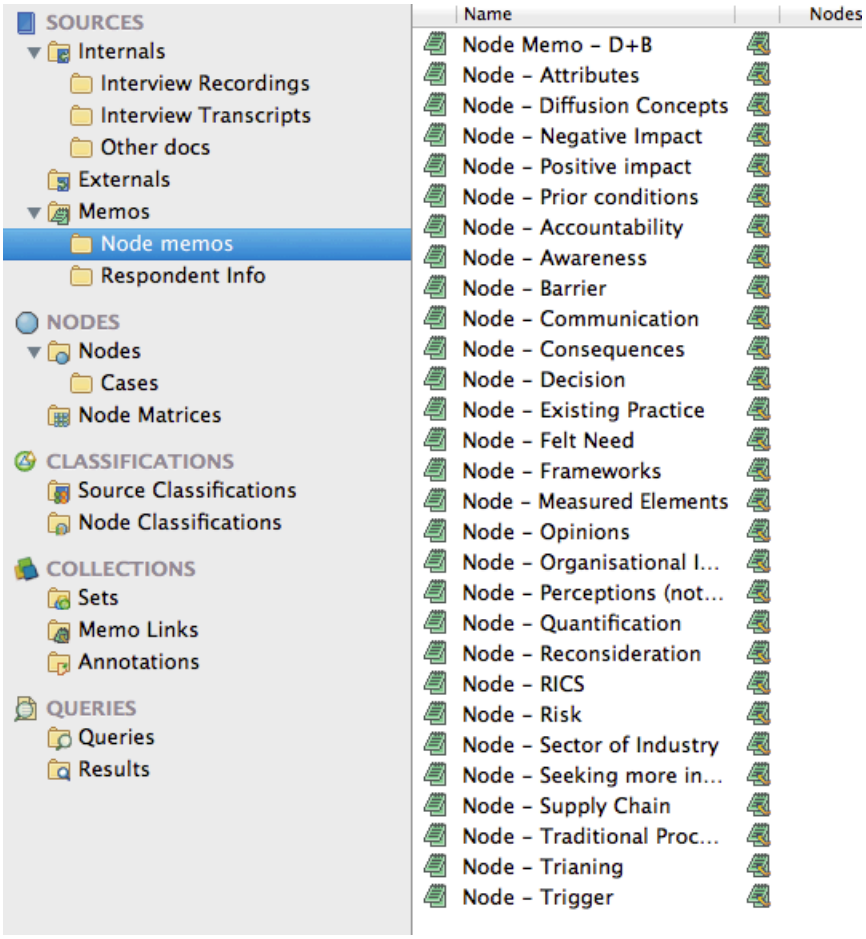


Figure 5.3 - Screen shot showing memos in NVivo.

As the coding process continued, new nodes were created as deemed necessary. One needs to be careful not the force the data into existing nodes for ease, while being conscious of a fast growing node structure (Richards 2015). In order to demonstrate this Appendix C shows an (edited) extract from the author's research diary and shows the ongoing thought process whilst coding.

What is evident from these extracts is that the coding process went through several stages where each piece of coded text was carefully considered and placed in the appropriate node. Other important developments not identified within the diary extracts are that the attribute data was expanded to include the following two attributes:

Knowledge of NRM	-	Excellent, Good, Poor or None.
Decision Type	-	Passive or Active.

As identified earlier, attribute data is data that is constant and is known about each respondent. The initial attribute data list was compiled very early on, before coding. Once coding commenced, it became clear that some nodes were populated with data that would allow more fine tuning of the attribute data, and in turn allow greater cross case analysis. The knowledge of NRM developed as it was clear that some respondents were much more converse with the NRM than others, so it was decided to rank their knowledge based on their responses. The ranks were decided upon using the NTU grade descriptor terminology, although the NTU term *insufficient* was replaced with *none* as this was deemed more appropriate.

The decision type developed when considering the *trigger* node, where it became apparent that some respondents were merely following the RICS guidance, whereas others had consciously made the decision to adopt or reject based on their own research and experiences.

One of the most useful tools for undertaking this fine tuning is the coding stripes function in NVivo, as shown in figure 5.4, that allows you to show any lines of text you wish, such as a full transcript, or maybe a node, and then simultaneously show exactly where else that text is coded. This was used to good effect when trying to answer some of the questions that were posed during the process as evidenced in the diary extracts.

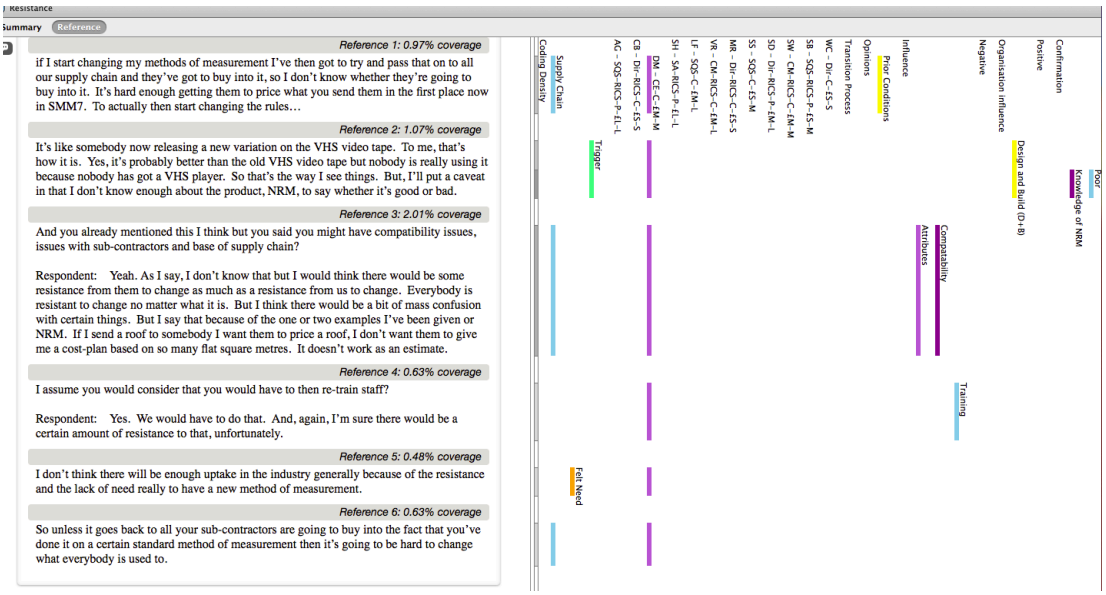
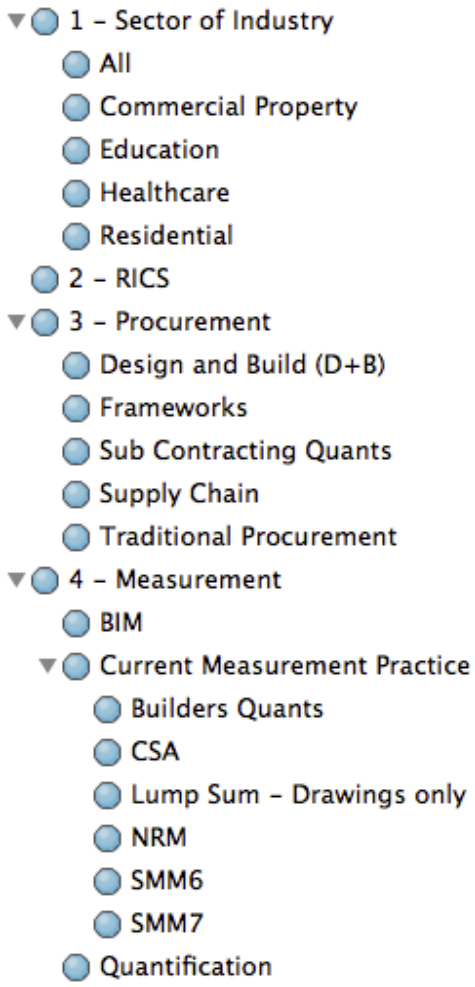


Figure 5.4 - Screen shot showing coded text against coding stripes.

Before the actual detailed analysis was undertaken, it was decided that the alphabetical order of nodes inherent in NVivo was not conducive to the analysis process and did not represent the chronological order of the various nodes, so it was decided to re-order the nodes by inserting a numeric marker as can be seen in figure 5.5 below.



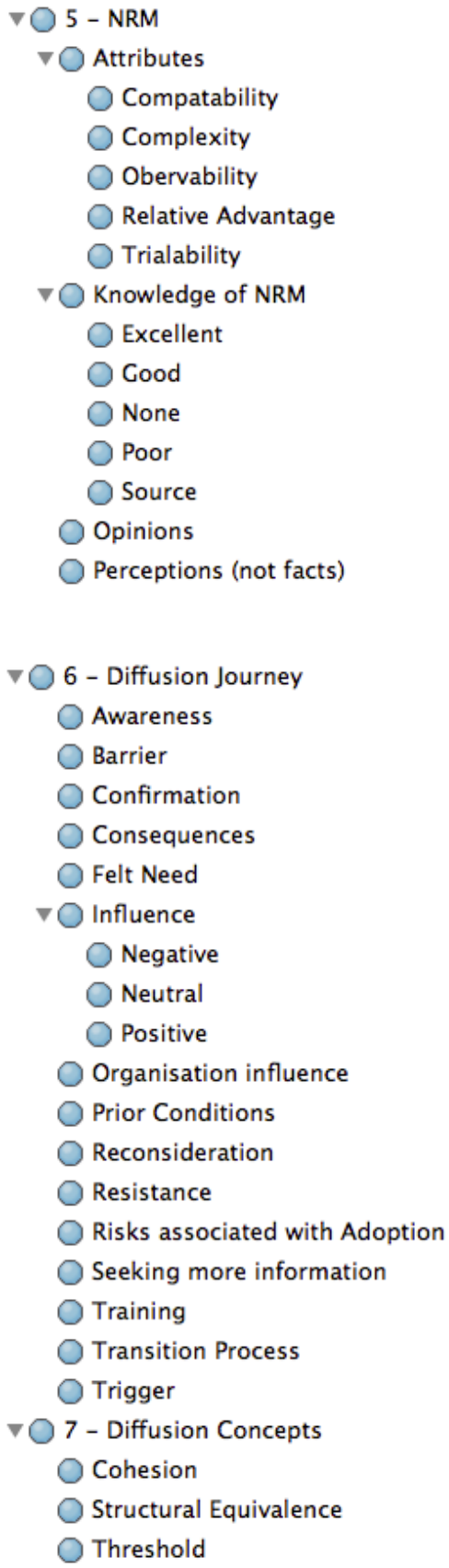


Figure 5.5 - Screen shot of final ordered node structure.

It is these nodes that will now be analysed in more detail to work towards the achievement of the research aim and objectives.

5.3 Construction Industry Norms

The data sample has been shown to be a cross section of the industry with all major sectors represented and a range of company sizes also included. Although this research makes no attempt to generalise the findings across the wider industry it is important to consider the norms of the sample under investigation and how these may influence the findings. These norms will be considered in four distinct aspects, namely procurement approach, which has a direct impact on the responsibility and liability of any quantification, measurement practice, which is concerned with the actual act of quantification itself, communication channels, which as identified in chapter three are essential for the diffusion process and finally professional body influence, as the RICS is the most represented professional body within the QS profession.

5.3.1 Procurement

D&B procurement was reported as being the most common, with any traditionally procured projects being of the drawings and specification variety. Only two CQS respondents have seen a BQ in NRM format. **SW – CM-RICS-C-£M-M** had a poor experience with it, and the other was **MR – Dir-RICS-C-£S-S** who had seen a project in NRM format but was unsuccessful at tender stage. Of the other traditional schemes mentioned by respondents all BQs were produced using SMM7.This has significant implications on the responsibility for measuring quantities as it means that the contractor is now responsible, and that the PQS has no requirement to provide any quantities at all, a position that is recognised by the RICS (2013d) within the NRM2 which clearly suggests that the NRM2 is not purely for the PQS to produce BQ's with. Not all respondents were particularly complimentary of D&B with **DM – CE-C-£M-M** stating that is had "ruined all our lives" with particular reference to the amount of risk transfer and the shorter tender periods, and several respondents referring to D&B as 'Design and Dump'. **GS – CM-C-£M-M** states that with regard to the design aspect there is little to no flexibility and that "They know what they want; they just want

somebody else to have the risk", but they are working in an environment where they do not get any choice. These findings are in line with those of the RICS contracts in use survey (RICS 2010) and the use of D&B shows no signs of slowing down.

This responsibility for the quantification of work has had a direct impact on the diffusion of NRM across the industry, and in particular with the CQS respondents who had all rejected the NRM. This is a direct result of the current nature of main contractors who sub-contract the majority of the work to specialist sub-contractors and this in turn adds another layer of responsibility for quantification as it can now be undertaken by the main contractor or pushed down to the sub-contractors. This in turn has a direct influence over the measurement process and therefore the diffusion of any new practice.

All CQS respondents highlighted this as their largest risk when contemplating using a new standard method of measurement. The supply chain itself is temporary by nature as it is project dependent, although many main contractors do utilise the same sub-contractors regularly, there is no guarantee and the project type, location and size all play their part in the selection process. What this means is that main contractors are constantly requesting price data on projects from numerous sub-contractors and have to rely on this data when they are tendering for the work, often within tight timescales. This was universally cited as a significant risk for the main contractors and is one of the main reasons why they are currently happy with their current working practices, with the term 'if it isn't broken don't fix it' being heard several times to support this. There was no consistency identified in the allocation of quantification with most CQS's reporting that they provide quantities where possible, but not always, while a few reported that they always leave the quantification to the sub-contractor to avoid any liability issues with the measure. One respondent even suggested that they provide quantities, to increase the chances of getting prices returned, but then state that they are indicative and will not form a part of the contract, leaving all responsibility with the sub-contractor. This individual approach of the CQS respondents supports the findings of Kale and Arditi (2010) who suggested that construction companies are more influenced by their own internal operations and workload than that of other companies within the same social system.

What is clear from this is that predominantly the responsibility, and therefore liability, for measurement rests with the main contractor and that they are often willing to pass this responsibility down their supply chain. This helps to understand the social structures involved in the measurement of building works and therefore forms a part of the social norms that influence the QSs in their daily activities, and subsequently the diffusion process.

5.3.2 Measurement

As identified above, the main contractor determines the current dominant measurement practice within the industry. This highlights several aspects that contribute towards the diffusion of the NRM and also how those main contractors deal this with on a practical level.

All but one respondent was not using a standard method day to day. The actual methods will be discussed separately, but the main consensus among the PQS respondents was that they were putting together a pricing document, and that ultimately this was reflective of their previous projects with some possible project specific amendments. Some respondents said that their pricing schedules were comparable to the NRM, but based on their apparent lack of knowledge of NRM this is unsubstantiated. The PQS respondents did say that they would usually ask for quantities from the tendering contractors, but that they would not be specific about the format they were provided in. The main concern revolved around the contractors cost data being able to map with the original pricing document, so that comparisons could be made with pre-tender estimates and also across projects within the company. There was no common consensus among the PQS respondents about what this pricing document should contain or its structure, which is understandable as the PQS are only responsible for monitoring the cost, not determining it and therefore they have a very different perspective to the role of the quantification of the works.

The first key finding was that the contractors interviewed all had experience of having their quantities produced by a third party. Some utilised these services on all projects, while others only when there was a particular need, for example if there were resourcing issues during a tender period. Universally the CQS's interviewed highlighted issues with the quality of the quantification produced by these third parties and that it then

became an exercise in checking someone else's work for errors before it could be priced. This is just moving the quantification of work further down the supply chain with little benefit to either of the main parties, but the CQS's cited the tight timescales for tendering projects as being the main rationale for this type of decision.

DM – CE-C-£M-M suggested that although he had found a mixed quality of work being produced, he still preferred to undertake the work in house. Other CQS respondents preferred to undertake the quantification in house as this allows them to become more familiar with the project which in turn can increase their competitive advantage and also give them more knowledge of the project if they are required to partake in contractor selection interviews, for example. Again, this was dependent upon current workload and staffing levels.

Both **GS – CM-C-£M-M** and **VR – CM-RICS-C-£M-L** stated that they had to provide something for the sub-contractors in terms of quantities, as if they failed to do so then this would adversely affect their chances of receiving a quotation back from the sub-contractor, and therefore impact on their own pricing and ultimately the chances of winning the project. This was attributed to the lack of time that a sub-contractor would have to be able to sit and measure the works before pricing it. To some extent this situation contradicts the earlier comments about the standard methods not being sufficient for sub-contractors to price from – one minute they are stating that sub-contractors will produce their own measures as the ones provided are not detailed enough, and the next they are stating that the sub-contractors will not price works without quantities being provided. It is suspected based on previous experiences of the author that this is quite trade specific and consequently a more detailed exploration of this issue is needed, but is beyond the scope of this research. For now, it is important to realise that whatever the preferences of an individual sub-contractor, no one can price works without first completing a measurement of some kind.

What was common to all respondents was the level of detail in which they were willing to discuss measurement and their own histories and stories associated with it. The level of technical knowledge that was demonstrated was impressive and fascinating at the same time, which supports the need for a standard method of measurement of some kind, but doesn't answer the question as to whether the NRM fits the bill or not.

The dominant method employed amongst respondents was that of builder's quantities. Chapter two highlighted the need for standards, and all of the current texts (Cartlidge 2011, 2013b, Towey 2012, Lee *et al* 2011) regarding measurement talk at length about the SMM7 and more recently the NRM, while also briefly describing the concept of builder's quantities with Cartlidge (2013a p.282) defining them as: "quantities measured and described from the builder's viewpoint, rather than in accordance with a set of prescribed rules, such as SMM7 or NRM2."

What became clear from the respondents is that the use of builder's quantities is universal, but that there is no fixed definition and that is why they work because they can be adapted to suit the current situation. All respondents cited SMM7 as being the main basis for their builder's quantities as this is the most well know standard method and gives a good basis to be adapted to suit the particular circumstances. One of the other influencing factors of the use of builder's quantities is that the measurement and estimating software being used by the respondents had SMM7 libraries included, and it is these that have been adapted and modified over time to be as useful as possible to the current needs of the business. What is clear from these discussions is that although most respondents have access to an NRM library, this comes at an additional cost and hasn't been adapted to suit their needs, so they would need to start again for utilisation as builder's quantities.

This re-invention of the SMM7 into a tool that is fit for purpose, and its necessity within the current construction industry, is now identified as not only the main form of measurement practice within the construction industry, but also the main reason for the rejection of the NRM, and in many respects an innovation in itself.

As NRM was utilised as the main vehicle for examining the diffusion process, it is important to identify its adoption and use in practice. Of all the respondents only four have formally adopted the NRM, all PQSs, and two have not formally adopted, but claim to be working in accordance with its requirements, also both PQS's. Having said this, only one respondent, **SH – SA-RICS-P-£L-L**, is using NRM2 for producing BQs, the others are using NRM1 for cost planning and CSA production but have not procured

a scheme using NRM2 yet, but all claim that if they had the need they would do. All PQS respondents that made this statement were members of the RICS.

There is no current research that clearly identifies this level of detail with regard to the industries measurement practices and therefore this is considered as adding to the existing knowledge in this specialist area.

5.3.3 Communication

When considering the norms of a social system with regard to diffusion it is important to consider the role and methods of communication employed, as this is a key factor in the diffusion process. Specifics with regard to communication between actors will be covered in more detail across the various discussions around the diffusion journey and the diffusion concepts later in this chapter.

For now, it is important to reflect on the findings of the primary research with regard to communication in a broader, social system focused manner, as opposed to the actor who will be the focus of the remains of this chapter. This will allow for some broader context to be provided in which further discussions can be based.

The structure and operation of the construction industry has a fragmented and temporary nature (RICS 2013a) and as such this has a direct impact on the communication channels that can be employed to aid the diffusion process. It quickly became apparent through the interview process that respondents were proficient in communicating about the specific projects that they were involved with, but that very little discussion was taking place between actors of a more general type. Specifically, all respondents confirmed that they very rarely discuss any broader aspects of the industry or professional practice with other actors outside of their own company, and that when this does take place it is of a fairly meaningless nature and usually at a conference or other gathering of equivalent professionals.

One could think that this fragmented and temporary nature of the actor's relationships could aid the diffusion process as one could utilise the weak links (Granovetter 1978) that are created to diffuse an innovation quickly and efficiently across the industry, but

what is actually happening is the temporary nature of the relationships is causing a project focused communication flow and network that disbands once the project is completed. This correlates with the findings of Kale and Arditi (2010) who found that construction companies are more influenced by their own internal operations and workload than that of other companies within the same social system.

This has a clear negative effect on the diffusion process as many companies are unaware of what others are doing which in turn prevents actors from being influenced by their peers outside of their immediate, usually company wide, social system. The following discussions will expand on this and consider this position from an individual actor's perspective.

5.3.4 Professional body representation

The RICS featured in all interviews and the membership of the RICS for each respondent was recoded as attribute data within NVivo. A total of eleven respondents were members of the RICS, and out of this four work as contractor QSs with the remainder working as PQS's.

In addition to the membership being discussed the RICS was raised with regard to several other issues such as influence in terms of adoption, awareness of the NRM and even the relevance of the profession to the QS and the fact that annual subscriptions are quite expensive. What was most noticeable though was that the members were all made aware of NRM by the RICS, while the non-members did state that they felt they were missing out on information about NRM as they were not members. What was unanimously agreed was that the RICS did not advertise or inform members particularly well of the NRM, particularly NRM2. **MR – Dir-RICS-C-£S-S** suggested that NRM1 had received much more coverage than NRM2 and suspected that the RICS had allocated more resource to the launch of NRM1. It was also stated that none of the respondents would know who to contact at the RICS should they have any queries on NRM and that there is no two-way communication. Overall this is an interesting finding, as the RICS developed and publish these documents so to find a general feeling of unease and wonder about the documents from its members is somewhat surprising.

For those who work within the large PQS practices, there was a clear influence from the RICS with regard to the adoption of NRM. Certainly three of the respondents work for companies with very strong links to the RICS so this level of influence was expected.

The RICS is the main professional body that represents QSs within the UK construction industry, and they are also the developers and publishers of the NRM, so their influence on the diffusion journey cannot be underestimated. What is clear here though, is that they do not actually represent the entire QS profession, and as such, their reach is not all encompassing. This leaves significant parts of the QS profession without the potential awareness and knowledge of the NRM as they are not members. This in turn can only have a detrimental effect on the diffusion of NRM which can be seen from the findings presented here.

5.4 Impact of Prior Conditions

Rogers (2003) refers to an actor's prior conditions as having influence over their innovation-decision process. No specific discussion is provided in his work around this topic, and no other research in any other area, including a construction management perspective, has specifically considered these prior conditions with regard to an actor's diffusion journey. This is considered a significant oversight as an actors' prior conditions could be one of the most influencing factors to the diffusion journey and one that will now be addressed.

Rogers (2003) refers to prior conditions as encompassing four key aspects namely; previous practice, felt need, innovativeness and norms of the social system. The norms of the social system have been identified in this chapter and showed that with a predominance of D&B procurement the most commonly practiced quantification approach in the industry is builders quantities, based on a modified version of SMM7, and that communication between companies with regard to professional practice is effectively none existent. This research is not a generalised sociological study and is not concerned with an actor's upbringing, wealth or race as it is focused on quantity surveyors within the UK construction industry and therefore this limitation needs to be taken into account in any further discussions and findings.

As this particular research is concerned with professional practice, the norms of the social system are to be considered in this respect and are therefore intrinsically linked to the current practice of its actors, so this research will not draw a distinction between social norms and previous practice and will continue to use only previous practice as a consideration under the broader heading of prior conditions.

Innovativeness of an actor has not been considered in this research and will be excluded from any further discussion. It was not felt relevant to this research as an individual's innovativeness is difficult to define and no research has been undertaken within the construction industry to ascertain the relative innovativeness of actors within this social system. This is an area for potential future research.

Hassinger's (1959) work on the felt need of an innovation and its influence on the diffusion process is well known, and a position that is supported by Rogers (2003). They posit that an actors felt need for an innovation is a key driver to them initially becoming aware of an innovation and ultimately adopting that innovation. This is another area that has received little attention in the diffusion literature but one that has a significant impact on an actor's attitude toward an innovation and therefore the diffusion of that innovation. What was clear from the primary research was that most respondents did not feel a need for the NRM and were happy with their current practices, with many quoting "if it's not broken, don't fix it".

Prior conditions refer to the stage prior to the innovation-decision journey. This is essentially identifying the current position of the actor before they become aware of an innovation. It is clear from the interviews that these prior conditions have a very heavy influence on the diffusion process amongst QS's. As will be seen from the list of barriers identified later in this chapter, the majority of these relate to existing practices or norms of the industry. Respondents, such as **AG – SQS-RICS-P-£L-L**, reasoned that they use their existing methods as they "know that it works", while others cited internal accountability issues if changing to another method of measurement.

All respondents discussed at length their involvement with SMM7, and many suggested that this was their biggest influence for not adopting the NRM, as they are so familiar with SMM7 and they know it works. They also know that everyone else understands

SMM7, even builder's quantities versions of it, so there are no compatibility issues with the supply chain, which as identified earlier, is one of the big worries for those who have not adopted. In contrast, **SB – SQS-RICS-P-£S-M** made an interesting comment with regard to other QS's suggesting that SMM7 is better, "But that's better because you used it for twenty years, not better because it was better."

While this quote sums up the influence of prior conditions, one also needs to factor age and experience into this, as several respondents had seen the transition from SMM6 to SMM7, but they all agreed that the transition between those was almost automatic, because everyone was using the SMM at the time, and D&B procurement wasn't even on their agenda. Respondents recalled the launch of SMM7 as being essentially an update and that there was no question as to whether you would adopt it or not. Today's construction industry is a very different place, and the use of a standard method is not what it once was. Consequently, the modification of SMM7 into builder's quantities over the last seventeen years since its last update could be seen as an innovation in itself, as actors have amended and altered the SMM7 to make it fit for their own purposes and work in an industry that is incredibly diverse.

It is this familiarity of the existing practices that appears to be the biggest barrier to the adoption of NRM and therefore the influence of prior conditions is more important than identified by Rogers (2003). This shares some similarity with the findings of Sheffer and Levitt (2010) who introduced the concept of a competency trap for professionals. This was where favourable performance with an existing product can lead to companies not wishing to try a new product of which they have no experience. Their research was not founded within the diffusion landscape, but the parallels are clear.

Overall the influence of prior conditions on the diffusion process is clear and its impact significant. Within this particular research it is so significant as to warrant a new stage in the diffusion journey, and that is of an actor's current position and their prior conditions that are known before the journey can begin. As such, it is proposed that the first stage in the diffusion process is an actor's prior conditions and only from this benchmark can one begin the diffusion journey as these prior conditions influence all aspects of the journey from beginning to end.

5.5 Innovation Attributes

Chapter three discussed the attributes of innovations as identified by Rogers (2003) and showed that they were an area where more careful consideration was needed to allow them to be relevant with regard to professional practice innovations within a construction specific context.

The primary data has highlighted that while some aspects of Rogers (2003) attributes are applicable, there are areas that need to be added and also areas that are not applicable at all. These will now be considered in turn, with appropriate rationale provided for each, all with relation to the NRM as the innovation under investigation.

5.5.1 Relative Advantage

This particular term is used to cover all manner of advantages of an innovation, but owing to the nature of the construction industry and the findings of the primary data it was felt that this broad heading was no longer suitable. In particular Rogers (2003) makes no mention of the commercial aspects of an innovation, and specifically the financial benefits. Therefore, this aspect of commercial advantage is seen as a key attribute and will be identified separately.

The notion of other advantages still stands and is similar to the findings of Kramer *et al*. (2009) who cited that the relevance and usefulness of the innovation would influence its diffusion. This is with regard to other aspects such as currency of the innovation and its practical advantages. The knowledge of NRM varied significantly across respondents, but there was a universal perception that it didn't really offer any advantage over existing practices. Even **SH – SA-RICS-P-£L-L**, the only respondent to actually produce a BQ using NRM2, could only identify the main advantage being links with NRM1 and how this provided a joined up approach to the cost management and analysis of projects. When asked about advantages to the actual rules themselves he stated "In terms of any ground-breaking changes in the way we measure, none at all".

One of the positive advantages that was highlighted in the primary data collection was that the NRM offers more robust measurement rules for modular building and also for demolition and alteration works. Therefore, this attribute is still applicable and can

remain as a key factor that can influence the diffusion process as not all advantages have to relate back to commercial aspects.

5.5.2 Commercial Advantage

The aspect of commercial advantage was raised by almost all respondents and in particular when asked what the main trigger to rejection was. It was felt that the NRM offered no commercial advantage and that the other relative advantages were not significant enough to outweigh the commercial aspect. Rogers (2003) overlooked the commercial attributes of innovations as his work was of a more general nature and covered innovations from new medicines through to the introduction of clean water supplies to developing countries so it is easy to see why it was not high on his agenda.

Within a construction context however the commercial aspects of an innovation have not been ignored with both Arditi (1997) and Mitropoulous and Tatum (2000) highlighting the concept of competitive advantage as a motivator to adoption, although neither of these directly addresses the concept of innovation attributes or their influence on an actor's diffusion journey with regard to the wider diffusion literature.

For the purposes of this research commercial advantage means any advantage offered by an innovation that provides the adopter with an improved commercial position, which can be in respect of time, financial or service quality.

5.5.3 Compatibility

Compatibility is an important attribute that was identified by Rogers (2003) and is to remain within the boundaries and context of this research. The two respondent groups, PQS and CQS, had very different perspectives on the compatibility of the NRM with the PQS respondents seeing no issues, while the CQS's were concerned with both internal and external compatibility. Internal compatibility was considered to be aspects such as existing staff abilities and software issues, while external compatibility was a key aspect of the rejection of the NRM as the compatibility with the supply chain was cited as being a risk that they were not prepared to take at this stage. The supply chain is a significant factor and one that is quite unique to the construction industry due to the

temporary nature of the projects and the project teams. This compatibility issue is significant and can be seen as a major barrier to the adoption of the NRM.

5.5.4 Complexity, Trialability and Observability

These attributes as identified by Rogers (2003) are considered irrelevant to the current research context and as such will be omitted from any further discussion.

Complexity was deemed irrelevant by respondents as they all considered themselves as able to adopt a new professional practice, in this case the NRM. No respondent reported this as being an influencing factor and in fact was quite the opposite with all having confidence in their own abilities to be able to adopt and use the NRM when and if required. This is not unexpected from professionals such as those interviewed. **MR – Dir-RICS-C-£S-S** stated that "as a practising quantity surveyor you should be able to use it (NRM) essentially", and this was mirrored by several respondents who all suggested that anyone who was familiar with the previous measurement methods should be able to utilise the new ones. **SW – CM-RICS-C-£M-M** suggested that there would be a transition period where one would need to get used to the NRM purely because of the length of experience of using the SMM7, but overall the respondents are all professionals and none suggested that the complexity of something would be a barrier to adoption, but that it was more a balance of complexity against commercial benefit.

Trialability was ruled out as respondents felt that they did not have the time to run trials, as they were all too busy on live projects. The other concern was that any trial would not identify the real consequences of the use of the NRM on a live project when dealing with multiple parties. This supports the findings of Pries and Janszen (1995) who suggested that the trialling of an innovation is not practical within the construction industry.

Observability was also ruled out as being possible by respondents owing to the confidential nature of the industry and the legal restrictions around competition between rival companies. The issue with measurement practice in particular is that it is linked with cost data, which is confidential on a project basis, so being able to see this data from afar is not possible. Not only is the data confidential for the organisation, they

need to be careful with cost data and any perceived improper practices such as bid rigging and cover pricing, both of which have been the subject of ongoing investigations from the Office of Fair Trading (OFT) in the UK (Building 2009). The only area where CQSs observed NRM in use was when an NRM BQ had been received for tender which, as identified earlier, is very rare.

This was further supported by respondents stating that they were quite isolated from the wider industry and very rarely spoke to other actors about their work and that any conversations were project specific. This was different to the respondent's discussion of observing others internally, within organisations, as some respondents work for very large organisations and regularly shares ideas within teams. This in turn gives a very narrow social network, and does not allow the development of the weak ties (Granovetter 1978) that are required for diffusion across wider networks.

5.5.5 Summary of Innovation Attributes

To summarise this section, it is clear that the literature and primary data support a revision to the classical Rogers (2003) innovation attributes. Whereas some are still relevant, there is a need for a more commercial aspect to these and also a realisation that the construction industry is unique with its fragmented nature and temporary supply chains. These aspects have a significant impact on how actors communicate with each other and therefore on the diffusion of innovation.

It is therefore proposed that the influence of the innovations attributes remains as a part of this contextual investigation and that the relevant attributes are as follows:

1. Relative Advantage.
2. Commercial Advantage.
3. Compatibility.

These will need to be considered in terms of their timing and influence on an actors' diffusion journey and this will be discussed in more detail in the next chapter where the development of the Rogers (2003) innovation-decision process is presented.

5.6 Actors Diffusion Journey

Using the primary data, along with existing diffusion literature, this section will now identify a QS's diffusion journey with regard to the NRM. Particular attention will be paid to how this relates back to Rogers (2003) innovation-decision model, as this is the most recognised and referenced example of this process. In addition, consideration will be given to aspects that may help to develop a more contextualised model of this journey, details of which will be discussed in the next chapter.

5.6.1 Awareness

As proposed in chapter three, the awareness of an innovation is the first stage in an actors' diffusion journey, and is distinct and separate to knowledge of an innovation, which therefore warrants a new stage in any model development of the diffusion journey. All but one respondent was aware of the NRM, with the method of awareness varying, the most common being direct correspondence from the RICS. Overall the experiences of the respondents highlighted them becoming aware through the trade press and not through direct contact with other actors, with the exception of some of the CQS respondents who highlighted that they became aware through student members of staff within their own companies.

WC – Dir-C-£S-S was the only respondent who was not aware of the NRM prior to interview. He was very surprised that it had been launched two years ago and that he, and his company, hadn't heard anything about it. He went on to say that although he was surprised, he doesn't make any attempt to find out about developments like the NRM and suggested that his focus was only on the day-to-day operations of the business. He said that unlike legislative changes, where he employs external companies to ensure compliance with any changes, the changes to any professional practice would just pass him by, and he is not motivated to research these in his spare time. This is a clear demonstration that the awareness stage is essentially a gateway to the diffusion process, as without awareness no diffusion can take place.

The findings also highlight that none of the respondents felt a need for the NRM and therefore did not actively seek information relating to a new method of measurement. This is in contrast with Hassinger (1959) who suggests that an actor's need for an

innovation is the key driver to becoming aware of an innovation. Larsen (2005) addresses this in his work and identified that an actor's awareness can be obtained through selective exposure, unavoidable messages, felt needs or chance events. As discussed in chapter three, these findings are still relevant today, but one needs to consider the increased chance of exposure given the amount of time actors spend online as part of their daily activities. This gives an exponential rise in probability of exposure to information about professional practice innovation than was the case ten years ago.

Larsen (2005) is the only author to directly address the issue of awareness and as detailed in chapter three his work in this area was extensive. His proposal of a polymorphic framework was highly detailed and well considered while his work on awareness is worthy of further consideration here.

Firstly, Larsen (2005) identified that weak ties aid the awareness of innovation, while strong ties drive the adoption and implementation. This is at odds with the findings of this research that shows a distinct lack of any evidence to support the influence of weak ties as all respondents reported very limited contact with other actors outside of their organisations, and none that provided awareness or influenced their adoption decision. This is possibly due to the context specific nature of this research, as the weak ties theory refers to an actor's social networks as a whole and in a more generic way, whereas this research is focused on an actor's work life and the social systems associated with that. What this contextual setting does then is limit the actor's social network to those that are in the construction industry and therefore limits the lines of communication. Previous studies, such as Larsen (2005) and the original work by Granovetter (1978), are more general and actors could therefore reflect on their wider social networks, including friends, that would provide more communication links such as the weak ties identified.

Larsen (2005) goes on to propose that the Threshold concept is tied to the awareness stage in the diffusion process and that this in turn leads to what he describes as an awareness threshold level, which is then broken down into a personal awareness threshold level and a system awareness threshold level. While this is not directly related to the findings of the primary research there is some clear evidence to support the need to identify the actor and the system separately. For example, the sample has shown that

one respondent was not aware, so therefore the system awareness has not reached that threshold yet, whereas on an individual level actors are aware and have therefore met their own personal awareness thresholds.

Thresholds will be discussed in more detail later in this chapter, but it is clear that they have an influence over the awareness stage, and also that the awareness stage is crucial to the diffusion process. In addition, it has been found that within the context of this research, the role of weak ties is not as influential in the awareness stage as previously thought. For the purposes of this research the awareness stage has been identified as an addition to those proposed by Rogers (2003) but no attempt has been made to identify the various ways in which actors can become aware, or to determine the most occurring method within the research sample. This is an area for further research and outside the scope of this initial investigation.

5.6.2 Knowledge

As already discussed, Rogers (2003) identified awareness-knowledge, which has already been discounted in this research, principles-knowledge and how-to-knowledge. Chapter three discussed these briefly, and that earlier discussion was confirmed by the findings of the primary data that showed that the principles-knowledge was present in all respondents as they are all professionals working in the construction industry and as such the reasons for the need of a standard method of measurement were known and clear. This then asks the question as to the relevance of this term, and for the purposes of this investigation it can be omitted.

The how-to-knowledge however is of more interest, and this formed one of the influencing factors with regard to the diffusion process. However, as most respondents rejected the NRM, and of those that have adopted only one is actually using it regularly, it was shown that the how-to-knowledge was very poor overall, and that most respondents had based their decisions on other factors. This then asks the question of the need for a knowledge stage at all, or certainly the need to reconsider its position within an actor's journey.

The analysis showed that many respondents had a poor knowledge of NRM and that many of their opinions of the NRM were based on perceived knowledge, which in fact was false, which then means that this is not knowledge at all, as knowledge is a justified *true* belief (Pritchard 2006). This therefore demonstrates that an actor can progress through the diffusion process with no knowledge beyond the propositional knowledge of awareness, and that this in turn results in a rejection scenario. As might be expected given the status of the NRM, all respondents that had any knowledge of the NRM gained it from the document itself in the first instance, with further knowledge gained from courses. No respondents reported any contact with the RICS or the use of any text books, but more importantly none reported that they had gained their knowledge from other QSs.

The analysis has shown that although these actors with no knowledge of the NRM, other than the initial awareness, have rejected it, they are happy with this decision but what is also clear is that the reason they are happy with this decision is that they do not feel any need for the NRM, and therefore their lack knowledge of it is irrelevant to them. Of course, if they did improve their knowledge of the NRM this could then influence their decision to adopt as they may find that it does offer some benefits, but the overwhelming response was that the NRM did not give the respondents the need to find out any more than they had, and this is another significant barrier to adoption.

Therefore, knowledge is a key stage in the diffusion process, but this needs to be factual knowledge and not perceived or incorrect knowledge as this increases the likelihood of rejection.

5.6.3 Opinion forming

Following the analysis of the primary data and also consideration of the previous literature, the decision has been made to represent a stage where an actor forms an attitude towards an innovation, either positive or negative, and where this opinion is influenced by the various innovation attributes.

Rogers (2003) referred to this as the persuasion stage, but as discussed previously it was felt that this term was misleading and did not represent the actors' activities at this

stage. Therefore, it was decided to utilise the term that Larsen (2005) used in his research *opinion forming*. Larsen provided no rational for using this term, but after careful consideration it was deemed the most appropriate and so shall be used here.

What is clear from the data analysis is a distinction between forming an opinion of the NRM and an actor's knowledge of the NRM. While forming an opinion one would expect knowledge to increase to a point where a decision can be made, so consideration needs to be given to the order of the various stages. This in turn can be affected by actor's forming opinions on an innovation based on incorrect information following communication with others, which has a negative impact on the diffusion process.

The primary data has demonstrated that a rejection decision can be made based on the actor's knowledge of the innovation, and that the opinion forming is a way to justify that initial decision. Some respondents had rejected the NRM based on their initial, and sometimes incorrect, knowledge while others had sought to justify their decision by at least obtaining a copy of the document to form their own opinions. Therefore, the opinion forming stage is not concerned with gathering hearsay and is more about an actor increasing their knowledge of the innovation and assessing the risks associated with adoption to be able to make an informed decision. This can be done through personal desktop style research or though communication with others, although the primary data within this sample suggests that most actors would undertake an in house analysis and decision making process as opposed to speaking to other members of the social system. This provides the sequencing of these stages so that knowledge is followed by opinion forming, with the caveat that knowledge of an innovation is not a fixed entity and can increase over time.

This is also the stage where an actor would consider the various attributes of an innovation, as well as influence from other factors such as word of mouth. The innovation attributes were discussed earlier in this chapter and it can be seen that these would indeed have to be considered when forming an opinion of an innovation and subsequently influence an adoption decision. This is also the stage where an actor would consider the influence of any external forces, such as their membership of professional bodies, or what Rose and Manley (2014) refer to as regulatory conditions. What the data has shown is that all PQS respondents were heavily influenced by the

RICS and have subsequently adopted the NRM. This is an external influence that needs particular consideration during the opinion forming stage as this influence can remove some of an actor's ability to make an independent decision.

In addition to the more classical literature based discussion on influence and forming of opinions the primary research identified several other factors that influence an actor's adoption decision. The negative influencing factors will be discussed in more detail later in this chapter as it is important to recognise these in order to attempt to improve future diffusion. The positive aspects fall into several broader categories with some being more related to social contagion, which will be discussed in this chapter as part of the diffusion concepts section, some relating directly to the innovations attributes with the remaining factors as follows:

- Direction from another surveyor (cohesion).
- Improvements in efficiency (commercial advantage).
- Organisational influence (linked to professional memberships).
- Weight of other adopters (thresholds).
- Clients requirements.
- Market demands (thresholds).
- Face to face contact (cohesion).
- RICS guidance (regulatory conditions).

This list shows that in addition to those aspects covered by the discussion thus far, the only other influencing factor is the client's requirements. This is relevant for all QSs as they are a service profession that work for a client, both PQS and CQS, albeit with different clients. All respondents reported that if their clients demanded the use of NRM then they would have to adopt and use it as required.

5.6.4 Decision

The decision stage is an integral part of any diffusion journey. The timing of this stage will vary from actor to actor as will the amount of information gathered before making that decision. No attempt has been made to chart the timeline of each respondent, as it

was felt unnecessary due to the lack of available reliable information around the respondent's recollections. Also, there is no clear research into the QS profession in terms of their innovativeness and so this aspect is best left to future research. As was identified previously, this research makes no attempt to chart the diffusion of the NRM in terms of a classical diffusion study as it seeks to gain a more contextual understanding of an actor's diffusion journey.

As is now clear, most respondents have rejected the NRM, with the exception of some of the PQS respondents. The rationale for this was discussed in earlier with specific regard to the influence of the RICS in this process. Of the non-adopters several triggers were identified giving reasons for rejection, and these will be discussed later on in a dedicated rejection discussion.

It is proposed that this stage is basically an adopt/reject stage, and that all appropriate influence and opinions have been considered prior to the decision. What follows this stage will depend upon the actor's decision and these will now be considered.

5.6.5 Implementation

Chapter three identified that up to this point the process has been a mental exercise of thinking and deciding. It is this stage where the reality of the decision will come to life and any difficulties, problems or barriers will need to be dealt with. What was clear from the analysis is that with only four adopters in the sample, and only one of these actually using the NRM, the implementation stage cannot be discussed in detail. It is clear however that following an adoption decision implementation is needed, so there is no questioning this particular stage. The respondent who has adopted and implemented reported no negative effects following adoption other than a slight increase in time taken to produce BQs due to the unfamiliarity of the NRM. At this point in time the respondent had only produced six BQs using NRM and had had no feedback, either positive or negative, from the surveying team who subsequently worked on the projects.

5.6.6 Confirmation / Reconsideration

Confirmation of an adoption decision can mean that an actor continues using the innovation or continues to reject the innovation. Rogers (2003 p.169) states that,

> *Confirmation takes place when an individual seeks reinforcement of an innovation-decision already made, but he or she may reverse this previous decision if exposed to conflicting messages about the innovation*

This can then lead to reconsideration of the decision that can be considered as a feedback loop where an actor can continue to gather information on an innovation and then revise their adoption decision.

This stage is similar to that proposed by Rogers (2003) and is supported by the data collection. Rogers (2003) model focused more on the adoption process and showed a side-line where an actor can reconsider their decision. This is not surprising as Rogers (2003) expressed a need for more rejection studies and that most diffusion studies were based on adoption case studies. Therefore, the decision was made to combine the confirmation stage with the reconsideration aspect to fully recognise the true flexibility of an actor's diffusion journey.

All adopters reported that they would continue to use the NRM in the future and could see no reason to reconsider. All rejecters confirmed that they were happy with their current decision, but would reconsider if there were a significant change in the needs of the industry overall in terms of the use of a standard method of measurement or there would have to be some commercial benefit to change. Most rejecters did state that they thought that they would be forced to adopt at some point in the future, but could not really explain why, and there was a certain amount of inevitability about the NRM becoming common practice. Having said this, none of the respondents were going to change their decision without a strong influencing factor, and based on this and the current procurement methods adopted within the industry it is doubtful that these respondents will have to reconsider their decision any time soon, or that the adoption of the NRM will ever reach critical mass (Valente 1995), which in turn minuses the effect of thresholds on the actors.

5.7 Diffusion Concepts

The three diffusion concepts, Cohesion, Structural Equivalence and Thresholds, have been identified and discussed in previous chapters. To recap, these concepts focus on the way in which innovations are communicated amongst actors within a social system. Rogers (2003) does not specifically identify these concepts in his work, although there are references to similar aspects throughout such as his discussions on communication flow (Cohesion) and critical mass (Thresholds). Although not directly addressed, it is apparent that Rogers (2003) was working beyond these concepts and felt that no single concept adequately explained the diffusion process. His work can therefore be regarded as superseding these concepts and therefore no further consideration is required, but this would miss important aspects of the nature of social contagion and would limit the understanding of an actor's diffusion journey.

Valente (1995) and Larsen (2005) recognised this in their work, with Larsen (2005) proposing that the individual concepts do not alone explain the diffusion process, but that they can all influence the process differently and at different stages. This is an interesting proposition and one that was explored through the primary data collection and will now be discussed in more detail with regard to the research context.

5.7.1 Cohesion

Cohesion is the earliest diffusion model and Katz (1964) observed that it is based around face-to-face contact and communication. Valente (1995 p.12) refers to this as social contagion within a network perspective and states "contagion refers to how individuals monitor others and imitate their behaviour to adopt or not adopt innovations". The role of communication has been discussed already, and the role that both strong and weak ties have in the diffusion of innovation is well documented (Granovetter 1973). This research has so far shown that the role of weak ties is insignificant when applied to a specific work based context such as that of the QS within the construction industry. This therefore limits the influence and impact that Cohesion can have upon an actor within this social setting.

Larsen (2005) demonstrated that Cohesion was a good fit with the initial awareness stage of the diffusion process and then the later promotion aspects, which has not been

supported by the findings of this research, which has demonstrated that none of the respondents had spoken to anyone outside of their own organisation about the NRM. No respondents utilised direct face-to-face communication with regard to the awareness stage either, with most reporting that awareness came from either email correspondence or trade press. The issue of discussing anything with competitors was raised several times with **DM – CE-C-£M-M** stating "Obviously (we) don't talk to our competitors". Overall the feeling from the respondents was that they all felt isolated from other QSs due to the pressures of work and the confidentiality that projects can bring.

Respondents did report that they felt that they would be influenced by face-to-face communication, but that this would only be through those who they knew well, which supports the earlier discussion of the use of strong ties, as opposed to weak ties. The fact that this had not happened in a single example is interesting and demonstrates that the lines of communication within the industry are limited in both direction and reach, but that the impact of direct communication can still be a consideration if utilised.

For the purposes of this research and within the bounds of the research sample it can be surmised that Cohesion does not play a significant role in any aspect of the QS's diffusion journey with regard to professional practice innovations.

5.7.2 Structural Equivalence

Structural Equivalence argues that another phenomenon is more influential in explaining how diffusion actually occurs and is based around actor's positions, their perception of equivalence and blocks of equivalent actors. Valente (1995) did not consider Structural Equivalence as being relevant to his work as he was concerned with network analysis, which charts communication channels, not people's perceptions of equivalent others. This is a good example of how diffusion scholars have taken differing views of the influencing factors within their research.

Larsen (2005) found that Structural Equivalence was a poor fit throughout the diffusion process with the only minor exception being at the initial awareness stage. The findings of the primary research demonstrated that respondents felt isolated and that there was very limited opportunity to observe others and gain knowledge of their professional

practices. Respondents did report that seeing others using a new professional practice would trigger them to find more information, so this could be considered as providing an actor with their initial awareness. Kale and Arditi (2010) made similar findings in their research and showed that construction companies are more influenced by their own internal operations and workload than that of other companies within the same social system.

5.7.3 Thresholds

Threshold concepts argue that an actor engages in behaviour based upon the ratio of actors in the social system already engaged in the behaviour (Granovetter, 1978). Within a diffusion setting Valente (1995) suggests that diffusion thresholds are the proportion of prior adopters in an individual's personal network when the individual adopts.

Larsen's (2005) main focus was on Thresholds and he found that they had a high relevance at three key stages, namely the decision-making, adoption and use stages. He also proposed that Thresholds need considering at all stages of the diffusion process and that they influence an actor throughout. One of the main contributions of Larsen's study was the introduction of the Awareness Threshold Level (AwTL), for both system and actor levels, which suggests that each system/actor will have a threshold with regard to their awareness and their ability to become aware. He also introduced the same concept for the adoption stage with the Adoption Threshold Level (AdTL), again, both at an actor and system level.

This classification was used to demonstrate that Thresholds influence both the actor and the system at the awareness and decision stages.

The findings of this research demonstrated that no respondents had made any attempt to discover how many others were aware or had adopted the NRM. This lack of knowledge about the wider industry means that the Threshold concept cannot influence the actor at any stage of the diffusion process, as they have no number, or perception of number in which to measure their individual threshold. However, Thresholds were raised by respondents, but in terms of the weight of the industry forcing the adoption of

the NRM. Numerous respondents highlighted this as they were happy with their current practices but appreciated that if the wider industry was moving in a particular direction then they would have to go with it or risk disadvantaging themselves commercially. No specifics were identified, but there was an understanding that no respondents wanted to be left behind once the wider industry started to adopt the NRM.

Therefore, there is only limited evidence to support the Threshold concept. Firstly, the discussions identified above, and secondly at the awareness stage, one respondent was not aware while all others were. This demonstrates that he hadn't reached his own threshold, and maybe more importantly that the industry has not reached its own threshold, because there are still actors who are unaware. Therefore, the industry has not reached critical mass as far as the awareness of NRM is concerned. The findings do support the consideration of thresholds at both the awareness and decision stages, on both an actor and a system level. This is bounded within the research context and is an important area for further study, as it can be seen from the responses that actors would be influenced by the weight of the industry, perceived or otherwise, and that this could have a significant impact on the diffusion process.

5.7.4 Concepts Summary

Although the diffusion concepts are based on years of research from multiple authors, their use has been found to be limited with regard to this research context and boundaries. This is thought to be a result of previous studies, such as Larsen (2005), investigating the concepts directly, as opposed to utilising a vehicle, in this case the NRM, to demonstrate them indirectly as in this research. Larsen (2005) specifically asked his respondents about the concepts and how they felt about them and their use. All the concepts are logical when considered in isolation, and this may have influenced the previous findings. For this particular context the responses were based on an actual professional practice innovation and real experiences, not perceived ones. This is only one possible explanation for the differences in findings and it is not the aim of this research to extensively test the previous findings, but only to move them on in terms of the point in time of the research and the specific context in which it is undertaken.

5.8 Rejection of Innovation

The rejection of innovation is an area that has not received the attention it deserves within the current body of diffusion literature. Rogers (2003), Valente (1995) and Larsen (2005) all comment that there is a lack of understanding around the rejection of innovation with Rogers (2003 p.106) referring to it as the 'innovation bias' and stating that "it is the implication in diffusion research that an innovation should be diffused and adopted by all members of a social system, that it should be diffused more rapidly and that the innovation should be neither re-invented nor rejected". This is patently not the case for many innovations, and as this research has found it is also not the case for the NRM and its diffusion among the QS profession. This bias is partly due to the fact that most diffusion studies are looking for laws of behaviour using quantitative methodologies across large population samples. This results in the aim of the research being about these trends and therefore an innovation that does not diffuse is no use. What this does is ignore the qualitative aspects of diffusion and fails to consider how and why diffusion may or may not occur within a social system.

What this research has found is that the majority of respondents have rejected the NRM, so this discussion will now focus on why this was the case and examine these reasons in the context of this investigation. The primary data has shown that there are barriers to adoption associated with the innovation itself, and also barriers to the actual diffusion process, so these will be identified and discussed separately to draw that clear distinction. This correlates with the Rogers (2003) diffusion model where the innovation attributes are distinct from the diffusion journey, but no one has identified this from a rejection perspective. This will then form a contribution to knowledge that informs all diffusion fields, and can be considered in any future diffusion studies.

5.8.1 Barriers to Adoption

Rogers (2003 p.178) suggested active and passive rejection, where an active rejection was a considered and informed decision and a passive rejection was where an actor had not really considered the innovation. He suggested that this was an interesting concept and that the two different types of behaviour have "seldom been distinguished in past diffusion research". The findings of this research can confirm that there are indeed two

distinct types of rejection and these were identified within the attributes category of respondents in NVivo. These can be seen in figure 5.6 below.

Name	Professional Qu...	industry Sector	Turnover	No of Employees	Adopted NRM	Knowledge of NRM	Decision Type
SW - CM-RICS-C-£M-M	RICS	CQS	£25-500 Mil...	0-49	No	Poor	Active
PR - QS-C-£S-S	CIOB	CQS	£0-25 Million	0-49	No	None	Passive
SS - SQS-C-£S-M	None	CQS	£0-25 Million	0-49	No	Poor	Passive
LF - SQS-C-£M-L	None	CQS	£25-500 Mil...	250+	No	Poor	Passive
JC - CE-C-£M-L	None	CQS	£25-500 Mil...	250+	No	None	Passive
GS - CM-C-£M-M	None	CQS	£25-500 Mil...	50-249	No	None	Passive
CB - Dir-RICS-C-£S-S	RICS	CQS	£0-25 Million	0-49	No	None	Active
VR - CM-RICS-C-£M-L	RICS	CQS	£25-500 Mil...	250+	No	Poor	Passive
DM - CE-C-£M-M	None	CQS	£25-500 Mil...	50-249	No	Poor	Active
JP - Part-P-£S-S	RICS	PQS	£0-25 Million	0-49	No	Good	Passive
WC - Dir-C-£S-S	None	CQS	£0-25 Million	0-49	No	None	Passive
MR - Dir-RICS-C-£S-S	RICS	CQS	£0-25 Million	0-49	No	Excellent	Active
SB - SQS-C-£M-L	None	CQS	£25-500 Mil...	250+	No	None	Passive

Figure 5.6 - Passive and active rejection categories.

Respondents demonstrated varying degrees of knowledge of the NRM, and this has some influence on their rejection decision, but as can be seen above, some respondents actually had a good knowledge of the NRM but have still passively rejected the NRM. This was where a respondent has an understanding of the NRM but has no specific need or desire to adopt, so this has been classified as passive, as they have not categorically rejected and would reconsider adoption if required. Where an active decision has been made this has been classified as an actor being more vocal in their rejection and includes those that have formed very negative opinions of the NRM and will resist adoption for as long as possible. Some of these rejection decisions were made on incorrect knowledge of the NRM, and this has been discussed previously. These findings show clear evidence for Rogers (2003) previously unsupported claims to rejection categorisation of actors.

In addition to the actor's rejection category, the attributes of the innovation play a clear influence on the rejection decision. The innovation attributes have been discussed at length in this chapter, and it is clear that these can be both positive and negative attributes. This is in line with the findings of both Kramer *et al*. (2009) and Rose and Manley (2014) who have identified several barriers to adoption with the most relevant examples being the relevance and usefulness of the innovation and the associated risks of new products.

The primary research identified several barriers to adoption, which are identified as follows:

Barriers to adoption

- Lack of customer demand.
- Sub-contractors – issues with compatibility and knowledge.
- Time restrictions on measurement process – encourages builder's quantities.
- Wide spread use of D&B, which changes the ownership of the measurement process.
- Lack of interest from young surveyors, which leads to a lack of ability in using a standard method of measurement.
- Minimal benefits for users over current practices.
- No commercial advantage.
- Lack of knowledge of it in the wider industry.
- Existing software restrictions.
- Expense of upgrading existing software.
- Use and familiarity of current practices – "if it isn't broken, don't fix it".
- Greater opportunity for errors when using a new method.

Of these barriers, the one that could be considered the most influential based on the emotion of the interview respondents when discussing this would be the impact on their supply chain, from both a PQS and CQS perspective. It was clear from the interviews that the supply chain plays an important role in the need and format of any measurement. Most contractors now sub-contract the majority of their work, so the sub-contractors also have a role to play in the measurement and pricing of building works.

The main point that all CQS respondents raised with regard to their supply chain was the lack of knowledge of NRM and adoption of it further down that chain. As can be seen from the attribute data, no CQS interviewed has adopted NRM, and one of the main reasons was the fear that if they were to adopt NRM then the sub-contractors would not understand their quantification and therefore miss items out, or make incorrect assumptions that could ultimately cost money. Another aspect that was raised

was that if the sub-contractors didn't understand the enquiry that was sent to them i.e. if an NRM measure was sent to them, then they would be more likely to refuse to price the work due to other commitments and the associated risks. This in turn affects the competitiveness of the main contractor which is unacceptable, and more importantly avoidable by just doing what has always been done.

MR – Dir-RICS-C-£S-S states that sub-contractors were not considered enough during the development of the NRM, and that the lack of knowledge down the supply chain is one of the main reasons he has not adopted the NRM. He also discussed the issue with estimating software and libraries that are all based on SMM7, and that his supply chain is happy with their current working practices.

Another aspect that was raised with regard to the supply chain was cost. Most CQSs thought that if they introduced NRM to their supply chain then the costs would increase as the sub-contractors would price in some aspects of risk due to the amount of uncertainty over what was included in the measure and what wasn't. **SW – CM-RICS-C-£M-M** spoke at length about this particular issue and claimed that the NRM just does not give enough information to be able to price works properly, and that "basically it gives them a quantity and then says really work it out for yourselves". This view was based on a recent experience of a project where an NRM BQ was used, and caused numerous issues with measured items, particularly in terms of what was included in items and what was not. It also caused him issues with buy in from the sub-contractors who were unwilling to move on price following the enquiry stage, which is very unusual and was attributed to the use of NRM.

As can be seen, there are many reasons for the rejection of the NRM, with several relating directly to the innovation itself, but also there are aspects that would affect any innovative professional practice innovation. So although this research is making no attempt to generalise these barriers across the wider population, these will at least give others a starting point for further research into the rejection of innovations.

5.8.2 Barriers to Diffusion Journey

Previous authors, such as Larsen (2005), Slaughter (1993) and Gambatese and Hallowell (2011a) have failed to draw the distinction between barriers to adoption and barriers to the diffusion process, but this is an important distinction to make. In addition to the rejection of the actual innovation itself, due consideration needs to be paid to the diffusion process and any barriers that actors have faced in this regard as this can directly influence an actor's ability to make informed decisions and can subsequently increase the likelihood of rejection. This is in addition to the barriers identified above that relate directly to the innovation.

The primary data analysis identified three key aspects that affected the diffusion process in a negative manner and were therefore classified as barriers to the process. These were:

- A lack of communication with others about the NRM.
- Too busy with projects to look at the wider industry.
- Expense of buying the document.

Sheffer and Levitt (2010), found that that low relational stability affects the rate of diffusion, and this is supported by the primary research as many actors reported that they were not in regular contact with other QSs outside of their organisation, and when they were it was only to discuss project specific tasks, and not to build relationships and discuss working practices for example. This lack of regular contact with a stable social network correlates with Valente's (1995) work where he considers the impact of exposure. Exposure is a measure of the likelihood that an actor is exposed to the innovation in the first instance, so relating to the awareness stage, but it is also a measure of the amount of exposure an actor receives in relation to the innovation, and this can subsequently influence their decision-making. This is related to the threshold concept, but where exposure is an influencing factor and the individual threshold determines the time of adoption. This study has found that an actor's exposure is limited in the construction industry due to the temporary nature of projects and therefore the relationships that are formed within them. It could be argued that exposure is high; in so much that an actor is being exposed to numerous other actors on a regular basis, but it is

the nature of the exposure that is the limiting factor. The exposure to *relevant* communication regarding an innovation, such as the NRM, just does not happen when the majority of communication is project and task focused.

The expense of buying the documents was seen as a barrier to the diffusion process, as opposed to the adoption, as those who had adopted did so partly due to their higher level of knowledge of the NRM, which was predominantly gained through reading the document. Therefore, it is considered that the rejecting actor's decision was partially influenced by their lack of knowledge, due the fact that they did not have a copy of the document. The document issue is interesting, as the NRM is provided as a free online copy for RICS members, but is approximately £20.00 for a digital version and £45.00 for a hard copy for non-members. This immediately raises questions about the target audience for NRM and the RICS's strategy for diffusion, and also helps to provide reasons as to why the non-members interviewed had very little knowledge of the NRM, as they would have had to purchase a copy before knowing what is contained within.

Other findings that have already been discussed with regard to the rejection were the impact of prior conditions, the lack of a felt need, miss-information and finally a general resistance to change.

Finally, for this section it is worth considering the impact that the diffusion concepts have on the actor's journey, mainly as these are always regarded as diffusion concepts, which implies that they facilitate diffusion, and do not impede it. This is supported by the primary research that has found that the absence of these concepts is a limiting aspect to an actor's diffusion journey. All three centre on communication as their main driver, be it face to face (Cohesion), equivalence (Structural Equivalence) or the relative weight of message (Thresholds), and the key aspect that has been identified as a barrier to the diffusion journey is the lack of, and type of, communication across the industry.

5.9 Summary

This chapter has identified and discussed the key topics with relation to the research aim and objectives, by drawing on the previous literature and primary research. This was

achieved by looking across the industry as described by the respondents to identify any social norms that could impact on the diffusion process, where it was found that procurement, measurement practice, communication and professional bodies are all important aspects for consideration when analysing an actor's diffusion journey.

It can be seen that while there are several differences between the two factions of QS within the industry, there is some consistency forming in their diffusion journeys. All respondents have questioned the need for the NRM and although some have adopted it is clear that the publishing professional body, the RICS, has had a distinct influence.

The impact of actor's prior conditions was also discussed and found to be another key aspect, particularly with regard to their measurement practices. The attributes of an innovation were identified with regard to the research context and the classical diffusion literature was found to be too generalised and did not provide a good enough explanation for this context. A revised set of attributes was proposed.

An actor's diffusion journey was discussed with particular focus on the timing of the various influences. These findings will form the foundations for the development of a contextual diffusion model in the next chapter.

The traditional diffusion concepts were investigated with regard to their relevance and suitability to the research context. It was found that their impact and usefulness as explanatory concepts was limited in this particular study.

Finally, the discussion focused on the rejection of an innovation, which is an area that has received very little attention from diffusion scholars in the past. It was found that there are distinct barriers to the adoption of an innovation, but also that there are barriers to the diffusion of an innovation and that a distinction needs to be drawn between these two aspects. The NRM itself has also been scrutinised throughout the interviews and it is clear that it exhibits certain attributes that aid its diffusion as well as several that do not.

The findings presented here are particularly interesting to the author, as it was the interplay between QSs and the wider industry that was the trigger for this entire

research project, and the findings actually mirror the authors own personal experiences in the industry. This is both reassuring, as it shows that the initial observations of the author were not isolated, but also concerning, as it also shows that the industry does have some issues with communication between actors outside of the project specifics. The following chapter will now consider these discussions and will develop and propose a new contextual model for the diffusion journey of QSs within the UK construction industry.

Chapter 6 – Development of a contextualised model

6.1 Introduction

The synthesis of the research findings was presented in chapter five. This chapter graphically represents that synthesis in the form of a contextualised model of diffusion for QSs and professional practice innovations. This will be achieved through the critical appraisal and development of the innovation decision process as proposed by Rogers (2003). It has been shown that many diffusion studies lack context, and that this results in a lack of understanding of the particular actor's diffusion journey and the various influences that act upon them.

Chapter five identified and discussed the key issues with regard to the research aim and objectives, and highlighted several themes that can be developed into a contextualised model. It began with identifying the social system norms with regard to the research sample and found that procurement, measurement and communication norms were the most influential impacting on the diffusion process. The remaining discussion was more focused on the actor's diffusion journey, including their current position and relation to their individual prior conditions. It is this journey that will now be rationalised and depicted through the development of a model that represents a QS's diffusion journey. This model is embedded in the context upon which it has been constructed.

All of the findings are based upon UK companies and all respondents were QSs working in the construction industry. This research focuses upon the QS, which is a unique perspective among the diffusion literature and is one of the areas that makes a contribution to knowledge. The proposed model will therefore be context specific and represents a development of the existing body of diffusion literature.

6.2 Development of a model for the diffusion journey.

By utilising the respondent's individual journeys and the synthesised work in the previous chapter, the following diffusion timeline becomes apparent. The duration that each actor spends within these stages is unique to the individual, and no attempt has been made to quantify this aspect of the journey.

Current Position (Prior Conditions)

The journey must start with an actor's current position, and therefore their prior conditions. It has been identified that these have a significant influence and as such need to be represented as the starting point of any diffusion process.

Awareness

From this initial position, for the diffusion process to commence an actor must now become aware of an innovation. This can be through many different channels and this is essentially a gateway to the diffusion journey. Awareness can be influenced by barriers, as previously identified, and also the actors personal and system-level thresholds.

Knowledge

Once an actor becomes aware, they will start to discover more about the innovation and begin to increase their knowledge of the innovation. This knowledge gathering can be influenced by barriers and also the social system norms.

Opinion Forming

Following the acquisition of knowledge about an innovation an actor will start to form opinions about the innovation, both positive and negative. These opinions can be formed on the basis of the knowledge acquired, and also through communication with others. This is also where an innovation's attributes are considered by the actor, along with specific requirements from their clients, and any other influencing factors such as regulatory bodies (Rose and Manley 2014), for example the RICS. This stage is also influenced by the barriers identified and the social system norms.

Decision (Adopt / Reject)

Once an opinion is formed, the actor will make a decision to adopt or reject an innovation. This is influenced by the barriers present and also the social system norms, and is also subject to the actor's system and personal thresholds.

Implementation

This journey will now either continue, where an actor will begin to implement the innovation, or it will end with a rejection decision. During implementation the influence of barriers continues as does the social system norms, both factors that could therefore influence an actor to such an extent that they make a reconsideration decision.

Confirmation / Reconsideration

Following either implementation or rejection, an actor may now reconsider their original decision, or continue to confirm their decision. This essentially provides a loop scenario where an actor can constantly reassess their decision through increasing their knowledge, forming new opinions or experiencing issues with implementation for example. The actor will continue to be influenced by the social norms and these could result in a later reconsideration.

6.3 A model of diffusion for QSs with regard to professional practice innovation

Rogers (2003) innovation-decision process is the most cited and used diffusion model within the diffusion research landscape. Many refer to it (Slaughter (1998, 2000), Harkola (1995)) but few have attempted to contextualise it, particularly within the construction industry. The exceptions to this are Emmitt (1997), Larsen (2005) and Rose and Manley (2014).

Emmitt (1997) amended the model to reflect his work within an Architectural practice, and introduced two new stages, namely the 'tender action' and 'specification substitution' stages. No attempt to revise the existing Rogers (2003) stages are made and the stages that were introduced were specific to the architectural practice when selecting products to specify. In addition, this work was focused on the hard copy library type of data storage as it predates the now widely used online libraries, and is therefore no longer relevant.

Larsen (2005) has been considered and critiqued throughout this thesis and he undertook a more detailed look at the Rogers (2003) model with regard to professionals working within the construction industry and overlaid the influence of the three main diffusion concepts. There was no specific focus in terms of the innovation itself, and the work was largely conceptual. He also introduced the concept of a layered system perspective and proposed a polymorphic framework. This work was still based on the original five-stage model proposed by Rogers (2003), but was a successful attempt to contextualise it within a social realist perspective.

Rose and Manley (2014) made no attempt to modify Rogers (2003) model and instead introduced a contextual determinants section, which is essentially just identifying the context specific social system norms to the persuasion stage of the process, such as procurement systems and regulatory conditions. These findings correlate with the findings of this research and as such have been taken into consideration; particularly the influence of regulatory conditions.

Figure 6.1 shows Rogers' (2003) innovation-decision process model and figure 6.2 the proposed new contextualised model. This clearly shows not only the development of the model, but also the inherent quality of the work of Rogers (2003). As already identified, this new model is contextualised for the diffusion of professional practice innovation, specifically the NRM, among QSs within the UK construction industry, and is a direct result of the data gathered through interviews and then collated and analysed in Chapter five, with the result demonstrating the timeless and far reaching aspects of Rogers (2003) model, but also the areas where a context specific view is required to avoid over generalisation which is one of the main criticisms of Rogers (2003) work (Larsen 2005).

For clarity, the new model makes no attempt to identify timescales associated with each stage, and neither does it imply that an actor has to follow each stage in the sequence shown. For example, some actors may gain knowledge of an innovation and decide immediately to adopt or reject, thereby bypassing the opinion forming stage.

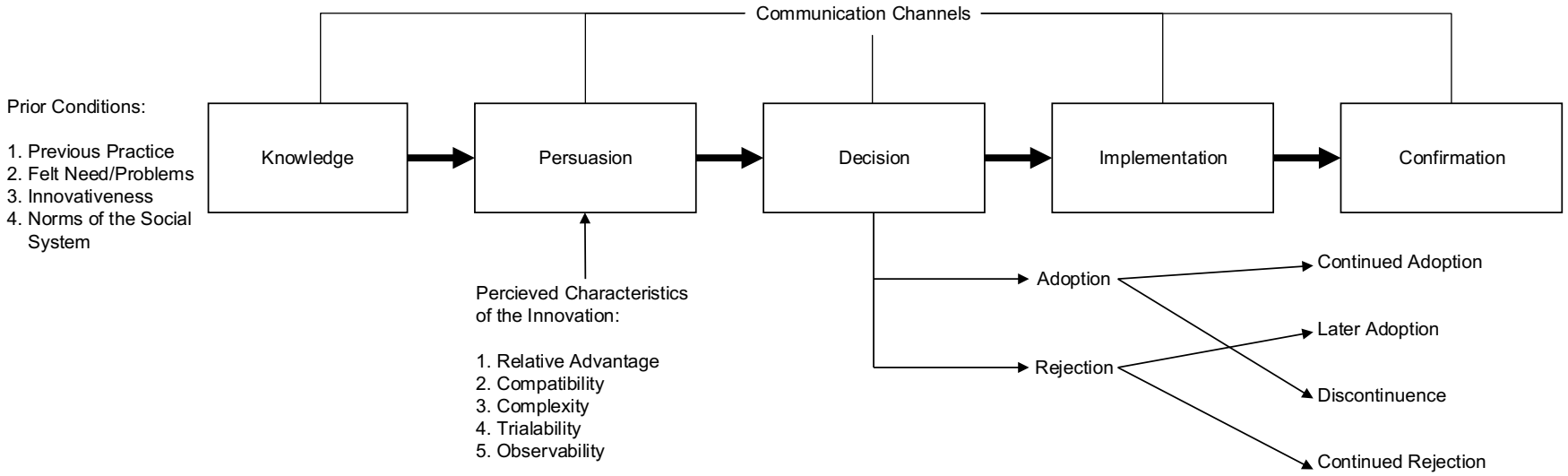


Figure 6.1 - Rogers (2003) Innovation-decision process

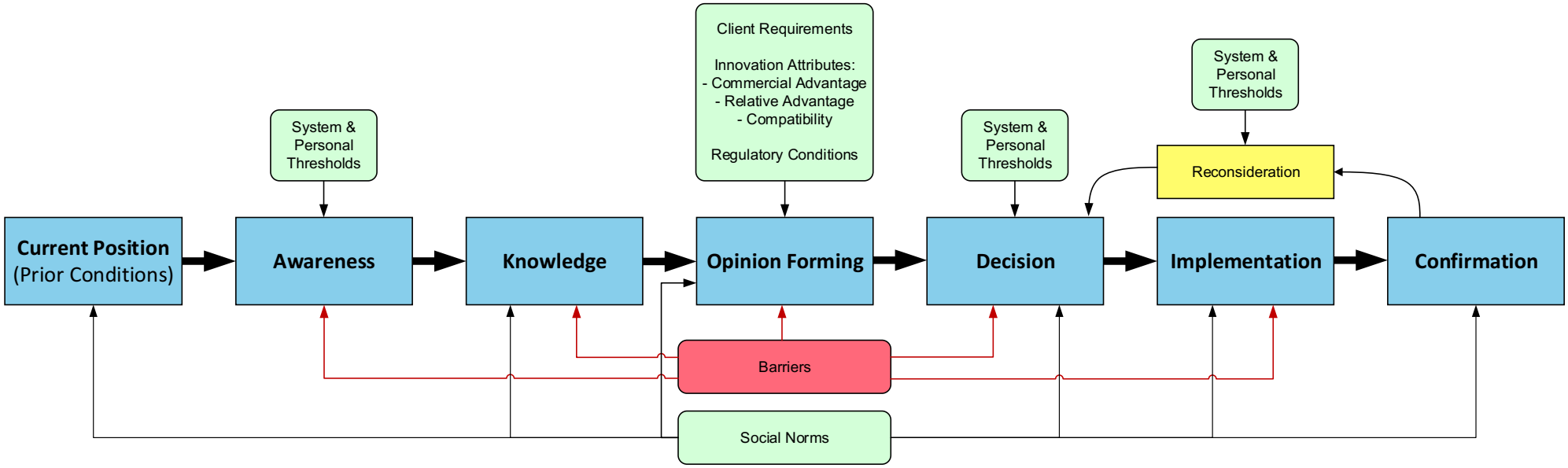


Figure 6.2 - A contextualised diffusion journey for Quantity Surveyors with regard to professional practice innovation

The development of this model has been discussed in detail, and it can be clearly seen that additional stages have been introduced, *current position* and *awareness*, to reflect the importance of these stages to the research sample. In addition, the influence of *barriers*, *social norms* and *thresholds* have also been shown, as these have a significant influence over an actor's diffusion journey and need to be represented. Finally, context specific influence on the opinion forming stage have been identified as *client's requirements*, *regulatory conditions* (Rose and Manley 2014) and the innovation attributes have been amended to reflect the context and now comprise of *commercial advantage*, *relative advantage* and *compatibility*.

The development of this model and its constituent parts is a significant development of the diffusion research landscape, providing a greater understanding of the QS as a social actor and therefore represents a contribution to knowledge.

6.4 Example diffusion journeys

In order to demonstrate the model in use, two of the respondent's diffusion journeys will now be described with respect to the model to internally validate the design and scope. Both respondents full interview transcripts are included in Appendix B.

6.4.1 SH – SA-RICS-P-£L-L Diffusion Journey

SH – SA-RICS-P-£L-L is a senior associate, RICS member and PQS working in a large turnover and large staff company. He is an active adopter with excellent knowledge of the NRM.

6.4.1.1 Prior Conditions

His diffusion journey started as a PQS producing BQs in the private sector, and he has years of experience of the SMM7, along with his team who all also have lots of SMM7 experience. As a RICS member he was influenced by their professional guidance and the company he works for are a well-known and long standing provider of cost consultancy services. All work produced through his team is traditionally procured, so the use of the BQ is paramount, and he felt that a new method was required as the SMM7 was not reflective of the more modern construction practices.

6.4.1.2 Awareness

He first became aware of NRM through correspondence from the RICS. His personal threshold with respect to awareness is low, as he regularly receives correspondence from the various trade press and professional bodies. He experienced no system level threshold issues as he is a member of the main professional body for his profession, and works in a large organisation with regular internal briefings and mailshots.

6.4.1.3 Knowledge

His knowledge of NRM is excellent, and this comes from acquiring a copy of the document and reading it, and then discussing it with colleagues. He did not attend any external training courses, or consult any other QSs about the NRM. This knowledge acquisition was driven by the fact that the NRM was published by the RICS. He experienced no barriers to this knowledge acquisition and behaved in a way that he considered to be in line with his profession, thereby complying with his social norms.

6.4.1.4 Opinion Forming

This stage was predominantly influenced by the RICS being the publishers of the NRM, which ties with the regulatory conditions influence shown. This stage was brief for this respondent and he did not question the next stage.

6.4.1.5 Decision

SH – SA-RICS-P-£L-L made an adoption decision soon after satisfying himself that the NRM was a workable document. He experienced no personal threshold resistance or barriers as identified. This demonstrated a system level threshold influence, as he was working on the basis that the rest of the industry would also adopt the NRM. This influence was a perception, but had impact none the less.

6.4.1.6 Implementation

Following the decision to adopt, **SH – SA-RICS-P-£L-L** organised team meetings to identify how they would implement the NRM. This essentially resulted in the team reading through the NRM and then choosing an appropriate live project to use it on. This is how the NRM was implemented in this instance.

6.4.1.7 Confirmation

At the time of writing **SH – SA-RICS-P-£L-L** has used the NRM on six projects, and has not received any negativity as a result. He could not give a single objection to this from the supply chain or his organisation. As such, he was confident that he would continue using the NRM, but did concede that should the industry turn against the NRM he would reconsider his decision. This shows that he would be clearly influenced by the social norms and that reconsideration would be impacted by the system threshold.

6.4.1.8 Summary

In summary, it is clear that **SH – SA-RICS-P-£L-L** has followed the proposed model throughout his diffusion journey and that the various influencing factors have played their roles in certain stages. As an adopter he faced less barriers to the diffusion process or adoption, and is a good fit with the proposal.

6.4.2 DM – CE-C-£M-M Diffusion Journey

DM – CE-C-£M-M is a Chief Estimator who works for a contracting organisation that has a medium turnover and medium staff levels. He is not a member of any professional bodies. He is an active rejecter with poor knowledge of the NRM.

6.4.2.1 Prior Conditions

As a CQS, **DM – CE-C-£M-M** has been producing BQs using SMM7 since it was launched in 1988. His company provide quantities to all sub-contractors and all work is done in house. He has tried to use external consultants for quantification but has found the quality to be poor. All in house work is measured using SMM7 as a benchmark, but it is adapted to suit their needs. He describes this as builder's quantities. The majority of the project undertaken are procured through the D&B system and this is reflected in his measurement practice. He felt no need for a new method of measurement, and regularly used the phrase "if it's not broken, don't fix it" during his interview.

6.4.2.2 Awareness

His first awareness came from a part time student working for the company who had heard about the NRM at university. His personal threshold for the awareness is high, as

he does not regularly follow the trade press and is not a member of any professional bodies, so his exposure is low. Following this initial awareness, he did not attempt to find out any more information about the NRM.

6.4.2.3 Knowledge

DM – CE-C-£M-M did not attempt to discover any more information about the NRM in addition to that initial awareness. This was attributed to the fact that his current practices work, and he saw no reason to change. In this respect the main barriers relate to the diffusion process itself, as he had little knowledge of the innovation. He had not spoken to, or attempted to speak to, anyone else about the NRM.

6.4.2.4 Opinion Forming

Based on the little amount of knowledge gained on the NRM, **DM – CE-C-£M-M** had formed very strong opinions about the NRM based on what he had heard through the various students in his office. Most of this information was found to be incorrect. He had not experienced any influence from any regulatory bodies or clients, and in his view the NRM provided no commercial or relative advantage, and would cause compatibility issues with his supply chain, thereby fitting into the proposed model at this stage.

6.4.2.5 Decision

The decision to reject the NRM was clear from the start of his journey. This was clearly influenced by rumours, but mainly the lack of need for the NRM given his current business operations.

6.4.2.6 Implementation

This stage does not apply to this respondent.

6.4.2.7 Confirmation

At the time of writing **DM – CE-C-£M-M** has no intention to adopt the NRM, but did suggest that if there was a need from his clients, or a swing in the industries adoption

level these may cause him to reconsider. This is a clear indicator of an actor with a high threshold that needs a system level intervention to effect change.

6.4.2.8 Summary

DM – CE-C-£M-M fits into the proposed model even though he has a completely different journey and adoption decision to **SH – SA-RICS-P-£L-L**. What is clear here is that the prior conditions have had the largest influence over the journey, and these conditions, predominantly the lack of a felt need, have influenced his opinion of the NRM to the point where reconsideration will require significant system level intervention.

6.5 Summary

This chapter has shown that there is a lack of a contextualised view of the diffusion process and that each actor experiences their own diffusion journey. Previous studies have either failed to address this, or have been focused on other sectors of the construction industry, while others are now simply not relevant given the advancements in technology and communication, for example Emmitt (1997).

An actor's diffusion journey is influenced by various factors, including prior conditions, social norms, barriers, thresholds, client requirements, innovation attributes and regulatory conditions.

This journey has been rationalised into a model depicting an actors journey and the various influences along the way. This has then been demonstrated using two of the interview respondents as a validation exercise. The proposed model depicts the culmination of the data collection and is based on the diffusion of professional practice innovation, specifically the NRM, among QSs within the UK construction industry. No attempt is made to generalise this across a wider population at this time. The model as shown is a contribution to knowledge, and opens up numerous avenues for further research that will be explored in the next chapter.

Chapter 7 – Conclusion

7.1 Introduction

The previous chapters have provided a comprehensive analysis of diffusion of innovation theory and proposed a new contextualised understanding. This chapter will now restate the research aim and objectives, summarise the major findings, impact on current professional practice, discuss the limitations of the work, areas for future research and most importantly clarify the contributions to knowledge that this research makes.

7.2 Research Aim and Objectives

This research had one main aim:

To further understanding in the context of the diffusion of a professional practice innovation among QSs within the UK construction industry. Not only to ascertain if stages exist in this process, but also to discover if the stages proposed by Rogers (2003) are suitable for this particular context, and if a new model is required to accurately represent diffusion within these particular parameters.

This was achieved through the completion of the following objectives, each of which will be reconsidered to conclude this thesis:

1. Define the context for the research in terms of actor, social system and innovation under investigation.
2. Identify the current measurement practices utilised by quantity surveyors.
3. Critically appraise and develop existing diffusion literature to suit the research context.
4. Identify barriers to the diffusion and adoption of professional practice innovation.

7.2.1 Objective 1

Define the context for the research in terms of actor, social system and innovation under investigation.

The research context was defined in chapter five, where it was ascertained that the social system under investigation was the QS profession, the actor at the centre of this social system was the QS and the type of innovation was innovative professional practice, specifically the NRM. These decisions were framed following a comprehensive literature review that allowed the research to investigate new directions and make a contribution to knowledge. The QS is an underrepresented profession when it comes to sociological research, and the diffusion of innovation is one area that is criticised for its lack of a contextual understanding, which this research sought to address.

7.2.2 Objective 2

Identify the current measurement practices utilised by quantity surveyors.

Following a detailed review of the current literature regarding measurement practices, it was found that there was a large disconnect between theory and practice. The findings in chapter seven showed that owing to the increase in D&B procurement and the demise of the BQ, more and more contractors were having to undertake their own measurement in-house, or sub-contract it at the tender stage. This has resulted in a lack of standardisation to the methods employed as the contractors are only relying on the data produced in-house. This means that most contractors are now utilising what is termed 'builder's quantities', which in most cases are loosely based on SMM7, or in some cases even SMM6. What was clear from the analysis is that no contractors are utilising NRM, nor do they see a need for its use. The PQS respondents had a different perspective, but only one PQS respondent is actively producing BQs for tendering purposes, so therefore the majority are not involved in any kind of pre-contract measurement at present, opting instead to produce simple CSA documents for pricing purposes. The amount of iterative differences between current practice within the industry is significant, and as chapter five clearly showed, the respondents all have their own preferred approaches. What this means for the future of measurement practice is

unclear, but it is looking increasingly like the concept of a standardised method is becoming a thing of the past.

7.2.3 Objective 3

Critically appraise and develop existing diffusion literature to suit the research context.

The existing diffusion literature was comprehensively reviewed in chapter three. The synthesis identified several areas where diffusion theory could be developed within a specific context, with each of these being discussed in detail in chapter five as part of the analysis. The areas under investigation were as follows:

1. Rogers (2003) concept of prior conditions.
2. Rogers (2003) innovation-decision process.
3. Three diffusion concepts of Cohesion, Structural Equivalence and Thresholds.
4. Rogers (2003) innovation attributes.

Prior Conditions were identified as an area that has received little attention within the literature, but proved to be of significance within the construction industry context. The industry has many practices that have developed over time, such as procurement and measurement, but this development has been slow and the industry is still utilising tools and techniques that were developed years ago. This creates a barrier to the innovation process and it was found these social norms have a significant influence over the actors concerned. Many practitioners are locked into their existing practices by failing to see a need for change, and this coupled with an overwhelming workload is preventing actors from having the capacity to commence the diffusion process. With actors too busy to try new practices, such as NRM, and the perception of little or no commercial advantage, this has slowed the diffusion of NRM to a standstill, and therefore the importance of an actor's prior conditions cannot be underestimated when considering diffusion within the construction industry context.

The most significant area of the existing diffusion literature that was developed was the actor's diffusion journey. This is called the innovation-decision process by Rogers (2003), and was developed to better represent the bounded context of this research. This

was developed through the detailed literature review, qualitative data analysis as presented in chapter seven, and the discussion presented in chapters eight and nine.

Areas that are unique to this model include the inclusion of the prior conditions stage in the process, along with the awareness stage, opinion forming stage and the reconsideration loop. Other additions include the influence of barriers to this process and the influence of client's requirements and regulatory conditions on the opinion forming stage. The model also shows where the greatest influence of system level and personal level thresholds are apparent. The model is shown in figure 7.1 below, and depicts an actors journey through the diffusion process and the various influences along the way. For clarity, this model makes no attempt to generalise across the wider population and is bounded within the context of this research.

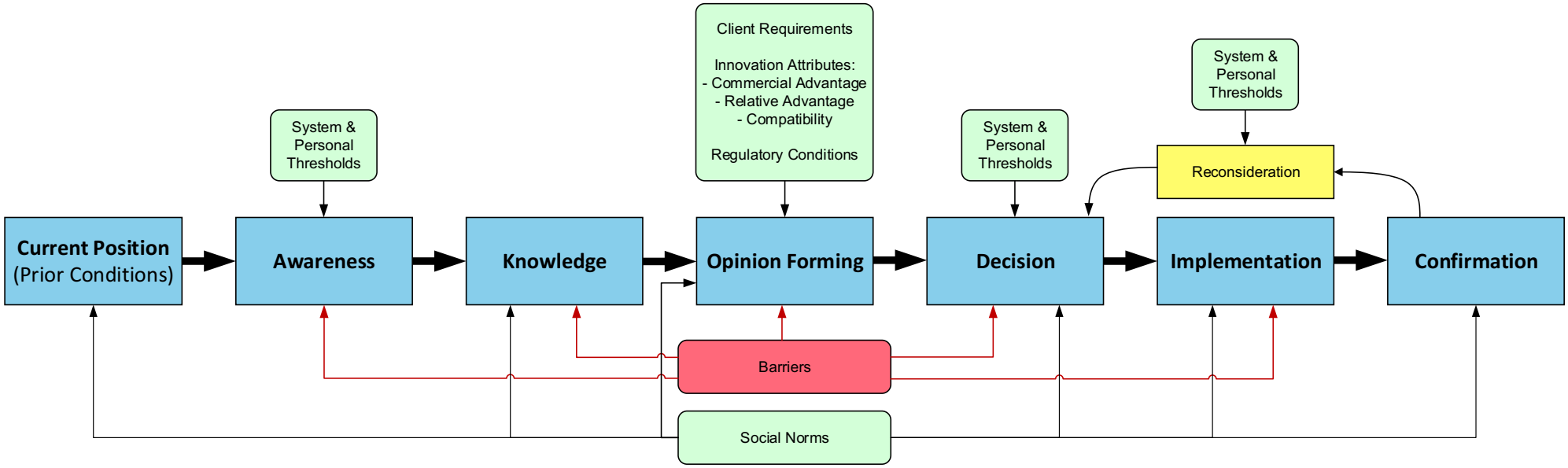


Figure 7.1 - A contextualised diffusion journey for Quantity Surveyors with regard to professional practice innovation

In addition to these areas, consideration was also given to the three diffusion concepts of Cohesion, Structural Equivalence and Thresholds. These do not specifically appear in the work of Rogers (2003) but have been embedded in other diffusion literature with authors such as Burt (1982, 1987), Valente (1995) and Larsen (2005) recognising the importance of social contagion and its influence on the diffusion process. For this particular research context, the influence of Cohesion and Structural Equivalence were not identified in the analysis and this was found to be as a direct result of the lack of communication between actors within their social system as most communication was project focused. Thresholds were found to be an influencing factor, both at a personal and system level, but only at the awareness and decision stages.

The final area of diffusion literature that was considered was that of innovation attributes. These form a crucial role in the diffusion process and have greatest influence at the opinion forming stage. This is where an actor will consider the innovation and its suitability, risks, advantages and disadvantages. It was found that the existing diffusion literature was reliant on the attributes proposed by Rogers (2003) and that little work had been done to contextualise these. It was found that although some of the classical attributes were suitable, many were not, and that some important areas were being overlooked. As such, it is proposed that the following attributes are more suitable for the current research context:

1. Relative Advantage.
2. Commercial Advantage.
3. Compatibility.

Relative advantage refers to the relevance and usefulness of an innovation, in addition to areas such as practical advantages. Commercial advantage is a new attribute and refers to any advantage, or otherwise, in terms of time, financial or service quality. Finally, compatibility needs to be considered as actors within the construction industry do not work alone, and need to consider the wider supply chain when looking to adopt an innovative professional practice.

7.2.4 Objective 4

Identify barriers to the diffusion and adoption of professional practice innovation.

The literature review identified a lack of diffusion literature that addresses failed innovations, and also the barriers to both the adoption and diffusion of innovation. Most literature focuses on the enablers of diffusion, not the barriers, and while Larsen (2005) provided the most comprehensive work to date to identify barriers to adoption, no previous authors have identified the distinction between these barriers associated with diffusion and those with adoption, or the role of passive or active rejection. These distinctions are important, as the barriers to adoption are quite different to those associated with the diffusion process and the role of the actor in the rejection needs to be known to further the understanding in this underrepresented area. The role of the actor was identified as being passive or active, and both were influenced by the actor's knowledge of the NRM and their prior conditions, which supports the development of the new model of diffusion as proposed earlier in this chapter. Passive rejection was apparent where a lack of knowledge was present, coupled with existing working practices that were embedded within the actor's organisation. Active rejection was attributed to a higher level of knowledge, in instances where an actor had more information to be able to make a more informed decision.

Barriers to the adoption of innovation were identified and discussed in chapter five. These are as follows:

- Lack of customer demand.
- Sub-contractors – issues with compatibility and knowledge.
- Time restrictions on measurement process – encourages builder's quantities.
- Wide spread use of D&B, which changes the ownership of the measurement process.
- Lack of interest from young surveyors, which leads to a lack of ability in using a standard method of measurement.
- Minimal benefits for users over current practices.
- No commercial advantage.
- Lack of knowledge of it in the wider industry.

- Existing software restrictions.
- Expense of upgrading existing software.
- Use and familiarity of current practices – "if it isn't broken, don't fix it".
- Greater opportunity for errors when using a new method.

Barriers to the diffusion process were identified separately as these are the factors that prevent the diffusion of the innovation, not disadvantages or problems with the innovation itself. Understanding this distinction is important to allow better understanding of why innovations do not diffuse within the construction industry. Diffusion barriers were identified as follows:

- A lack of communication with others about the NRM.
- Too busy with projects to look at the wider industry.
- Expense of buying the document.

These findings are also bounded by the context of this research, in particular the expense of buying the document, in this case the NRM, is unique to this study. However, the two other identified barriers are significant and this is an important area that requires further research.

7.2.5 Aim

To further understanding in the context of the diffusion of a professional practice innovation among QSs within the UK construction industry. Not only to ascertain if stages exist in this process, but also to discover if the stages proposed by Rogers (2003) are suitable for this particular context, and if a new model is required to accurately represent diffusion within these particular parameters.

The aim of this research was to develop a contextualised understanding, and it is clear from the discussion of the objectives outlined above, that this has been achieved. By limiting the research context to the role of the QS and the innovation to professional practice, in particular the NRM, a rich understanding has been achieved that has allowed the development of the existing literature base and has provided a context specific understanding of the diffusion process among QSs. Importantly, this has

resulted in several original contributions to knowledge and this will be identified for clarity later in this chapter.

It is hoped that by undertaking this research journey and development of this contextualised understanding will lead to further research in this underdeveloped area within the diffusion landscape, both by the author and other researchers within the construction management field.

7.3 Contributions to Knowledge

The completion of this thesis has resulted in several original contributions to knowledge. Each will now be identified and discussed.

7.3.1 Existing measurement practices

This thesis has identified current measurement practices among QSs engaged in the UK construction industry. Contemporary texts only describe the measurement practices that are used in the industry and there is a need for a greater understanding of current practice. This research has shown that the predominant method for measurement is builder's quantities, based loosely around older methods of measurement, such as SMM7. In addition, this research has highlighted the significant differences in practice between the PQS and CQS. These findings are bounded within the research sample and do not attempt to generalise across a wider population, but anecdotal evidence from the authors own experiences suggest that these findings are credible.

7.3.2 Contextualised diffusion journey

The main contribution of this research is the development of the contextualised understanding of the diffusion process among QSs in the UK construction industry. By developing this improved understanding, several areas have been developed that add to the existing diffusion theory landscape, and therefore supports the coherentist epistemological position adopted. The context in which this research has been undertaken is unique within the diffusion field, as the research has been based entirely on the QS profession as a specific social system within the wider UK construction industry. The use of a professional practice innovation, the NRM, has allowed a detailed discussion to take place with respondents about their individual diffusion journeys that

are actual accounts rather than discussions around existing theory. These discussions have been analysed and key themes have been identified to develop the model. This has direct implications on the QS profession in terms of understanding the specific social system structure, communication channels, areas of influence and also barriers that aid or impede diffusion.

The development of the model has identified several new aspects to the Rogers (2003) classical diffusion journey, and has highlighted the importance of the prior conditions and awareness stages. The most significant contribution of this research is the development and presentation of the contextualised diffusion journey model which can be seen in Figure 7.1.

The importance of the actors' current position when commencing a diffusion journey is of particular importance to the QS, especially when considering the NRM as in this study. The use of previous methods of measurement and the integration of this into the actors existing working practices has been found to be one of the main contributors to the lack of adoption of the NRM. It is therefore crucial to consider this when thinking about the diffusion process.

In addition, the introduction of the awareness stage is also important as it has been shown in this study that awareness and knowledge are quite distinct, and that one does not necessarily lead to the other. Many respondents were aware of the NRM but had very poor knowledge of it, which has also impeded the diffusion process. This gap between awareness and knowledge was attributed to a lack of marketing from the RICS and also due to a lack of time or inclination from respondents to actively find out more about the NRM. This mirrors the authors own experiences and was one of the main reasons for the choice and commencement of this research, so the findings have been particularly interesting to discover.

Further to the additional stages identified, other impacting factors have been incorporated into the model, specifically the influence of system and personal thresholds. These have not been directly considered by Rogers (2003) and although their positioning along the diffusion process timeline was proposed by Larsen (2005), the finding of this research have shown that thresholds do play an important role and

need to be included in any model, but that they have an influence at different stages to those proposed by Larsen (2005). This can be attributed to the specific context under investigation in this research.

Also, the influence of the various barriers to the diffusion and adoption process have been identified and included in the model. These form a separate contribution to knowledge and are discussed separately.

Finally, the various influences at the opinion forming stage have been identified, and in addition to developing Rogers (2003) innovation attributes, see discussion below for more details on these, it has been found that additional influences need to be considered at this stage in the journey. Clients requirements were universally seen to be a serious consideration at this stage, because the client is ultimately driving the construction process and can make demands where they see fit. In this case, the client can be the purchaser of the construction works, or the main contractor sub-contracting, but either way it is the person who is requesting the works who can have a significant influence on the various decisions that the supply chain has to then comply with. This position is not unique to the construction industry, but it is clear why this type of influence would be missing from Rogers (2003) more generalised diffusion model. The impact of regulatory conditions was also found to be influential at this stage, as the RICS is the main professional body that represents QSs in the UK and they had made the NRM a part of their guidance notes documentation. This was enough of an incentive for some of the PQS respondents to adopt the NRM above all others, and therefore this is another significant factor to be included within any contextualised model.

Overall the proposed model represents a new contextualised understanding of the diffusion process for the QS profession and has considered the actors journey from their current position, through the awareness stage all the way to confirmation. This forms an important addition to the existing diffusion landscape as it highlights the need for contextualisation and also furthers the existing understanding of the QS profession as social actors and how we interact when considering innovative professional practice such as the NRM.

7.3.3 Innovation Attributes

The identification of the innovation attributes is a contribution to knowledge as they influence the opinion forming stage of the diffusion journey, and these attributes are unique to this study in this context. Rogers (2003) attributes are more generalised and miss the importance of context, especially with regard to commercial advantage which is a proposed new attribute. In addition, several of the classical innovation attributes have been discounted as they are not deemed relevant within the context of this study.

7.3.4 Diffusion concepts

Few authors have discussed the diffusion concepts in recent years, with the exception being Larsen (2005). This research has shown very different findings to those of Larsen (2005), which can be attributed to both the research context and methods. The findings have shown that communication between actors is very poor, and that this limits the applicability of the concepts of Cohesion and Structural Equivalence, both of which rely on communication channels as part of the social contagion theories. This research did find evidence to support the Threshold concept and identified that this has influence at the awareness and decision stages. The inclusion of these findings into the diffusion journey model is a unique addition to the classical Rogers (2003) model and is an important contribution as the influence of thresholds can be significant, with many respondents reporting that it would be the relative weight of other using the NRM that would make them reconsider their decision.

7.3.5 Rejection and barriers

An area of diffusion research that has very little representation is that concerned with rejected innovations. Although not known at the beginning of this research process, this research has identified an innovation that has failed to diffuse and has identified the barriers associated with this failure, both from an adoption perspective and also a diffusion perspective. In addition, this research has highlighted that rejection can be either passive or active, and that this is influenced by several factors including an actor's knowledge of an innovation. These findings are important to address the perceived lack of innovation adoption within the construction industry and will help to make QSs aware of the various factors that can hinder and even prevent innovations from diffusing.

7.4 Impact on Practice

The introduction to this thesis made the following statement:

> *If innovation is to solve the perceived problems associated with the construction industry, any new products or services will need to be utilised by the industry and more importantly the people working in the industry. The process by which an innovation is introduced to, and then adopted by, members of a social system is called diffusion.*

What this research has found is that the journey a QS goes through when faced with new professional practice is different to that proposed in the classical diffusion literature. This improved understanding will now allow those in the QS profession to understand the journey that they may go through and also the various influencing factors such as their prior conditions, social norms and the various barriers to diffusion and adoption. It is hoped that this research can be used to at least make the QS profession more aware of its inherent social norms, and how these can have such a negative impact on the diffusion of innovation, but also make them aware that although the industry is deemed fragmented with temporary relationships, there is still an overwhelming sense that all of those interviewed are striving to be the best they can be in their chosen profession, and that sometimes it really is a case of 'better the devil you know', and that adopting an innovation may not be the best thing to do at that particular point in time.

What is clear from the findings is that there are many different practices being used by the QS in terms of quantification, but that universally the most significant factors are commercial considerations, both in terms of the cost benefits, but also those associated with the supply chain, and the working relationships that make up the industry itself. This awareness of the commercial social systems that makes up the UK construction industry is a key factor to the continued success of the industry, and while it may restrict innovative practice it is clear that those in the industry know how to get the best out of their current circumstances, and most importantly are willing to consider and embrace change if they see a need for it.

This research has also highlighted weaknesses in the communication of the NRM by the RICS to QSs working in the UK construction industry, particularly at the awareness stage of the diffusion process. This is seen as a serious issue that has negatively impacted on the diffusion of the NRM, and this is from the professional body who developed and publish the NRM.

7.5 Research Limitations

No research is without limitations, so it is important to recognise any so that the research can be considered within its current form and future researchers can learn from these.

7.5.1 Context

This research was undertaken within a limited social context, namely the QS profession. This suited the purposes of the research in achieving the aim and objectives, and also allowed a richer understanding of the diffusion process within this social system than would have been feasible had a broader context, such as the entire construction industry, been used.

The use of a professional practice innovation was to allow this research to consider a type of innovation that has received very little attention in the diffusion literature, as most have focused on products and processes. However, this research focused on one sole professional practice innovation, the NRM, and therefore this also narrows the context of this research. The constructivist position adopted and the coherentist epistemological considerations support this approach and justify the nature of this investigation, but this is still seen as a limitation that others could address in the future by exploring different innovations or different social systems.

7.5.2 Generalisation of findings

This research set out to develop a contextualised understanding, which has been achieved, but the understanding is bounded by the research context as discussed above, and as such the generalisability of the findings is not relevant. This research made no attempt to generalise across the wider population, but rather explore an

underrepresented area of diffusion research. Therefore, the lack of generalisation is not seen as a limitation in terms of the quality or need of this research, but rather a limitation on how far its findings can be seen across a wider population.

7.6 Areas for future research

Given the limitations outlined above, there are several areas of further research that have become apparent during this study. These are exciting developments and will allow this underdeveloped area of diffusion research to continue into the future.

7.6.1 Measurement Practices

The importance of measurement within the industry is not under question, but the future of a standard method is, and this research has shown that very few have adopted the NRM. Further research is required in this area to gain a broader picture of the use of builder's quantities, the lack of adoption of NRM and any other current practices.

7.6.2 Awareness

The awareness stage of the diffusion process is clear and has been discussed at length in this research. But the actual methods of awareness and transmission of innovative messages needs further consideration. Are QSs more susceptible to certain communication methods, and which are the most appropriate given the industry and its structure?

7.6.3 Attributes

The innovation attributes have been contextualised, but no attempt has been made to rank them in order of importance or influence. The attributes identified are also specific to professional practice innovation in this research context, so further research is required to ascertain if these translate to product and process innovations.

7.6.4 Innovativeness

One area that was not considered in this research was the relative innovativeness of the QS respondents. This was outside the scope of this research but is another interesting

area that is underdeveloped, not only in the construction literature but the wider diffusion literature as well. Further work could include a comparison against other industries and consideration of the relative barriers and facilitators of innovativeness.

7.6.5 Rejection of innovation

This research has identified several important aspects regarding the rejection of an innovation, but this requires further research to fully appreciate the rejection of innovations and the barriers of adoption and diffusion. This could be a specific research topic in its own right, and is one that needs more exploration.

7.6.6 Social Network Analysis

This research has not attempted to undertake any form of social network analysis, but the later work of Larsen (2011) is showing promise in this under researched area. Further research is required to fully realise the potential of social network analysis.

References

6, P., and BELLAMY, C. (2012). **Principles of Methodology**. London: Sage.

ALBRECHT, T., and ROPP, V (1984) Communicating about innovation in networks of three U.S. organisations. **Journal of Communication**. 34 (summer), pp.79-91.

ANDERSON, J., and JAY, S. (1985). The Diffusion of Medical Technology: Social Network Analysis and Policy Research. **The Sociological Quarterly.** 26 (1), pp.49-64.

ARDITI, D., KALE, S and TANGKAR, M. (1997). Innovation in construction equipment and its flow into the construction industry. **Journal of Construction Engineering and Management.** 123 (4), pp.371-378

ASHWORTH, A., HOGG, K., HIGGS, C. (2013). **Willis's Practice and Procedure for the Quantity Surveyor**. 13th Edition., West Sussex: Wiley-Blackwell.

BANWELL, H. (1964). **The Placing and Management of Contracts for Building and Civil Engineering Work.** London: HMSO.

BARRETT, P. (2008). **Revaluing Construction**. Oxford: Blackwell Publishing

BASS, F. (1969). A New Product Growth Model for Consumer Durables. **Management Science**. (15), pp.215-227.

BASS, F., TRICHY, K., and DIPAK, J. (1994). Why the Bass Model Fits Without Decision Variables. **Marketing Science**. 13 (3), pp.203-223

BAZELEY, P., and JACKSON, K. (2013). **Qualitative Data Analysis with NVIVO.** London: Sage.

BIJKER, W., and LAW, J. (2000). **Shaping Technology/Building Society: Studies in Sociotechnical Change**. London: MIT Press.

BLAYSE, A., and MANLEY, K. (2004). Key Influences on Construction Innovation. **Construction Innovation**. (4), pp.143-154.

BOURDEAU, M. (2014). Auguste Comte. **The Stanford Encyclopedia of Philosophy** (Spring 2014 Edition). ZALTA, E., ed. Available at http://plato.stanford.edu/archives/spr2014/entries/comte/ [Accessed 23 May 2014].

BRESNEN, M., and MARSHALL, N. (2001). Understanding the Diffusion and Application of New Management Ideas in Construction. **Engineering, Construction and Architectural Management**. 8 (5/6), pp.335-345.

BRINGER, J., JOHNSTON, L., and BRAKENRIDGE, C. (2004). Maximising transparency in a doctoral thesis: the complexities of writing about the use of QSR NVivo within a grounded theory study. **Qualitative Research**. 4, (2), pp.247-265.

BRYMAN, A. (2008). **Social Research Methods**. Third Edition. Oxford: Oxford University Press.

BRYMAN, A., and Bell, E. (2011). **Business Research Methods**. Third Edition. Oxford: Oxford University Press.

BUILDING (2009). OFT Press Release: **Construction firms fined for illegal bid-rigging.** Available at: http://www.building.co.uk/oft-press-release-construction-firms-fined-for-illegal-bid-rigging/3149231.article [Accessed 23rd October 2015].

BURREL, G., and MORGAN, G. (1979). **Sociological Paradigms and Organisational Analysis.** London: Heineman.

BURT, R (1982) **Towards a Structural Theory of Action**: Network Models of Social Structure. New York: Academic Press.

BURT, R (1987). Social contagion and innovation: Cohesion versus Structural Equivalence. **American Journal of Sociology**. 92, pp.1287-1335

CARTLIDGE, D. 2011. **New Aspects of Quantity Surveying Practice**. Oxon: Spon Press.

CARTLIDGE, D. (2013a). **Estimators Pocket Book**. Oxon: Routledge.

CARTLIDGE, D. (2013b). **Quantity Surveyors Pocket Book**. Second Edition. Oxon: Routledge.

CHATTERJEE, R., and ELIASHBERG, J. (1990). The Innovation Diffusion Process in a Hetrogeneous Population: A Micromodeling Approach. **Management Science.** 36 (9), pp.1057-1079.

COLEMAN, J., KATZ, E., and MENZEL, H. (1966). **Medical innovation: A Diffusion Study.** New York: Bobbs-Merill.

CORBIN, J., and STRAUSS, A. (1990) **Basics of Qualitative Research: Grounded Theory Procedures and Techniques**. Newbury Park, CA: Sage.

CORBIN, J., and STRAUSS, A. (2008). **Basics of Qualitative Research**. Third Edition. London: Sage.

CRESWELL, J. (2014). **Research Design. Qualitative, Quantitative & Mixed Methods approaches**. Fourth Edition. London: Sage.

CRIPPS, A. (2003). Why isn't construction more innovative? In: ANUMBA, C J (ed), **Innovative Developments in Architecture, Engineering and Construction,** Loughborough: Millpress pp.515-524.

DAINTY, A. (2008). Methodological Pluralism in Construction Management Research. In: KNIGHT, A., and RUDDOCK, L., eds. **Advanced Research Methods in the Built Environment**. Oxford: Wiley-Blackwell, pp 1-12.

DENSCOMBE, M. (2010). **The Good Research Guide for Small Scale Social Research Projects.** Fourth Edition. Berkshire: McGraw-Hill.

DENZIN, N.K., and LINCOLN, Y.S. (2005) 'Introduction: The Discipline and Practice of Qualitative Research.' In: N.K. DENZIN and Y.S. LINCOLN (eds.) **The Sage Handbook of Qualitative Research. 3rd ed**. London: Sage Publications Limited, pp. 1-32.

DUBOIS, A., and GADDE, L. (2002). The construction industry as a loosely coupled system: implications for productivity and innovation. **Construction management and Economics**. 20, pp.621-631.

EGAN, J. (1998). **Rethinking Construction**. Report for the Construction Task Force on the Scope for Improving the Quality and Efficiency of UK Construction, Department of the Environment, transport and the Regions, London.

EMMITT, S. (1997). **The diffusion of innovations in the building industry**. PhD. Faculty of Arts, Manchester University.

FELLOWS, R., and LIU, A. (2008). **Research Methods for Construction**. Oxford : Wiley-Blackwell.

FLIEGEL, F., and KILVIN, J. (1966) Attributes of Innovations as Factors in Diffusion. **American Journal of Sociology.** 72 (3), pp.235-248.

FRIEDKIN, N (1984). Structural Cohesion and Equivalence Explanations of Social Homogeneity. **Sociological Methods and Research**. 12 (3), pp.235-261.

FORTUNE, C., and SKITMORE, M. (1994). Quantification skills in the construction industry. **Construction Management and Economics.** 12, pp.79-88.

GAMBATESE, J., and HALLOWELL, M. (2011a). Factors that influence the development and diffusion of technical innovations in the construction industry. **Construction Management and Economics.** 29 (5), pp.507-517.

GAMBATESE, J., and HALLOWELL, M. (2011b). Enabling and measuring innovation in the construction industry. **Construction Management and Economics.** 29 (6), pp.553-567.

GETTIER, E. (1963). Is Justified True Belief Knowledge? **Analysis**. Oxford University Press. 23 (6), pp. 121-123

GLASER, B., (2003). **The grounded theory perspective II: descriptions remodeling of grounded theory methodology.** Sociology Press.

GLASER, B., and STRAUSS, A. (1967). **The Discovery of Grounded Theory. Strategies for Qualitative Research**. New York: Aldine Publishing.

GOULDING, C. (2002). **Grounded Theory : A Practical Guide for Management, Business and Market Researchers**. London : SAGE

GRANOVETTER, M (1973). The Strength of Weak Ties. **American Journal of Sociology**. 78, pp.1360-1380.

GRANOVETTER, M (1978). Threshold Models of Collective Behaviour. **American Journal of Sociology.** 9, pp.165-179.

GUYER, P. (2004). Kant, Immanuel. In CRAIG, E., ed. **Routledge Encyclopedia of Philosophy**. London: Routledge. Available at:, from: http://www.rep.routledge.com/article/DB047. [Accessed 23 May 2014]

HAIGH, R. (2008). Interviews: A Negotiated Partnership. In: KNIGHT, A., and RUDDOCK, L, eds. **Advanced Research Methods in the Built Environment**. Oxford: Wiley-Blackwell, 2008, pp 111-120.

HARKOLA, J. (1995). **Diffusion of Construction Technology: in a Japanese firm**. PhD. Department of Civil Engineering, Stanford University.

HARTY, C. (2008). Implementing Innovation in Construction: Contexts, Relative Boundedness and actor-network Theory. **Construction Management and Economics**. 26 (10), pp.1029-1041.

HATCH, J. A. (2002). **Doing Qualitative Research in Educational Settings**. Albany: State University of New York Press.

HASSINGER, E. (1959). Stages in the adoption Process. **Rural Sociology**. 24. pp.52-53.

HAWTHORNE, J. (2014). Inductive Logic. **The Stanford Encyclopedia of Philosophy** (Winter 2014 Edition). ZALTA, E., ed. Available at: http://plato.stanford.edu/archives/win2014/entries/logic-inductive/ [Accessed 6th February 2015].

HM GOVERNMENT. (2012). **Mid-Sized Businesses**. Available at: https://www.gov.uk/government/collections/mid-sized-businesses [Accessed 6th April 2016].

HM GOVERNMENT. (2013). **Construction 2025**. Industrial Strategy: Government and Industry in Partnership. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/210099/bis-13-955-construction-2025-industrial-strategy.pdf [Accessed 4th April 2016].

HUGHES, J., and SHARROCK, W. (1997). **The Philosophy of Social Research**. Third Edition. Harlow: Pearson.

IACOBUCCI, D (1996). Review of Network Models of the Diffusion of Innovations. **Journal of Marketing.** 60 (3), pp.134-135.

ICAEW. (2016). **Companies Act 2006 and related regulations: major accounting changes**. Available at: http://www.icaew.com/en/technical/financial-reporting/other-reporting-issues/companies-act/companies-act-2006-and-related-regulations-major-accounting-changes-156108 [Accessed 6th April 2016].

JOHNSON, J. (1986). Social Networks and Innovation Adoption: A Look at Burt's use of Structural Equivalence. **Social Networks.** (8), pp.343-364.

JOHNSTON, L. (2006). Software and Method: Reflections on teaching and using QSR NVivo in Doctoral Research. **International Journal of Social Research Methodology**. 9 (5), pp.379-391.

JONES, M., and SAAD, M. (2003). **Managing Innovation in Construction**. London: Thomas Telford.

KALE, S., and ARDITI, D. (2010) Innovation Diffusion Modelling in the Construction Industry. **Journal of Construction Engineering and Management.** March. pp.329-340.

KATZ, E. (1961). The Social Itinerary of Technical Change: Two Studies on the Diffusion of Innovation. **Human Organisation**. 20. pp.70-82. Cited in Rogers (2003)

KATZ, E., and LAZARSFELD, F. (1964). **Personal Influence**. New York: The Free Press.

KATZ, E. (1999). Theorizing Diffusion: Tarde and Sorkin Revisited. The Annals. 556. Pp.144-155

SUNG HO, K., (2012). Max Weber. In ZALTA, E., ed. **The Stanford Encyclopedia of Philosophy** (Fall 2012 Edition). Available at: http://plato.stanford.edu/archives/fall2012/entries/weber/ [Accessed May 23 2014]

KING, A. (2008). Using Software to Analyse Qualitative Data. In: KNIGHT, A., and RUDDOCK, L, eds. **Advanced Research Methods in the Built Environment**. Oxford: Wiley-Blackwell, 2008, pp 135-141.

KINGS, S. (2002). **Pricing Documentation for Contractors' Estimators: Establishing a more Effective Approach**. PhD Thesis. Nottingham Trent University 2002.

KNIGHT, A., and TURNBULL. (2008). Epistemology. In: KNIGHT, A., and RUDDOCK, L, eds. **Advanced Research Methods in the Built Environment**. Oxford: Wiley-Blackwell, 2008, pp 64-73.

KNIGHT, A., and RUDDOCK, L., eds. (2008). **Advanced Research Methods in the Built Environment**. Oxford: Wiley-Blackwell.

KODIKARA, G., THORPE, A., and McCaffer, R. (1993). The use of Bills of Quantities in building contractor organisations. **Construction Management and Economics.** 11, pp.261-269.

KOSKELA, L., and VRIJHOEF, R. (2001). Is the Current Theory of Construction a Hindrance to Innovation? **Building Research and Information**. 29 (3), pp.197-207.

KRAMER, D., BIGELOW, P., ENZO GARRITANO, P., CARLAN, N., and WELLS, R. (2009). Spreading Good Ideas: A Case Study of the Adoption of an Innovation in the Construction Sector. **Applied Ergonomics**. 40, pp.826-832.

KVALE, S. (1996) **Interviews: An introduction to Qualitative Research Interviewing.** Thousand Oaks CA: Sage.

LARSEN, G. (2005). **A Polymorphic Framework for Understanding the Diffusion of Innovations.** PhD thesis. School of Construction Management and Engineering. University of Reading.

LARSEN, G., and BALLAL, T. M. A. (2005). The diffusion of innovations within a UKCI context: An explanatory framework. **Construction Management and Economics**. 23 (1), pp.81-91.

LARSEN, G. (2011). Understanding the Early Stages of the Innovation Diffusion process: Awareness, Influence and Communication Networks. **Construction Management and Economics.** 29 (10), pp.987-1002.

LATHAM, M. (1994). **Constructing the Team**. Final Report of the Joint Government/Industry Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry. London: HMSO

LAZARSFELD, P., BERELSON., and GAUDET. (1968). **The Peoples Choice: How the Voter Makes Up His Mind in a Presidential Election.** New York: Columbia University Press.

LAZARSFELD, P., and MERTON, R. (1964). Friendship as Social Process: A Substantive and Methodological Analysis. In: Berger *et al*. eds. **Freedom and Control in Modern Society**. New York: Octagon.

LEE, S., TRENCH, W., and WILLIS, A (2011). **Willis's Elements of Quantity Surveying**. 11th Edition. West Sussex: Wiley-Blackwell.

LING, F. (2003). Managing the implementation of construction innovations. **Construction Management and Economics.** 21 (9), pp.635-649.

MAHAJAN, V., and PETERSON, R. (1985). **Models for Innovation Diffusion**. Sage University paper on Quantitative Applications in the Social Sciences. London: Sage.

MAKSE, T., and VOLDEN, C. (2011). The Role of Policy Attributes in the Diffusion of Innovations. **The Journal of Politics.** 73 (1), pp.108-124.

MARSDEN, P., and PODOLNY, J (1990). Dynamic analysis of network diffusion processes. In: Flap, H, eds., **Social Networks Through Time**. Utrecht: ISOR.

MARSHALL, C., and ROSSMAN, G. (2011). **Designing Qualitative Research**. London : SAGE.

MENZEL, H., and KATZ, E. (1955). Social relations and innovation in the medical profession: The epidemiology of a new drug. **Public Opinion Quarterly**. 19, pp.337-352.

MILES, M., HUBERMAN, A. and SALDANA, J. (2013) **Qualitative Data Analysis.** Third Edition. Thousand Oaks, CA: Sage.

MILES, N and HUBERMAN, A. (2002). **The Qualitative Researchers Companion.** Thousand Oaks, CA: Sage.

MITROPOULOS, P., and TATUM, C. (2000). Forces Driving Adoption of New Information Technologies. **Journal of Construction Engineering and Management.** Sept/Oct, pp.340-348.

MOORE, G., and BENBASAT, I. (1991). Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. **Information Systems Research.** 2 (3) pp.192-222.

MOSES, J., and KNUTSEN, T. (2012). **Ways of Knowing. Competing methodologies in Social and Political Research**. Second Edition. Hampshire: Palgrave MacMillan.

NAM, C., and TATUM, C. (1997). Leaders and Champions for Construction Innovation. **Construction Management and Economics**. 15, pp.259-270.

NAOUM, S.G. (2007). **Dissertation Research & Writing for Construction Students**. New York: Routledge.

ONS [Office for National Statistics]. (2015). **Construction Statistics - No. 16, 2015 Edition.** Available at: https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/constructionstatisticsannualtables [Accessed 4th April 2016]

OSTROWSKI, S. (2013). **Measurement Using the New Rules of Measurement**. Oxford: Wiley-Blackwell.

PEANSUPAP, V., and WALKER, D. (2006). Innovation Diffusion at the Implementation Stage of a Construction Project: A Case Study of Information Communication Technology. **Construction Management and Economics.** 24 (3), pp.321-332.

PRIES, F., and JANSZEN, F. (1995). Innovation in the Construction Industry: The Dominant Role of the Environment. **Construction Management and Economics.** 13, pp.43-51.

PRITCHARD, D. (2006). **What is this thing called knowledge?** Oxon: Routledge.

PUNCH, K. (2014). **Introduction to Social Research: Quantitative and Qualitative Approaches.** London: Sage.

REICHSTEIN, T., SALTER, A., and GANN, D. (2005). Last Among Equals: A Comparison of Innovation in Construction, Services and Manufacturing in the UK. **Construction Management and Economics**. 23 (6), pp.631-644.

RICHARDS, L. (2015). **Handling Qualitative Data: A practical guide**. Third Edition. London: Sage.

RICS (2010). **Contracts in Use Survey. A survey of building contracts in use during 2007.** London: RICS.

RICS (2013). **Contracts in Use Survey. A survey of building contracts in use during 2010.** London: RICS.

RICS (2013a). **Construction Sectors and roles for chartered quantity surveyors.** 1st Edition. RICS professional information. London: RICS.

RICS (2013b). **Assessment of professional Competence Quantity Surveying and Construction. Pathway Guide.** London: RICS.

RICS (2013c). **Developing a Construction Procurement Strategy and Selecting and Appropriate Route.** 1st Edition. RICS Professional Guidance. London: RICS.

RICS (2013d). **RICS New Rules of measurement (NRM2). Detailed Measurement for building works.** 1st Edition. London: RICS.

RITZER, G. (2000). **Sociological Theory,** 5th Edition. McGraw-Hill Higher Education.

ROGERS, E., and SHOEMAKER, F. (1971). **Communication of Innovations: A cross Cultural Approach.** New York: Free Press.

ROGERS, E., ASHCROFT, J., and ROLING, N. (1970). **Diffusion of Innovations in Brazil, Nigeria and India**. East Lansing, Michigan State University, Department of Communication, Diffusion of Innovations Research Report 24.

ROGERS, E., and KINCAID. (1981). **Communication Networks: Towards a New paradigm for Research**. New York: Free Press.

ROGERS, E. (1962). **Diffusion of Innovations.** Free Press: New York.

ROGERS, E. (1995). **Diffusion of Innovations.** Fourth edition. Free Press: New York.

ROGERS, E. (2003). **Diffusion of Innovations,** fifth edition. Free Press: New York.

ROSE, T., and MANLEY, K. (2012). **Measurement constructs to explore innovation diffusion in construction.** RICS COBRA, Las Vegas, Nevada USA. 11-13th September 2012.

ROSE, T., and MANLEY, K. (2014). Revisiting the adoption of innovative products on Australian road infrastructure projects. **Construction Management and Economics**. 32 (9), pp.904-917.

SAILER, L. (1978) Structural Equivalence: Meaning and Definition, Computation and Application. **Social Networks** (1), pp.73-90.

SALDANA, J. (2009). **The Coding Manual for Qualitative Researchers.** London, Sage.

SAUNDERS, M., LEWIS, P., and THORNHILL, A. (2009). **Research methods for business students**. 5th Edition. Essex: Pearson Education.

SCHWANDT, T. (2007). **The Sage Dictionary of Qualitative Inquiry.** (Third Edition). Thousand Oaks, CA: Sage.

SEELY, I., and WINFIELD, R. (1999). **Building Quantities Explained.** 5th Edition. Hampshire: Palgrave.

SEXTON, M., BARRETT, P., MIOZZO, M., WHATON, A., and LEHO, E. (2001). Innovation in Small Construction Firms: Is it just a Frame of Mind. In: Hughes, W, ed. **17th ARCOM Conference**, Salford University. ARCOM.

SEXTON, M., and LU, S. (2009). **Innovation in small professional practices in the built environment.** Chichester: Wiley Blackwell.

SHEFFER, D., and LEVITT, R. (2010). How Industry Structure Retards Diffusion of Innovations in Construction: Challenges and Opportunities. **Collaboratory for Research on Global Projects.** Working Paper 59.

SILVERMAN, D. (2013). **Doing Qualitative Research**. London: Sage.

SKITMORE, M., and WILCOCK, J. (1994). Estimating processes of smaller builders. **Construction Management and Economics**. 12, pp.139-154.

SLAUGHTER, S. (1998). Models of Construction Innovation. **Journal of Construction Engineering and Management.** May/June. pp.226-231.

SLAUGHTER, S. (2000). Implementation of Construction Innovations. **Building Research and Information.** 28 (1), pp.2-17.

SONGIP, A., LAU, B., JUSOFF, K., and RAMLI, H. (2013). A Working Integrated Model for the Diffusion of Construction Innovation. **American Journal of Applied Sciences**. 10 (2), pp.147-158.

STRAUSS, A. (1987). **Qualitative Analysis for Social Scientists.** Cambridge: Cambridge University Press.

TICHY, N., TUSHMAN, M., and FOMBRUN, C. (1979). Social Network Analysis for organisations. **Academy of Management Review**. 4 (4), pp.507-519.

TORNATZKY, L B., and FLEISHER, M. (1990). **The process of technological innovation.** Lexington: Lexington Books.

TOWEY, D. 2012. **Construction Quantity Surveying. A practical guide for the contractor's QS.** West Sussex: Wiley-Blackwell.

VALENTE, T. (1995). **Network models of the diffusion of innovations**. New Jersey: Hampton Press.

VALENTE, T. (1999). Accelerating the diffusion of innovations using opinion leaders. **Annals of the American Academy of Political and Social Science**. 566 (1) pg:55.

WOLFE, R. (1994). Organisational Innovation: Review, Critique and Suggested Research. **Journal of management Studies**. 31 (3), pp.405.

YUCEL, G., and DAALEN, C. (2011). Exploratory Analysis of the Impact of Information Dynamics on Innovation Diffusion. **Technological Forecasting & Social Change.** 78, pp.358-372.

Appendix A – Interview Guide

Interview Details:

Interviewer: Anthony Ward, Nottingham Trent University

Interviewee:

Permission to record:

Date/Time:

Setting:

Anonymous in thesis?:

Interview Structure (Rev C)

Section A - Prior Conditions

1. Type of company – QS, Contractor, Sub-contractor etc.
2. Size of company – workforce, turnover, etc.
3. Type of projects most commonly encountered?
4. Typical value?
5. Most commonly used procurement routes?
6. Individual information – Role, membership of professional bodies, qualifications?

PQS Current practice - Measurement

7. Do you produce BQ's for tendering purposes?
8. If so, do these BQ's follow a standard method?
9. If not, how do you send out tenders? CSA?
10. Current measurement practice – NRM1? NRM2? SMM7? Adapted SMM7? Internal rules?
11. How long have you used this method?
12. Do you request measured quantities from contractors? If so, do you specify the format?

Contractors Current Practice - Measurement

6. Do you receive any BQ's for tendering? If so what is the most common format?
7. Do you produce BQ's for subcontractor enquiries?
8. What methods do you use for in house estimating? NRM2 etc.
9. Do these follow a standard method?
10. How long have you used this method?

ADOPTED NRM2

Section B - Innovation – decision process

Q1 - Prior conditions

a. Having adopted NRM2, did you feel a need for a new standard method before you became aware of the NRM2?

Q2 - Knowledge

a. How did you **first** become aware of NRM2?
   - Email
   - Internet
   - Social media
   - Conference
   - Word of mouth
   - Direct mail from RICS
   - Observing other professionals

b. When was this? Roughly?

c. Once you became aware of its existence, how did this alter your perception of the need for new rules? (relate back to previous question about felt needs and the individuals answer)

Q3 - Persuasion (finding out more, reducing risks, forming attitudes)

a. Did you seek any further information about NRM2 from anywhere? If so where? What type of information?

b. Did you attempt to discover what other equivalent professionals were using?

c. Any attempt to identify how many others had already adopted?

d. Did this further information assist in the persuasion stage? How? Why?

e. If part of an organisation, was the NRM2 discussed at meetings? Was a common attitude towards adoption formed?

Q4 - Decision (activities that lead to choice)

a. Did you trial NRM2 on any projects before adoption? How?
b. Did you observe any other users of NRM2 before adoption? How?
c. Can you identify any specific trigger that led to adoption?
d. Was this due mainly to levels of exposure or the relative 'weight' of the trigger?
e. In your opinion, which would you say influenced your decision most - face to face contact, other distant professionals or the collective number of existing adopters? None of these?
f. Was this a collective or authority led decision?

Q5 - Implementation

a. How many projects have you used NRM2 on? Roughly?
b. Did you encounter any resistance to its implementation?
c. Have you had to have (or provide) any additional training?
d. Was it difficult to find time to implement?
e. Have the RICS assisted in this process?
f. How has this decision been received within the company/practice?

Q6 - Confirmation

a. Would you say that NRM2 is now fully adopted for use on all future projects?
b. Has it offered any commercial benefit?
c. Have you encountered any issues using NRM2 from other parties?
d. Do you think you will continue to use NRM2?
e. Any unexpected consequences?

Section C (Adopted) - Innovation attributes

Q1 - Relative advantage

a. Do you think NRM2 offers any advantages over your previous practice?
b. If so, in any particular area?
c. Why? Examples?

Q2 - Compatibility

a. How different do you consider NRM2 to your previous practice?
b. Is it compatible with your existing practices and procedures?
c. Compatibility with other companies/supply chain?

Q3 - Complexity

a. Do you consider NRM2 as difficult to understand?
b. Difficult to use?
c. Too complex for your specific requirements?
d. Do you consider additional training as being required before adoption due to complexity?

Q4 - Trialability

a. Did you trial NRM? How?
b. Is this even possible on this type of innovation in construction?
    - Time constraints?

Q5 - Observability

a. Have you seen NRM2 in use by any other practice/individual/project?
b. How possible is this type of observation in construction?
c. Have you heard any reports on the use of NRM2? How?

NOT ADOPTED NRM2

Section B - Innovation – decision process

Q1 - Prior conditions

a. Having not adopted NRM2, do you feel that there is a need for a new standard method in the wider industry?

Q2 - Knowledge

a. Are you aware of NRM2 – i.e. did you know it exists before this interview?
b. If so, how did you **first** become aware of NRM2?
    - Email
    - Internet
    - Social media
    - Conference
    - Word of mouth
    - Direct mail from RICS
    - Observing other professionals
c. When was this? Roughly?

Q3 - Persuasion (finding out more, reducing risks, forming attitudes)

a. Did you seek any further information about NRM2 from anywhere? If so where? What type of information?
b. Did you attempt to discover what other equivalent professionals were using?
c. Any attempt to identify how many others had already adopted?
d. Did this further information assist in the persuasion stage? How? Why?
e. If part of an organisation, was the NRM2 discussed at meetings? Was a common attitude towards rejection formed?

Q4 - Decision (activities that lead to choice)

a. Did you trial NRM2 on any projects before rejection? How?
b. Did you observe any other users before rejection? How?
c. Can you identify any specific trigger that led to rejection?
    - commercial advantage?
    - Time constraints?
d. In your opinion, which would you say influenced your decision most - face to face contact, other distant professionals or the collective number of existing adopters? None of these?
e. Was this a collective or authority led decision?

Q5 - Implementation

- Not applicable if not adopted…..unless they have implemented and then rejected.

Q6 - Confirmation

a. Do you think you might reconsider NRM2 in the future?
b. If so what might trigger this reconsideration?
    - Influence from clients?
c. Face to face? Other companies/professionals? Number of other users?

Section C (NOT adopted) - Innovation attributes

Q1 - Relative advantage

d. Do you think NRM2 offers any advantages over your existing practice?
e. Do you consider NRM2 to be an improvement over your existing methods in any particular area?
f. Why? Examples?

Q2 - Compatibility

d. How different do you consider NRM2 to your existing practice?
e. Compatibility with your existing practices and procedures?
f. Compatibility with other companies? Supply chain?

Q3 - Complexity

e. Do you consider NRM2 as difficult to understand?
f. Difficult to use?
g. Too complex for your specific requirements?
h. Do you consider additional training as being required before adoption due to complexity?

Q4 - Trialability

c. Have you trialled NRM? How?
d. Is this even possible on this type of innovation in construction?
    - Time constraints?

Q5 - Observability

d. Have you seen NRM2 in use by any other practice/individual/project?
e. How possible is this in construction?
f. Have you heard any reports on the use of NRM2? How?

Section D – Unaware of NRM2

In the unlikely event that a respondent is unaware of NRM2 then the line of questioning will focus on the respondent's communication with the wider industry to explore initial awareness of innovation etc.

1. Based on your existing practice, do you consider a need for a new standard method of measurement?

2. Are you surprised that such a significant development in measuring practice has gone unnoticed? Why do you feel you are unaware?

3. Do you seek information on construction related content from any particular sources? E.g. Online, magazines, courses, conferences, professional bodies?

4. Do you ever discuss the wider industry with colleagues or other industry professionals? Or is the focus more on the specific project/task at hand?

5. Do you consider yourself isolated in terms of the wider industry?

6. Now you have been made aware, do you think you will seek any further information on NRM2?

Appendix B – Interview Transcript Examples

Interview Transcript for DM – CE-C-£M-M

Interviewer: So if we just start off with a little bit about the company, the size of the company and the type of projects that you encounter, is that okay?

Respondent: Yes, that's fine, yes.

Interviewer: So in terms of company type, obviously a contractor?

Respondent: Yes, main contractor.

Interviewer: What about in terms of size, workforce and so on?

Respondent: So we are B&K Building Services, we are part of the Bomer and Kirkland Group. We concentrate on projects from £1 million up to about £12 million. Usual sort of cup of tea is £4/5 million, that's where we're comfortable and most competitive at. Turnover wise we this year probably are looking at something of £60 million from this office. As a group that's obviously a lot more. Head Office, I don't know what their turnover is but basically as a business it was supposed to be coming in at £1 billion a year business at one point. Obviously with the recession that's reduced, but they are picking up like the industry is generally at the moment so they are probably looking at a £350/400 million turnover this year whereas we're at about £60 million. Employee wise, we've probably got 45 people in the office, probably about 18 site managers, probably a mix of half directly employed, half sub-contract agency type labour which is something that's new in the last five/six years for us as a business to do that; we always used to have people on the books. So that's a mix of people that we've got. Mainly we don't have directly employed labourers as such joiners, bricklayers etc. it's all sub-contracted out, but we do have a buying department that buys materials for trades like ground works, joinery and brick works. So all the other trades, plastering, painting etc. is sub-contracted out.

We have in-house companies that do quite a lot of those trades within Bowmer and Kirkland; painters, plastering division, M+E company, so suspended ceilings, interiors, so there's quite a lot of in-house companies but we do use other companies as well, more so probably than in-house companies, to be honest. So that's generally where we are coming from really; that's where we're at.

Interviewer: So in terms of you said about your bread and butter would be £5 million-ish, what sort of projects are they predominantly would you say?

Respondent: It's quite varied here which is something we pride ourselves on really in that we do anything from works in airports, office blocks, school, education, factories, industrial, refurb, new build… we just do absolutely everything and anything. We don't do housing per se; we're not really into housing, but we've done the odd residential flat development where you've got 60 flats or something like that, we've done the odd one of those, but general house building is not our forte. Within the group there is a company called Peverill Homes that do housing, their own housing. It is quite good that it's diverse in that we do anything, basically.

Interviewer: That sounds good. In terms of those diverse range of projects then, if you had to choose a particular type of procurement that you see most across your desk what would that be?

Respondent: Design and build, without a doubt.

Interviewer: Okay.

Respondent: 98% guessing off the top of my head, 98/99% of what we do now is design and build that comes through the door, and what we actually convert is 98% design and build, probably 99%.

Interviewer: So that gives us a bit of a background on the projects and things. In terms of you and your professional background, are you a member of any professional bodies?

Respondent: No, my background really started here in the accounts department when I was 18, did an ONC HNC part-time and then degree, honours degree part-time, so that's my route. I didn't go down the other route, I did the degree route.

Interviewer: Okay, so that just sets a bit of a benchmark so I can compare and contrast. In terms of your measuring practice then, I've just got a few questions focussing on that and then we'll start to look at the NRM2 and where that might fit into this equation. So in terms of your own in-house estimating, so drawings and things, what methods do you actually employ? Do you use a standard method or do you use your own?

[0:05:04]

Respondent: We generally use SMM7 as a benchmark. Any estimator that comes and joins me I expect them to be able to measure to a level of SMM7. Obviously we don't measure 100% SMM7 so you might call it builder's quantities but it is based around the SMM7 model.

Interviewer: Like an adapted SMM.

Respondent: Yes. The estimating software that we use is called Conquest. The library, as they call it, that's in there is generally based around SMM7 and we've had that for 15/17 years, something like that. So after the SMM7 came in in '88-

Interviewer: It did, yes, that's a good memory.

Respondent: All the time we've been using that. And the way that the software works is you basically click through the levels of SMM7, so excavating

to reduce levels not exceeding a metre deep bla bla bla and that's generally how we use it, but obviously we do create standard bills and then copy and re-use them. But generally, as a model, it is based around SMM7.

Interviewer: We used to call them 'rogue items'.

Respondent: Yes.

Interviewer: Same difference. So you mentioned about – so that's great, thanks. So you mentioned about sub-contracting a lot of the work out.

Respondent: Yes.

Interviewer: Do you ever provide quantities for subbies?

Respondent: Always.

Interviewer: You always provide quants?

Respondent: Yes, for every job that we do apart from lump sum packages like steel work, M+E… what else? We may send out windows on a package but we generally back that up with quantities.

Interviewer: And you stand by those quants, do you?

Respondent: Yes, they're our quants. We check all ground works, brick works, joinery, finishes, everything, we check it all off.

Interviewer: Wow! Okay.

Respondent: So it takes quite a while, as you know-

Interviewer: Yes, absolutely. That's surprised me, actually.

Respondent: That's what we generally do here. It may be a topic of discussion for later but sub-contracting quants is quite big in the industry, as you well know from your background. From this office we've done it occasionally where we've had to, basically, where we just haven't got the capacity. Varying degrees of success, I would say – some okay, some terrible, to be honest with you. And I know that our head office probably 80% of their stuff is sent out to be taken off, 90% probably. I know our competitors a lot of them are sending all their stuff out to be taken off. Just a balance on resources and cost. You either have successful estimators taking it off and pricing it, or you have three estimators and spend £180,000 a year on getting quants done. So we always find that it's better for the estimator to do the quants because they know the job inside out. And from my history and experience, we've won jobs on the back of that, that an estimator can go into an interview, post-tender interview, and talk about the job in depth whereas if all you've done is priced a bill of quants that somebody else has produced you just are bill bashing and you don't know the job. So it might be a topic for later. That's it, really. We do our own quants and, yes, SMM7/builders quants but generally around the SMM7 model and we do quants for all trades apart from lump sum packages where we can.

[0:08:40]

Interviewer: And that's been for as long as, I suppose, you can remember?

Respondent: Yeah, we've always done that.

Interviewer: So you touched on bills of quantities, that's my next question really. Do you receive many from the client side for pricing or…?

Respondent: No, which probably throws your model out totally.

Interviewer: No, this is all good.

Respondent: Probably out of… let's just try and throw some numbers in the air… I've not got it written down. It's become irrelevant because, as I say, 98% is design and build, 99%. But, basically, the only people that generally are producing quantities still are local authority and that's it. Derby City Council, Nottingham City Council and hospitals, those sort of organisations are still getting bills done and probably, I would say, one in 25, one in 30 of our enquiries is a bill. Whether that's our marketing or whatever I don't know but I think it's just the industry; I think it's just the way it is now.

Interviewer: Obviously with my background we were just crunching bills all the time, so it backs that up. In terms of the format then, SMM7 still?

Respondent: Still SMM7, yes.

Interviewer: Have you seen an NRM bill?

Respondent: Never.

Interviewer: Interesting.

Respondent: Never.

Interviewer: So it's safe to assume you haven't adopted NRM2?

Respondent: Correct.

Interviewer: So now the questions are going to focus around your perception of that and your journey through becoming aware of it, if you like, and the reason not to adopt. And then I would like to talk a little bit about NRM2 itself as a product in terms of what you may or may know about it as well, if that's okay.

Respondent: That's fine, yeah.

Interviewer: So, to start with then, definitely not adopted NRM2. Did you feel that there was ever a need for a new method of measurement or are you happy with what you've got?

[0:10:51]

Respondent: I would say SMM7 as an estimator is probably 95% - 98% there, I would say. Certain elements such as the way that drain trenches are measured, for instance, I would say is incorrect, personally. The depth should be the depth stated and not averages and things like that. But generally I think it's probably 98% there. That's my experience of SMM7. I'm comfortable with it, I've grown up with it, it's logical (98% of it is logical), some bits of it aren't and generally when you are pricing it you are pricing what it says on the tin, basically, which may lead on to other conversations about NRM for the very little knowledge I've got of it, some of it seems to be more cost-planning rather than actual estimating. Now, as I say, I know very little about NRM which is presumably why we are talking today and hopefully you'll be able to educate me on exactly what it is. But the little bits I've heard about it it's not suitable for accurate pricing. That may be just word of mouth rumours because I've never actually seen it.

Interviewer: I was going to bring a copy with me but I didn't, actually, but I could send you a PDF of it?

Respondent: Yeah, if you've got one. I would be interested to see what the differences are. As I say, SMM7 from in here we've got a range of people aging from, well, 40 to 63 as estimators in here and we're all comfortable with SMM7. I've heard of NRM basically through college students that have gone to college. That's the primary route and that may be a question later on

Interviewer: That was the next one actually so this is going well.

Respondent: That is where I've heard of it. I've never heard of it – well, like I say, I've never seen a bill of quantities produced in it. I'm pretty sure if I spoke to the QS's that I know that do a lot of taking off for other contractors they've probably never heard of it, and they won't adopt it probably. Certain age still using SMM6 or that sort of level of information. And builder's quants, basically, which is what is builder's quants? That is a big question because everybody's interpretation of builder's quants is different. We caveat it that it's SMM7 but it's also builder's quants because you are never going to pick up all of SMM7 in two weeks of taking a job on. The route, I've heard of it, has come through college students who have already gone through college at Nottingham and other places and they've mentioned it to me, and they've mentioned some of the changes to it. I think the main one that they've talked about is the way that roofs are measured. As I say, I don't know whether this is true or not but roofs are measured on plan or something and…

Interviewer: I'll go into a bit more detail actually after, if that's okay.

Respondent: As an estimator I'm thinking that's just useless; it's not giving you the full picture of what the job is. I may be wrong in what I'm saying because it's all second-hand information that I've had but that's the route where I've heard it from.

Interviewer: So can you think back to when that might have been when you first heard about it?

Respondent: Two to three years ago, something like that. I can't remember which one of the students said it. Probably three years ago, something like that. Joe I think, one of the lads, he was on about it and he is fully

qualified now and practising surveying. Might have been longer, might have been shorter, but I reckon it was around that sort of time.

Interviewer: So when you did hear about it, did you think to go and find out any more information about it?

Respondent: No, to be frank.

Interviewer: No, that's perfectly fine.

Respondent: And the reason being that, basically, 98% of our workload is design and build so there's no point reinventing the wheel for something that works, I suppose, at the moment. It works at the moment. I think from my perspective if it works for me and I'm used to doing a certain thing in a certain way, if I start changing my methods of measurement I've then got to try and pass that on to all our supply chain and they've got to buy into it, so I don't know whether they're going to buy into it. It's hard enough getting them to price what you send them in the first place now in SMM7. To actually then start changing the rules… I just think SMM7, like I say, has been around since 1988, it's a long time, everybody is well-versed in what should be measured and what shouldn't be measured. To start changing it now, might sound a bit dinosaur-ish but it is a big change to change something that's been around that long. I started in the industry in 1988 so it came in as I started, so it's quite good for me that I learnt that method and it has not changed. I've got people in here that are 63 that have worked on SMM5 and 6 and what have you and they moaned like hell about 7 when it came in. So they struggle to adopt 7 but now they are fully versed in it and they won't have it any other way. So to try and change that again… obviously things do change but with the invention of design and build, which has ruined all our lives, but with the invention of design and build it's as if you are trying to change something that's not now required. It's like somebody now releasing a new variation on the VHS video tape. To me, that's how it is. Yes, it's probably better than the old VHS

video tape but nobody is really using it because nobody has got a VHS player. So that's the way I see things. But, I'll put a caveat in that I don't know enough about the product, NRM, to say whether it's good or bad.

[0:17:42]

Interviewer: So in terms of that knowledge stage then, have you come across anybody else in your position in other companies that are using it at all, do you know?

Respondent: No, not that I know of. I know obviously we don't talk to our competitors but I have got very close friends in the industry and they've never talked about NRM. A lot are still SMM7 or SMM6 even and builder's quants, basically, because of the way the industry has gone with design and build; obviously clients are trying to save money, you're not getting bills done etc.

Interviewer: Has it ever been discussed at an organisational level or within B&K or is it just up to you?

Respondent: No, again, it's because of the type of work that we do as a business and I'm sure as an industry, it's not really – none of our directors have mentioned it and probably don't even know it exists, to be perfectly honest with you, unless they are talking to their students like I am. It's just not something that's at the forefront of our knowledge base, "That's it, we should adopt it, we shouldn't adopt it," nobody has ever thought about it because it just seems to be… I heard about SMM8, they were talking about SMM8, and then somebody said they were using this other system at college or they were shown this other system. Now I don't know whether I'm right in my recollection but I think the teaching was based on 7 but then there were little bits of NRM brought into it to highlight what this new thing is.

Interviewer: That's right, that's how we started it.

Respondent: So whether that's still the case in education I don't know. Say we're talking about obviously Steph coming to Nottingham etc. I would say SMM7 is what we want her to learn. However, that's what is offered…

Interviewer: We've fully switched to NRM2 now.

Respondent: Yeah.

Interviewer: Actually – well, we'll have a bit of a chat after, but it will be fine. So, this is nice and easy now because you haven't trialled it so that's fine. You haven't seen anybody else using it.

Respondent: Correct.

Interviewer: I think you've probably covered this but can you identify a specific trigger that has led to your rejection? I think you said it's previous practice really, isn't it?

Respondent: It's previous practice and it's the type of work and procurement routes that clients are taking, basically. So 98% D&B… it's not worth it – we don't see it as worth the change in inventing a new product that's…

Interviewer: Okay. So, in terms of that trigger, it doesn't really fit into what we class as the common areas, if you like, so normally people rely on face-to-face contact with other professionals, other professionals doing similar things or collective authority, collective decision, and essentially it's none of those things. You've made your own decision and from what I've heard that seems to be the general consensus as well.

Respondent: Yes. I think it's just a lack of… I don't know, advertising I suppose. It's not been thrown in your face. Obviously things change all the time in construction, building regulations for instance, suppliers who will

jump on the bandwagon of a building regulation change, so if Part L2 changes all of a sudden you are getting 20 emails a day from installation suppliers and boiler suppliers and bla bla bla, and if the disabled rate is changed at DDA bla bla bla, loads of e-mails… methods of measurement, there's nothing in the press generally. You might have read one line about it in the construction magazine once upon a time but it's not at the forefront of peoples' minds to…

[0:21:45]

Interviewer: Do you think you might reconsider in the future?

Respondent: I can't say 'no' because I've not seen the product so I don't know what it actually does. As I say, from the second hand information I've had I don't think it's suitable for accurate estimating purposes, I would say.

Interviewer: If you had to choose a trigger that might tip you over, let's say you see it and you are not totally averse to it, do you think it would be more a discussion with somebody else that you might have that might influence you? Or do you think you would look at what everybody else is doing? Or do you think you would wait until there's a bit more of a ground swell of people using it?

Respondent: I… I would like to think that we would – everybody likes to be at the forefront of something. The reality is we would probably follow, to be perfectly honest with you.

Interviewer: Would that be anybody in particular? Or would it be the weight?

Respondent: It would just be the weight of the industry, really. If we start seeing loads of bills of quants coming through with it and if we started seeing lots of quotations with caveats on that refer to it, because that could be another route of knowledge, that it comes through that this has been measured in accordance with NRM bill or whatever then we would

probably have to react to that and follow suit, I would say. It probably sounds a very narrow-minded view but just as we are at the moment everybody knows what's what in the industry and, as I say, it is a narrow-minded view and I'm sure in 1987 when they were talking about SMM7 everybody had the same view, "No, we're not going to change from SMM6, it's fine." And I know even when we started here with the estimating system the libraries that they had on were both SMM6 and SMM7, and lots of people were using SMM6. I've got a friend that works for – has just got a position at Mansells down Birmingham Way and they've got the same estimating system we've got and they are still running SMM6.

Interviewer: Really? Wow! Okay.

Respondent: So we thought we were behind on SMM7 but they are still running SMM6 on a software system that's recently been updated in the last three to four years and they are still running SMM6.

Interviewer: Okay.

Respondent: But they are comfortable with that. As I say, with the way things have gone it's probably good enough to get by. Sub-contractors understand it. But it's an SMM6 library but generally they're probably still taking off builder's quants at the end of the day. It's not SMM6 per se they are still taking builder's quants off. So the descriptions aren't going to be that much different in the way things are measured. And even now within the estimating software that we've got there's all – in some sections, there's always an override function to put in the 'not SMM7' clause in the description.

Interviewer: Like a composite item type of thing.

[0:25:18]

Respondent: Well, it might be plasterboard linings. The SMM7 rule might be height stated, length in linear metres, but lots of estimators measure in square metres so there's always that override that it's not in accordance with SMM7, 900 square metres or 10,000 square metres or whatever. So there is still the variation within the SMM7 that we use to override it and to make it into more of a user-friendly set of quantities that the sub-contractor can actually price. Because, like I say, there is the odd occasion still in SMM7 where I don't agree with the way that it's measured because it just doesn't give you the accuracy that you need to actually price the item properly. If you've got drain trenches that average 2 metres, it could be 4 metres and 0. Digging a 4 metre trench is a lot different to digging a 2 metre trench, as an estimator. It's got it flaws still, SMM7.

Interviewer: I've got some bad news for you on NRM but we'll tell you about that after we've finished. So in terms of the actual new rules themselves then, at this moment in time you don't consider that they offer you any advantage over your current practice?

Respondent: No is the answer but, basically, because we don't know enough about the rules.

Interviewer: And because of that sort of lack of initial knowledge, if you like, you think they are quite different?

Respondent: Yeah.

Interviewer: And you already mentioned this I think but you said you might have compatibility issues, issues with sub-contractors and base of supply chain?

Respondent: Yeah. As I say, I don't know that but I would think there would be some resistance from them to change as much as a resistance from us to change. Everybody is resistant to change no matter what it is. But I

think there would be a bit of mass confusion with certain things. But I say that because of the one or two examples I've been given or NRM. If I send a roof to somebody I want them to price a roof, I don't want them to give me a cost-plan based on so many flat square metres. It doesn't work as an estimate.

Interviewer: I can shine some light on that.

Respondent: Yeah.

Interviewer: In terms of the complexity of it, again, you haven't seen the actual specific rules?

Respondent: Yeah.

Interviewer: I assume you would consider that you would have to then re-train staff?

Respondent: Yes. We would have to do that. And, again, I'm sure there would be a certain amount of resistance to that, unfortunately.

Interviewer: With that 'professional practice' shall we call it, this measurement technique if you like, do you think there would be any way of you trialling it? Do you think that's even possible for this type of thing?

Respondent: Could we trial it? There's no reason why we couldn't trial it. But again without seeing it it's difficult to say that. There's no reason why we couldn't – but how effective that would be… It would just be a paper exercise I think that would be trialled because having the confidence in a live project to do it and for the sub-contractors to understand it… Lots of sub-contractors now are getting to the stage on certain trades where they just won't price a bill anyway because they think that the bills that are being produced in SMM7 format aren't detailed enough for them to price their particular trade. So Rainscreen Cladding, for instance, all the bits and bats that go with cladding the interfaces, junctions, you'll

send them a bill the best you can and you'll pick it up as best you can but they will always just come back to you with their own interpretation because they know… And that's probably because the architects don't know.

Interviewer: Yes, that's true.

[0:29:23]

Respondent: And they can't put it on the drawings adequately enough or specify adequately enough. So it throws the whole measurement thing out of the window a little bit because you are relying on sub-contractors. It's like M+E, isn't it? How many people actually measure M+E? People might have done it in college in the seventies but… and you might do it now, I don't know, but…

Interviewer: We don't do it now, no.

Respondent: It would be a futile exercise for me to train one of my staff up to measure M+E because of the design and build route and everything else; everybody is going to look at it differently. It's a bit pointless. More and more trades are getting like that because of the design and build route. You'll measure it and you might put a superficial area down and a superficial junction with existing wall, junction with roof, junction with whatever, external angle, internal angle, but the actual nuts and bolts of what goes into that external angle whether it be fillers, air seals, whatever, we'll leave that lot to the sub-contractors because the professionals, architects etc. aren't actually clued up enough to put it on.

Interviewer: So just to clarify an earlier point, you said that you send quants out to sub-contractors. Is that exclusive of M+E then?

Respondent: Yes, exclusive of M+E, structural steelwork generally… what else would we send out on a lump? That's probably it, really. Everything else, ground works, brick work, floor slabs, plastering, brickwork… everything else we measure.

Interviewer: Okay. So the last point then is in terms of – it's probably tricky to visualise, but in terms of observability, from a distance do you think you would ever be able to see someone else using NRM and see how it works? Or do you think that's just an impossibility in the industry?

Respondent: My personal view is that people won't use it.

Interviewer: Okay. And you won't be able to see someone using it?

Respondent: No, I don't think they will. The same reasons stated earlier in that the majority of work these days is design and build. Even local authority I understand now do Derby City Council who have traditionally sent out bills of quantities for years and years and years, they now actually are looking at the design and build route for their procurement. So that's another source of bills gone down the drain. Bills are great for us because there's a lot easier to process and are quicker and everything else. I don't think there will be enough uptake in the industry generally because of the resistance and the lack of need really to have a new method of measurement.

Interviewer: With the confidentiality of pricing and everything you are never going to be able to see how others are using it even if they are using it.

Respondent: Yeah, yeah. We wouldn't be able to get access to that.

Interviewer: No.

Respondent: It's a sort of… difficult to say 'never' because ultimately things get re-measured so there's got to be a standard to measure to. So it's alright

me, as an estimator, sitting here and saying, "Right, I'll take my quant off to SMM7 or near as damn it," send it out, get my prices in, win the job, pass it to our surveying team. Ultimately then they've got to pay people and that payment will be on the basis of a measure of some type. So unless it goes back to all your sub-contractors are going to buy into the fact that you've done it on a certain standard method of measurement then it's going to be hard to change what everybody is used to. Ultimately – I'm not a surveyor, but I think ultimately everybody at the moment generally works within the builder's quant realm so you are not necessarily getting sub-contractors – well, you may get some sub-contractors but they won't work for you for long, but you may get them coming – you don't necessarily get them coming back quoting SMM7 infinite… "This clause… says… and I want an extra 2 metres or whatever because of that clause." I'm not a surveyor but you're not generally getting that. Everybody is still in this world of builder's quants. I know when I first started I was very focussed on getting it exactly right, SMM7, and when I first became a manager and started teaching people I was of the same opinion. I must admit, over the last few years it's become… I don't know if you want to call it dumbing-down but I think the industry has dumbed-down. It's not that I've dumbed-down, I think the industry has dumbed-down in their reaction to what people are actually pricing. But, as I say, I'm not the surveyor but I've not had any adverse comments coming back that, "You've not measured something in accordance with column 5 of SMM7."

[0:34:53]

Interviewer: I suppose that's the assumption I'm making that you package the project and then you have a handover and let them get on with it.

Respondent: Yes, that's what we do, yes. Example, I suppose, everything in staircases is supposed to be measured separately. We never do that and we never get anybody coming back saying, "Well, actually, those six

square metres of suspended ceiling tiles that's in the staircase…" I think people have got bigger things to worry about in the industry than-

Interviewer: I was going to say, you've got to look at the bigger picture.

Respondent… arguing over 50p/square metre above six square metres of ceiling tiles is not worth the phone call.

Interviewer: Do you think that's influenced a little bit by the size of project that you encounter? If you were encountering half a million to £1.5 million, do you think you would get more disputes?

Respondent: No, I think you would get less. I think you would get less because of the type of sub-contractors that you would be using. I think the more… they're, "Yeah, I've got to go and do square metres of ceiling," it's that. I think the industry has dumbed-down personally so I would say go back ten years the detailing and what we'd go into generally in everything was a lot more than what it is now. Now that's predominantly probably because of time more than anything. If you had the time you would spend a lot more time detailing everything down to the nth degree. But tender periods have come down that much. You used to get five weeks for a bill of quants, now you get three and a half weeks with design and build. So you've got to take it all off and get it out and price it in three and a half weeks. It's not long enough, really. So you dumb-down a little bit and the old 80% of the value is in 20% of the items rule does apply; it applies more now than ever. So that's the way I think it's going. As I say, the days of… it may be the level that we're at but the days of claim surveyors going through SMM7 and nailing everybody to the ground I'm sure the likes of Laings and people who still have those sort of people working for them, but I think generally you haven't got enough time and people haven't got enough money in the overhead to employ people to do that. That's my personal view on it. I think things are a little bit more lapse and more about

getting the job done than actually worrying about the nth degree of measurement, really.

Interviewer: Okay.

Respondent: But we try and do it as best we can.

Interviewer: Well, at the end of the day…

Respondent: When you are producing 300 page bills of quantities in 2 weeks it's a big ask still to do it to that sort of degree and that's what we do.

Interviewer: And you do… I suppose to summarise what we've just said, you are not actually finding it a problem that you don't use NRM? Everything is fine; business is running fine, profitable, so why change it?

Respondent: Yeah. Unfortunately, I don't know what your remit is but that's the truthful answer about it, basically.

Interviewer: I'll just stop this now.

[End of Transcript]

Interview Transcript for SH – SA-RICS-P-£L-L

Interviewer: Okay, so just to start off then if you could just describe the company, sort of what you do day to day and if you could divulge it, the turnover and the size of the workforce.

Male: I'll leave that to - well okay, I'll give my opinion on it…

Interviewer: That's okay.

Male: …but the turnover is published. I can't actually remember what the latest figures are, but we're probably in London 400 strong QSs. Coming out of the recession it's been building up in the last 18 months we've been recruiting quite a lot. So we're back to where we were pre 2008 recession in terms of size. In terms of our turnover I think my best guess would be a thousand million…

Female: I can't remember. I read it some time ago.

Male: About 900 million to 1000 million…

Interviewer: Yes.

Male: …turnover.

Interviewer: I just read the brochure downstairs, I think that's what it said.

Male: Yeah, so that's roughly what we're talking about and we're back to those again, pre-2008 levels of profitability for the partnership.

Interviewer: That's good.

Male: It's an LLP - so that's Limited Liability Partnership. We are a core skill in that, what they would consider to be no longer quantity surveyors, but cost consultant practice. So we are sort of the last bastions of, what I would consider the core skill quantity surveying in terms of measurement. So my role within the firm is to provide bills of quantities when requested by a client if they want to take a traditional view. So we do full measured BQ using whatever method the measurement is required. Whether that's a civil method or a building method.

Interviewer: Okay.

Male: Ada as you said works for me as part of my team, but basically we use freelance resource to supplement that from our in house. We use all methods of measurements - the latest NRM too.

Interviewer: Okay. In terms of the type of project you encounter is it very varied, is there any particular niche that you encounter a lot?

Male: Well in terms of bills of quantities I think it's mainly educational. So obviously schools - private schools, public schools, they need to have some form of accountability, audit ability at the end of it and I think traditional BQ is probably one of the best routes to provide that, as well as cost certainty as well. So a majority…

Female: There's some private clients as well.

Male: Private schools, yeah, as well.

Female: In the past - not long ago - they were quite a few other private clients.

Male: Yeah, so again we're doing predominantly schools, but more recently private companies, generally in the Southampton area, we've done two cruise terminals. We've done BQs for hotel refurbishments. It's all sectors traditionally, but more recently due to financial constraints and recessionary pressures, it's been more schools and things.

Interviewer: Okay.

Male: But we have covered all sectors - civils and building.

Interviewer: Yeah. Is there a typical ceiling of value that you find?

Male: Well there is. I mean I would think for a BQ to be a full BQ now to be cost efficient in terms of the time and money spent on it, probably £30 million would be a ceiling that I would be comfortable saying we can produce a BQ in six to eight weeks…

Interviewer: Yeah, that's interesting.

Male: Using a small-scale team. But more realistically in the education sector, probably £5 - £10 million, if that's their spend, that's the money they can raise privately to do what they need to do. So that's probably the range of BQs we do. The cruise terminal's the same - £10 million spend in six to eight weeks measurement

periods - four to five man teams. So very small group and that's again limited by the resources.

Interviewer: Yeah. So how many - just coming back to your sort of team if you like - how many are in your measurement team?

Male: So we can call on - we've got Ada in London, plus a technical support guy and then we've got Newcastle has a technical support guy there as well. Then we use the likes of up to six or seven freelance resources. So a team of 10 people would be called on. So we could probably run two jobs concurrently at the moment.

Interviewer: Okay.

Male: In the past that's been 30. So we'd probably run five or six jobs concurrently. But like I said, bills of quantities as you know probably, not as in favour as they…

Interviewer: No.

Male: ...always were…

Interviewer: No.

Male: They've all been saying that we're getting rid of bills of quantities for the last 20 years, but there's still a need.

Female: I think it's coming back now.

Male: Well…

Female: I think the contractors these days do not really like D and B.

Male: No.

Interviewer: No.

Female: They try - they prefer bills of quantities.

Male: Have a bill of quantity, yeah.

Interviewer: Yeah.

Male: Saves them the time and I think obviously they've got to do it in four weeks what we've had to do in six weeks or eight weeks. So there're lots of pressures on them and they never get the actual result they want. I think it teaches a much better quantity surveyor if they know how to put a full measured BQ together. So that's obviously where you're coming from as well.

Interviewer: Yeah.

Male: But that skill basing is being neglected and lost quite a lot through graduation and graduates' courses now.

Interviewer: It does, yeah. So just filling in what I think you're saying then - essentially then the measurement traditional BQ production accounts for quite a small proportion really.

Male: Yes. Yeah, I would say a very small proportion of what G&T actually turnover is measured documents or pricing documents - whatever those schedules of works…

Interviewer: So is it predominantly frameworks, D&B?

Male: I would say yes. Probably design and build framework agreements.

Interviewer: Okay. So just - again you might not know the answer to this, but if you're sending out a D&B scheme, do you request quantities back from contractors do you know?

Male: Probably Ian would be better to ask that, but from what I gather the approach is obviously the D&B, they would prepare a schedule that, principle quants that they would like to see so that they can do some sort of analysis. I mean we've even done full measure BQs where we said we're not responsible for the quantities. So a high level of measure, but not really a full measure. Not fully designed. So it's all - it could be a one-pager right through to a full document based on the measurement.

But they do always request some form of pricing so they can do tender comparisons.

Interviewer: Yeah, absolutely. Okay. So just a little bit about yourself or both of you for one second. Are you both members of any professional bodies?

Male: I think Ada is.

Female: I'm an MRICS.

Interviewer: Okay, yeah.

Male: I'm TechRICS and a member of the Institution of Civil Engineering Surveyors as well.

Interviewer: Yeah, okay. Yeah, just looking to see how that might…

Male: Yeah.

Interviewer: …influence the decision process. Okay, so you do still produce BQs for tending purposes then?

Male: Yeah.

Interviewer: Should be very interesting. [Laughs]

Male: Yeah. As said, we're good at it - what we do - the small team that we use, it's an efficient process and I've always believed it's the best way to get cost certainty.

Interviewer: Absolutely.

Male: Make sure the design teams have actually produced documents that actually can build you something on site.

Interviewer: Yeah.

Male: That's the other issue. Unpaid benefit of the BQ. Interrogating the drawings, the query list that we raise. Certainly we've found - I should think in every job that we do - an architect thinks that he's produced a set of drawings that's good enough to construct from and certainly to build from in his mind. I think we need to look at the two sides of that as, drawings just to get out to tenders is a completely different set of information, but ultimately it's not.

Interviewer: So which standard method are you following then just for the record?

Male: We use, now, NRM2, that's obviously since it became mandatory which took a while to adjust and obviously we had projects in the pipeline that were all fully SMM7, so we had an overlap period for the last three, four bills we've done are all NRM2.

Interviewer: Great, okay. You've been using that essentially the last couple of years.

Male: Three years.

Interviewer: With some overlap, yeah. Okay. So having now adopted NRM2 then, did you feel that there was a need for NRM2 before you became aware of it?

Male: Was there a need? Well in terms of the age of SMM7, it was obviously due - something was due. But in all honesty I didn't think it was needed because in my own opinion bills of quantities as you said aren't really the core anymore of what's the process going

forward. So I think when they started to look, they probably looked to say something was a different type of method of measurement. I think at the very beginning I was involved in some of the initial analysis of what they were going to do, but you could see it was being fragmented so much and you were getting so many different opinions on which trades to keep the same, which ones were going to change, which ones were going to be simplified. We've down this version - revision - a long time with abridged methods, the measurements and all these sorts of things. So I stepped away then because I just didn't think I was going to add anything to that.

Female: I think regarding the SMM7 in the past, there were certain items required to be measured in too much detail. It's not really cost significant items. We spent a lot of time to measure something very insignificant - working space. The height of partitions divided into, I think, 300mm stage. It takes a lot of time and effort. So I think to some extent the movement from SMM7 to NRM2 is more cost effective from company points of view.

Male: Yeah, that was the driver I think. They just wanted to try and simplify. Whether they've achieved that I'm not possibly certain in certain sections. Drainage is a much simpler section…

Interviewer: Yeah, absolutely.

Male: …. But it always measured that way anyway, we just adopted a civils method of measurement on the building. So things that are put into and are probably standard practice in most measurement departments I would have thought. The good thing obviously is the way that the NRM2 in isolation is obviously a measurement document, but it's also linked to NRM1. I think what they tried to do there to make sure the client knew exactly when he asked for a cost plan, he got the same cost plan. That was a great advancement. I can’t think of anyone who aren't seeing the benefit of that. Obviously that translated into an elemental bill of quantities where you can link the same components and possibly get some use on your cost plan measures into your bill of quantities.

Interviewer: Yeah, absolutely.

Male: Again, is a great step forward. The only thing I think that's thrown a spanner in the works is BIM.

Interviewer: Yeah.

Male: Which means this is almost dead in the water.

Interviewer: Potentially.

Male: Even though they're trying to say this has been - this works really well with BIM and you can make it work, it doesn't really reflect the way…

Interviewer: I know.

Male: …the industry's going now in terms of modular measurement and things. So we've adopted it. We've had no real resistance from our surveyors who have used it, but as you've measured in the past measurement isn't there for the measuring, you just make it work. I don't think Ada's had any problem with the transition. There're a couple of grey areas where we've had a few problems.

Female: No I think that's - it just quite straightforward…

Interviewer: Yes.

Female: …to move from this one…

Male: To that one.

Female: I mean from SMM7 to NRM2.

Interviewer: Yeah.

Female: A surveyor really need to read the rules for this now. I think some people just don't like reading the rules.

Interviewer: [Laughs].

Male: You're right and of course the big, big difficulty is obviously you've had a long time with SMM7 and even I've said when you're describing things in the BQ, you can't forget the principle is that you've got to be able to describe something for an estimated price and it's again, SMM7 tried to move away from that by heavily relying on the specification. For NRM2 it doesn't adopt a specification. You can refer to it but it's not as…

Interviewer: There's no coordinated project information.

Male: Exactly right. The coordinated project information is not there, so you really have to go back to those principles where you describe what you're billing using these work sets, and that's SMM7 again, because we always did four level three descriptions. You can just refer to the specs at the end as much as information as possible.

Interviewer: Mm.

Male: So in that respect again, I think moving away from the coordinate project information it's probably a bit risky as well.

Interviewer: Yeah, but then when was the last time you saw fully detailed NBS?

Male: Yeah, well like you said and that's - [laughs] - that is the big problem and that's where we spend most - I mean as I said, I think that's a real unpaid benefit QS for bringing this to the team. When he looks at the engineers, architects drawings in isolation. I mean they're supposed to coordinate everything at the end of the day.

Female: But that's the benefit of preparing a BQ come from because the NBS and the drawings - explicit detail drawings - are not usually - sometimes there are a lot of discrepancies and insufficiencies. So when we prepare the BQ we raise queries so in this way it helps to build a certainty of cost.

Male: This way's better for the client for us to - as you said…

Interviewer: Yeah, absolutely.

Male: They're the main advantages we see now.

Interviewer: Okay. Can you remember how you became aware of NRM2 in the first instance?

Male: Well mine was I work quite closely with a member of the RICS working party teams and said that this was coming forward and there would be a request for people who were interesting in providing third party use.

Interviewer: So very early.

Male: Yeah, very early on in its life span. But like I said, it then started getting - there was quite a lot of them emailing from the RICS on the working parties and things and it got quite fragmented I thought and it kept getting delayed and delayed. Looking at the drafts of things you could see there were different authors on everything and

they weren't really what I considered to be quite standardised. So yeah, very early on in its development.

Interviewer: What about you Ada?

Female: For me it's published by the RICS. First the NRM1 came into effect - effective first and then they announced or published NRM2 would come into effect in 2013 - January '13 and JCT 2011 contract has been amended to be in line with the NRM2. So RICS has been in a way promoting the use of the NRM2 a long while ago.

Interviewer: Okay. So once you became aware of it and you understood that it was coming, did that then start you thinking actually how this is quite welcome. You sort of welcomed the idea of the new rules or were you a bit hesitant to start with?

Male: I think much like anything; I mean everyone's a bit hesitant of applying a new set of skills or set of rules to the skill base you've already got. Obviously we were all hoping that it would be simplifying the things that Ada's mentioned before all the complexity and dry lining measurements and all those sorts of things where you spend all your time working out beads and angles and intersections. Do you really need all that information when the price comes back? Normally a composite price, they know what to allow.

So looking for those sorts of enhancements obviously takes a while to adapt to. But I think - I wasn't worried about any – like I said, as a professional measurer you use any measuring you're asked to, whether you make one up or you apply one.

Female: I think on the day to day work basis I'm not too worried about change from one set of rules to another set of rules because I understand that this - the NRM2 - really developed from the SMM7. But from the point of view for being a practice - being a company, we discuss about it, other parts of the contract documents, the preliminaries, need to be updated to be in line with this new set of documents and the JCT 2011 contracts.

Male: Yeah. I think it was a harder transition obviously being cost consultants - it was a harder transition accepting NRM1 because obviously all the database, all the skill sets are all based on SMM7 and costings and what's included in the composite item. This did cause a little bit of resistance in its adoption and whether they all use it upstairs now, it's still [laughs] debated. There are people who favour it and people who don't. Probably the old school people still do the same thing and make it fit rather than start from that fresh and use that as your template to make it…
But as I said, it's a practice from the practicing and procedure side of it, obviously that's quite a bit shake up.

Interviewer: Yes, absolutely.

Female: Also the software that we use, we need to…

Male: New licences for libraries and things.

Interviewer: Yeah.

Male: Again, there are extra costs. Minimal in terms of what we spend on…

Interviewer: Yeah, but it's all added together.

Male: Yeah. It's like anything. Challenge breeds resistance from some and welcome from others.

Interviewer: So when you first found out about NRM2 did you attempt to find out any more information about it from anywhere else other than direct correspondence from the RICS or were you proactive in trying to find out more about it or did you sort of just let it come.

Female: Yes, our company had a seminar to help us to understand both NRM1 and NRM2.

Interviewer: Okay.

Female: When they start, where they come from and also as a member of RICS we downloaded the NRM2 and then went through it. It's quite a comprehensive document to introduce the benefits of using BQ et cetera, et cetera.

Interviewer: Yeah. At any point through this adoption process, did you make any attempt to find out what your competitors are doing - equivalent QSs in practice?

Male: Only from when we got together on a conference or something then you'd ask them. There were some early adopters but I don't think anybody rushed to adopt it.

Interviewer: No.

Male: Because of the longevity of the projects you're working on, there's obviously a natural process of time when things have got to change, so we just said, right, all projects we're currently working on with the architects in and teams are all working in the traditional SMM7 route, then we'll keep those, but anything new, we just decided obviously it's effective on 1 January, the first new project that we got as a BQ from the measurement group and not from the practice point of view. We just said, right, let's bite the bullet we'll be the first people that do it.

My teams were the same thing, they'd never used it before so we all had to just jump on board on the very first one and obviously took the opinion that we may take a little bit longer because we're learning new rules, but it's got to be done. Of course once you've done one and realised that it's not as bad as it looks. Saying that, there's still a few areas and things within this document that still need to be ironed out.

Interviewer: Yeah, absolutely.

Male: That's the worst thing about the RICS this - you don't get the two way. They say you can just speak to somebody there and [unclear]. There's never any guidance from them. You have to make your own mind up. As I said, we muddled through and whenever we got any doubts or anything we obviously stand by our BQ so the contractors are aware.

Interviewer: So you said that with the document essentially becoming effective from that date, was there any question in your mind that you would or wouldn't adopt it even?

Male: No.

Interviewer: No?

Male: No.

Interviewer: So you weren't influenced by anything other than the fact that it's professional guidance from the RICS?

Male: Well we took the view from the BQ point of view that we needed to make a step forward anyway I think just to check whether this was a workable document. We always had the fall-back position of going back to SMM7. My main concern was that the contractors were now starting to price a different rule set of inclusions and exclusions and things and were they ready for that. So whether the contractors were as proactive as the PQSs or the public sector guys I don't know.

But we just took the decision, next BQ to jump on board and go with it.

Interviewer: Okay. So not influenced by…

Male: No influence, no.

Interviewer: Okay, that's great.

Male: There was no mandate anyway. There was no, you have to use it. There was no directive from above. It was basically when the right project came along.

Interviewer: Yeah. So did you attempt to trial it on anything before you used it on a live project?

Male: No.

Interviewer: No? Had you seen anybody else using it before you started using it?

Male: We'd never seen a document put together by anybody else. We've billed elementally and certainly in my time here that's the best way to relate back to a cost plan, an elemental cost plan. So we've always used the elemental bill. We've adopted elemental bills through again into this. So the transition in that respect was quite simple, it was just different headings. We've gone away from a trade based measurement system now to more elemental.

Interviewer: Yeah. So if you had to put your finger on one thing that made you adopt it in a sort of a short sentence if you like, what do you think it would be?

Female: Yes, one short sentence.

Interviewer: [Laughs].

Female: Because the requirement in the JCT 2011…

Interviewer: Yes.

Female: …it's stated there. The NRM2 need to be used after 2013. After the company has sorted out the software for the BQ measurement we started using.

Interviewer: Okay. So you didn't ever think to just get your red pen out on the JCT and…

Female: No.

Interviewer: …scribble it out. [Laughs].

Male: We've got a different - yeah we obviously did do that until the first BQ.

Interviewer: Yes.

Male: But that - the measurement section doesn't get involved in the contract side. So you've got your team who've commissioned us effectively – in house. So if they said, Steve, it has to be SMM7, we use SMM7. They'd come to us and say, you can use whatever method of measurement you like and obviously they've got the JCT with the contract right - we would amend the contract if it was an SMM7, but it's obviously simpler not to start amending things in the contract. It's not hardship for us.

Interviewer: No. So within your team then it was pretty much a collective decision.

Male: Well like I said, we get asked by the practice to produce a bill of quantities. Obviously I ask what the design teams have been preparing it based on. Are we going to get full NBS specification and things like that. There are pre-conditions of what level and development the drawings are going to be to. Are we going to old stage E/F. Once we know that information, like I said, the rules are irrelevant and I think from my point of view and everybody else, we want to become the leaders in the market.

Interviewer: Yes, absolutely.

Male: We need to be saying we're using the right things. We're doing what's been mandated by the RICS - sorry, requested by the RICS.

So we've always said cutting edge - we want to be leading edge in everything we do. So I think probably we weren't very far off being first or second to publish a full BQ - a full measured BQ…

Interviewer: Sure.

Male: ...on NRM2.

Interviewer: Okay. So to date then how many projects have you produced on NRM2? Only roughly.

Male: Probably I'm saying six now full BQs.

Interviewer: Okay. Did you encounter any internal resistance from the team to NRM2?

Male: No.

Interviewer: No? Okay.

Male: Was there any resistance?

Female: No.

Male: Not by you.

Interviewer: No. [Laughs].

Male: Ada likes NRM.

Interviewer: Yeah. Did you have any extra training on it or was it something that you just took home and read and [laughs]…

Male: Well Ada did a very comprehensive exercise. She went through comparing SMM7 to NRM2.

Interviewer: Wow, excellent, yeah.

Male: Yeah, so I mean from her point of view as the measurer she's fully aware I think of the changes.

Female: I think so.

Male: You did it didn't you?

Female: Yes, I did the…

Male: Yeah.

Female: It's just for personal reference.

Male: Yeah.

Interviewer: Yeah.

Male: It wasn't a published thing. It's just for our own personal reference. My other guys are the same.

Interviewer: Yeah, we've done the same thing. I just picked up an old job I knew quite well and took it off with that. That's the first thing I did and then just tried to compare.

Male: Compare the two.

Interviewer: Yeah.

Male: That's the first thing.

Female: Also your question about whether we have provided training because all the people who work in this team to produce a BQ often are very experienced from SMM7. So to us it's not really - need a review of training.

Interviewer: No.

Female: Just the reference number is different.

Interviewer: Appreciate that. Yeah, okay.

Male: The good thing about a team that's experienced is they talk.

Interviewer: Yeah, absolutely.

Male: That's the big difference I think for anyone who's learning quality surveying, especially if you're measuring as a team. If you're measuring an element you've got to talk to other people.

Interviewer: Yeah, absolutely. Did you find any difficulties with its implementation? You mentioned about taking a little bit longer, but that's natural…

Male: I mean that was just an allowance, but then I'm not too sure - I mean obviously they're reading a set of rules for the set of rules for the first time and they're expecting to be measuring as Ada said - your working space and things like this which are no longer required. Higher stages and, like I said, drainage is a good example where it's a lot simpler. So even though there's an allowance for more time with the measurement, it probably in theory was no longer. The guys are experienced guys.

Female: It's not really much longer. I think for the first project when we started to use the NRM2 we need to read through it before we actually measure it, that takes a bit longer. A little bit more time. Also we need to see where we should put the measurement in - which section.

Male: Yeah, which section.

Female: In the past example it's in our head, which…

Male: Yes…

Female: Partition is K10, we don't even need to think. Now for the first time we need to refer to this…

Interviewer: The numbers. The numbers are hard aren't they? [Laughs]

Male: There're a lot of them as well.

Interviewer: There are 44 in there now, something like that and you think oh wow, okay.

Male: Yeah. So that - but like you said…

Interviewer: yeah..

Male: …getting around the trade to element transition did take a bit of time, but like I said, if you were familiar with NRM1, which my measurers probably aren't, they don't do any cost planning work, then that's a good guide to where you'd be looking in here. But this is fairly comprehensive on what's included and what's not.

Interviewer: Yeah, absolutely. Did the RICS assist in any way?

Male: No.

Interviewer: No, okay.

Male: We didn't ask for any assistance.

Interviewer: No?

Male: But obviously we've got people in the practice and procedures who put up the training sessions, so they've been interacting with RICS process.

Interviewer: So completely in house essentially.

Male: Yeah. But from the measurement team as an NRM team driven by me, we just print the rules and went with it…

Interviewer: Overall it's been quite well received do you think?

Male: I'm not too sure from the contractors. Obviously anything that goes out into the contracting world is different to what they've had before. The first time they probably got an NRM BQ it caused the estimating departments I'm sure a few headaches. But in terms of what we produce for our client - obviously my own team in here - they seem to be happy with that.

Interviewer: Good. Okay, so essentially then you're happy and NRM2 is now adopted…

Male: Yes.

Interviewer: …unless specifically a client asked for SMM7.

Male: Yes.

Interviewer: Which I suppose would be unusual.

Male: Would be a retrograde step in my mind and I would try and talk them out of that.

Interviewer: Okay, great. Do you think that that it's actually offered any commercial benefit? I mean it's early stages isn't it.

Male: Yeah, I think it is. Well I think it's been - in my opinion that's been clouded by this BIM coming so close to the issue of that.

Interviewer: Yeah.

Male: That's basically overshadowed everything in the last two or three years, what's going on the BIM world. A lot of the clients are not even looking about what method of measurements they're using.

Interviewer: No.

Male: They just want the model at the end of the day to do FM. So commercially for us it is no quicker I don't think to produce a bill of quantities using NRM2. Maybe a little bit more time to ask queries and things. The subtleties in this are such that you're not spending a lot of time measuring.

Female: I think the time that's spent on measuring is sometimes waste queries, it's not about which set of rules we use.

Interviewer: No, yeah.

Male: So we're not seeing any, I think.

Interviewer: Okay.

Male: Well, let's put it this way, it's still the time period for me to allow for a BQ that hasn't changed. We've not seen a week benefit because of the new rules of measurement. I wouldn't expect that because as Ada said, a lot of the time we spend interrogating drawings. If we take that part out of the process, i.e. have a fully set of coordinated drawings delivered on day one, I'm quite happy to suddenly take two weeks off a project. [Laughs]

Interviewer: Yes, quite. [Laughs]

Male: 150 queries on each element is just crazy. Anyway…

Interviewer: Okay. So definitely going to keep using it. Yep?

Male: For the foreseeable future for full BQ measure on traditional projects, yeah.

Interviewer: Just now you've actually used it for a number of projects, have there been any unexpected consequences? So you go into these things quite eyes open. Are there any positives that maybe you weren't expecting or maybe negatives that you weren't expecting?

Male: I don't know how you'd answer that.

Interviewer: You seem very cool and calm about it Ada.

Female: There's not any - there wasn't any particular unexpected outcome.

Interviewer: No.

Female: No.

Interviewer: So it's all as you'd hoped and imagined essentially.

Female: Yes.

Interviewer: Yeah, okay.

Male: My only trouble…

Female: I can't remember anything.

Male: No, no, like I said we…

Female: Unexpected outcomes.

Male: My only comment would be that some of them have gone quite a way to making things simpler and some of them have stayed exactly the same, just reformatted some things. There's one that I was thinking of the other day. There's nothing that's untoward or anything.

Interviewer: No.

Male: Where it's been simplified it's probably been simplified for the benefit of the quantity surveyor rather than the actual builder.

Interviewer: Yeah, yeah.

Male: Yeah, exactly right. I mean there are some things they've tried to just - that's getting a bit tiresome, but in my mind the more detail you provide, the better the price.

Interviewer: Yes.

Male: So any of those little ‘enhancements’ are detracting from your core skill. Anybody can measure that it's just four walls and the ceiling and the floor, but if anyone's got to measure reveals, jambs and all this sort of stuff, and know some construction detail, which is what, when you're building is where the cost comes. Like I said, they're insignificant in terms of measurement, but they actually are where all the money is on the site.

If you start to lose too much of that, bills of quantities might just be a schedule of work.

Interviewer: Yes. This stuff mirrors a lot of the comments apart from contractors actually. As a contractor obviously they're quite happy just package it up and fire it out and they have been having a few issues with subcontractors not understanding it.

Male: yeah.

Interviewer: Then they've just been saying well look, we've got your headings now essentially, so we'll go and do our own thing, put a price together and then just split it over your items essentially. But again, it's because it hasn't really diffused down through the supply chain I wouldn't say based on what I've found.

Male: That's putting it - yeah, that's the biggest probably criticism still staying at the same high level QSs inputting their years of experience rather than engaging further down. That is a big concern really.

Interviewer: Yeah. I mean what's quite telling is obviously I'm similar to you, I've picked it up and we've been using it and teaching it as you've been using it, but then speaking to some contractors they've actually NRM2 bills through the post to tender and didn't even realise.

Male: Yeah, they didn't know.

Interviewer: Didn't know. Then they've priced it as they would normally and unfortunately made errors which it's - well that's their own fault isn't it, but unfortunate.

Male: Yeah, but you still get into that contractual argument because they'll try and play that game when they get to the detail.

Interviewer: Yes.

Male: Like I said, the biggest disappointment I've got is where we've got too much CDP, like I said, you try and do CDP in a full measure BQ, it just clouds the issue. It gives the contractor an opportunity to put a sum of money in and then come back later on with all the detail. So if we can move away from that and listen - almost adopt - allow CDP to be sitting there with it, in my mind I'd have said look, we'll go full design or you go - or they're two separate contracts and pulling away from the main one.

Interviewer: Yeah, so a section of one.

Male: That's what we try and do, we keep them separate.

Interviewer: Yeah, that makes sense then. Okay, just conscious of the time.

Male: No, it's fine, that's fine. I've got another five minutes.

Interviewer: Okay, so just a few points. We may have touched on some of this, so I'll try not to repeat myself too much. In terms of the advantages of NRM2 then, anything that stands out. Essentially to try and summarise what you've already said - link in with NRM1 is a big benefit.

Male: Yeah, well that's the big benefit. Like I said that consistency is the thing I would say is probably the main advantage of it. In terms of any ground-breaking changes in the way we measure, none at all.

Interviewer: Okay, perfect. In terms of how you've adopted it, it sounds like it's been quite seamless and you haven't had any real compatibility issues with your practice.

Male: Just libraries for the software. We're obviously a core user of Causeway software and they were fairly proactive. They made sure the software had its library as it was issued. So not really a problem there. Obviously the library has a few issues itself but we're just dealing with those as we come across them.

Interviewer: Yeah. As far as you're aware you haven't had any issues with the supply chain, but that's something that's still…

Male: Probably - mm, yeah, a couple of the projects they're not supply chain issues, they're more method of measurement issues, where there's some grey areas still and what's included and what's not

included, has it been measured correctly. Upstands is a good example about different levels. Banding of upstands and things, we've caught out a couple of those, but other than that nothing…

Interviewer: Nothing serious though?

Male: No.

Interviewer: No. Okay. Sounds like you haven't found it difficult to understand or use - you've adopted it and you've been using it quite proficiently.

Male: Yeah.

Female: Yes.

Interviewer: Yeah. Okay. You've already talked about training, perfect. You didn't trial it.

Male: No.

Interviewer: So you went straight for a live project.

Male: Yeah.

Interviewer: Do you think it's impossible to trial something like this?

Male: Like I said, in a commercial organisation there's not that appetite - is probably the word.

Interviewer: Yes.

Male: If you were doing this as a private person and you needed to be guaranteeing the service you might, as you did, take an old bill measurement and then do a comparison. We could have done that I guess, but like I said, the level of skill of the guys that we use have, they were all hard-core measurers. If they struggled and I got any feedback on that, obviously that's where I would have intervened and said okay, well we need to just check everything that's coming out of this.

Interviewer: Sure.

Male: The good thing also we've got a cost plan to check it against.

Interviewer: Yeah, it's good.

Male: So there's always that last balance check that we're in the right ballpark in terms of quantities…

Interviewer: Yeah, I always look at - I just use the same drawings from last year's course work. [Laughs].

Male: That's a great comparison because obviously you are just doing the same thing with a different set of rules. Unfortunately, we don't get two jobs the bloody same. [Laughs].

Interviewer: [Laughs].

Male: Ever.

Interviewer: So essentially the time constraints and that commercial appetite it's impossible.

Male: One, the need to do it and just to verify that you're going to measure something - I mean if you're doing it for efficiency benefit then obviously I would say yes, but I don't - we're paying our guys hourly so I manage that target - we set a target and obviously if we overspend the target we'll have to justify it and then they'll be probably an enquiry into why we did that. If I bring it in under budget then it's the benefit of the method of measurement, so be it. So like I said, most of our time is trying to extract the proper information from the architects and the engineers.

Interviewer: Yeah, sure. Just thinking a bit beyond G&T then, have you seen anyone else using NRM2? Have you seen any BQs from anywhere else?

Male: We never get exposed to it. I know other practices are using NRM2 because we go to BIM things where we talk about it.

Interviewer: Okay. But it's quite difficult to observe that other professional practice in our industries then…

Male: Yeah, it is. Like I said, it's basically what's under the table isn't it?

Interviewer: Yeah.

Male: They are obviously using it. It's been adopted. I'd love to hear what the contractors think of it, but…

Interviewer: Have you heard any reports because you mentioned about the conferences and things and you speak to other people.

Male: No, I mean most people have taken the same pragmatic approach as us. It's obviously been put out by the RICS. They obviously think there's a benefit of it and I agree with that in terms of any method of measurement that's trying to make things more understood by everybody. It is a move in the right direction. As I

said, whether it's gone the whole way to reflecting how the industry's moving as a profession, I don't know. Like I said, for that last 20 years no BQs were going to be produced, but people are still measuring.

Interviewer: Yes. Well quite, I mean all contractors I've spoken to, I haven't found one - well I found that one that's used NRM, but didn't use it particularly well.

Female: Do you know why?

Interviewer: Essentially it was because they didn't understand really the differences between the two and they didn't really realise they were pricing NRM2. They thought there was an error in the prelims. So I didn't go into detail because it wasn't my project it was just this sort of situation, but he was very, very upset about it shall we say, to the point where he said, normally there would price zero risk on a BQ but he says if he gets another NRM2 bill in, then he would have sit and think about prices to make sure of that.

Male: It's a risk.

Interviewer: Yeah. Smaller scale turnover of £500 million turnover contractor. So not insignificant.

Male: No, no.

Interviewer: But…

Male: Very surprised though that he couldn't tell the difference in the formatting.

Interviewer: Yeah.

Male: I mean obviously ours look the same.

Interviewer: But he said - what did he say? I think he said in the last 12 years he's been at that company. That was only the third BQ he'd had through the door though.

Male: In 12 years?

Interviewer: Yeah. So you can kind of understand maybe…

Male: Yes. The wording would just not be familiar.

Female: to be fair, before 2008 most contractors - most jobs were based on design build.

Interviewer: Yes, absolutely.

Female: In 2008 onto I think 2010, 2011…

Male: Yeah, but prior to that…

Female: …we were…

Interviewer: Depends on your sectors as well doesn't it.

Male: Yeah, I mean we were doing more bills in the 80s - sorry, mid 80s to mid-90s onto the 2000s and BQs were being done all the time. But probably in the volume fivefold to what we're doing now.

Interviewer: Yeah, absolutely. I was the same.

Male: There was the same after 2008 there was a - oh, hang about, we need to get cost certainty. Any pound I want to spend I want to guarantee it's going to buy something. So that's when BQs came a little bit more in the forefront.

Female: I think so.

Male: Yeah, they did, definitely. We saw that.

Female: Came bit a little bit more I think.

Interviewer: Some of the contractors I've spoken to, their actual pricing systems were based on SMM6 still.

Male: Oh wow. Again, that's picking up on more detail. They know that if they rope in an SMM6 into an SMM7 BQ they're actually covering things that included…

Female: That's an interesting question. I haven't used SMM6 but I heard that SMM6 is better than SMM7.

Interviewer: Yeah, well I've never measured six, but I've used six on a project when I first started.

Female: Because SMM7 had gone too far.

Interviewer: It's heavy going though, SMM6.

Male: It's very heavy going.

Female: I haven't used it before. I can't comment on that.

Male: I've got an SMM4 in my office that was given to me as part of the - and I've got BQs that were originally done where you were measuring every nut and screw and so the industry's moving away from trying to provide too much information, but then I think contracts then where a lot simpler now we're trying to use a BQ to

do £50, £60, £70 million residential scheme. There's a lot of repetition. It's not really suitable.

Interviewer: If I had to summarise it, a lot of the contractors they're either in the camp where they're doing exclusively D&B and have been for a long time. Anything they get from the client and they're kind of just put to one side…

Male: Do their own thing.

Interviewer: …get on and do their own thing. Of those, half of them are doing it in house, measuring, half of them subcontract that.

Male: Send it out, yeah.

Interviewer: Then again, some of them aren't - some of them are doing quants in house, but then telling the subcontractors that they're just indicative, we're not taking the risk on them. So just passing it down. Others are just packaging it up and sending it out, but then they're experiencing difficulties in getting prices back.

Male: That's the issue I think, yes.

Interviewer: Subbies just don't have the time to do it.

Male: Time to do it. Especially now we're ramping up again. So anything which can take a little bit of time off will then…

Interviewer: Yeah that's it. So everyone I've spoken to is quite scared of NRM because they're sort of saying, look, if I get it I don't understand what's in and out.

Male: Well that was our concern. Obviously the item coverage is slightly different and you need to read it a little bit closer. But the descriptions, hopefully have been - BQ descriptions are still full enough to give them an idea of where to look and what to allow for…

Interviewer: Oh absolutely, yeah. I think it's that unknown again isn't it.

Male: Yeah, if they're doing it without a BQ.

Interviewer: Bearing in mind most people haven't seen it.

Male: If they try and do it without a BQ, like you said they've got know that inside out. They've got to know it better than SMM7 because they are going to catch a cold on what they've put the money where.

Interviewer: They're just using what they've always used really.

Male: Yeah. So there will be a risk of that.

Interviewer: Yeah. Okay. Right. I'll just stop this. Thank you for that.

Male: That's fine. Perfect timing for me.

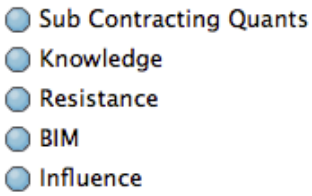
Appendix C – Extract from Research Diary

As the coding process was undertaken, new nodes were created as deemed necessary. Care needs to be taken not the force the data into existing nodes for ease, while being conscious of a fast growing node structure (Richards 2015). In order to demonstrate this, the following is an (edited) extract from the author's research diary and shows the ongoing thought process whilst coding.

5th August 2015

Continued coding transcripts. Deleted the sub categories under *risk* node as it was felt that this would be better segregated once all data pertaining to risk had been identified.

In addition, several new nodes were created as follows:



Screen shot 5th August 2015 showing new nodes

It was decided that *influence* was an important factor, even though up to this point the coding of influence has been predominantly under the *diffusion concepts* node. This node was added to see if influence can come from other sources and to not restrict the analysis to the three diffusion concepts. In addition, *sub-contracting of quantities* was identified as being common practice, so this has been added.

Knowledge is a broad heading, but it was deemed necessary to capture all occurrences of knowledge of NRM to see if there is anything worth discussing later. Up to this point coding was relying on *awareness* and *seeking further information*, without considering what knowledge an actor may already have on NRM.

Resistance was added to document any aspects that may resist the adoption of NRM, while the *BIM* node was added as this was mentioned in one of the interviews and may be a possible lead for later analysis.

Other thoughts revolved around *Structural Equivalence* being coded almost identically to the attribute of o*bservability*. Without being able to observe others, SE cannot function and so cannot influence the diffusion process. It was decided to leave both nodes for now, as this could lead to some important discoveries later on.

6th August 2015

Continued coding transcripts. *Influence* is getting very similar to the three *diffusion concepts* and will need to be rationalised to avoid any duplication later.

It is getting more difficult to distinguish between *SE* and *Cohesion*, so need to refer back to the literature to ensure a strict definition is applied when coding.

Adapted SMM7 and *Builders Quantities* are very similar. It was decided to keep them separate for now, but a quick look at the nodes identifies that where Builders Quantities's are being used, they are using a form of SMM7, even if not specifically mentioned.

The *Trigger* node is too similar to the *Adopt* and *Reject* nodes. Will continue to populate these but may need to merge later.

Initial *awareness* is good for NRM, but no cases so far seem to take it any further. The *felt need* doesn't appear to be there, and there doesn't appear to be any external influence to encourage adoption – certainly not from the contractors.

It was decided to merge the *measured elements* and q*uantification* nodes. These were very similar and it was starting to get confusing as to which to code data into, so these were merged and can be deconstructed later if required.

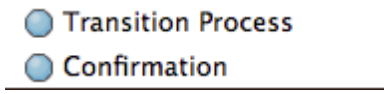
It is getting difficult to remember all the nodes when reading the text. It is felt that some are repeating, such as i*nfluence / Cohesion / SE* etc. also, *resistance* is very similar to *barriers*. *Existing practices* are also very similar to other aspects, so this node will need some more detailed scrutiny.

On reflection, all *triggers* can be put together, as the attribute data clearly identified who has adopted and who hasn't. There is a need to be more general with the data where the decision is made, and group them all under *trigger* not *adopt/reject*. Maybe rename it 'Decision Rationale'? Decided to move all data into *trigger* for now and see how this progresses.

10th August 2015

Continued coding at existing nodes. Plan from this point is to complete all transcripts and then rework them to clear up the nodes and also look to create more hierarchical trees, although care is needed with creating too complex trees, as the software can search using Boolean logic, which negates the need for too complex structures with repetitive child nodes.

Two new nodes created following coding of two more transcripts:



Screen shot 10th August 2015 showing new nodes

This is because one case reported the adoption of NRM, and was referring to how staff were experiencing a period of transition from one method to another.

The *confirmation* node was created as one adopting case was referring to how he would now use NRM on future projects – this is something that needs revisiting with the previous cases.

Awareness -> knowledge. How does this transition work? Some cases were aware, but then didn't pursue any more information - Why? Some proceeded based on perceptions of NRM and didn't adopt - this without even seeing the document.

Those that did seek more information – how did they? What happened then?

Once again, *observability* is very close to *SE* and needs further consideration.

11th August 2015

Continuation of coding. As noted before, *builder's quantities* seem to be basically *adapted SMM7*. When rationalising the nodes, these need to be combined for clarity.

The relationship between *knowledge* and *barriers* is starting to become interesting. A lack of knowledge seems to be a barrier to adoption at this stage, but then so does some perceived knowledge as actors are rejecting without possession of the facts about NRM.

Attributes appear to be a way of obtaining knowledge of the NRM, but not a way of becoming aware of the NRM, so *knowledge* and *awareness* need to be kept separate as already proposed in the synthesis chapter.

Seeking more information is very similar to the *diffusion concepts*, so need to undertake a more detailed analysis to see where these fit.

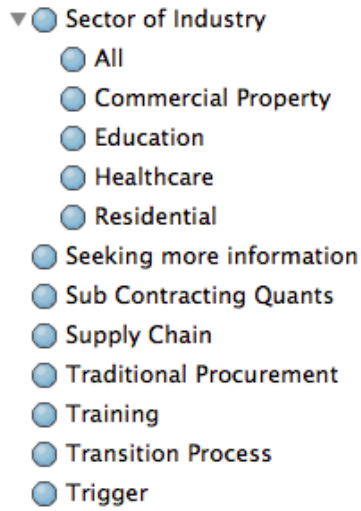
Barriers could be barriers to adoption, or possibly barriers to the attributes, for example time pressures seem to be limiting the possibility of trialling the NRM.

All transcripts first wave coded.

13th August 2015

Current nodes look as follows:

- Accountability
- Attributes
- Awareness
- Barrier
- BIM
- Communication
- Confirmation
- Consequences
- Design and Build (D+B)
- Diffusion Concepts
  - Cohesion
  - Structural Equivalence
  - Threshold
- Existing Practice
  - Adapted SMM7
  - Builders Quants
  - CSA
  - Lump Sum – Drawing…
  - NRM
  - SMM6
  - SMM7
- Felt Need
- Frameworks
- Influence
- Knowledge of NRM
- Negatives
- Opinions
- Organisation influence
- Perceptions (not facts)
- Positives
- Prior Conditions
- Quantification
- Reconsideration
- Resistance
- RICS
- Risk



Screen shot 13th August 2015 showing node structure

The node structure needs to be rationalised, and look for commonality and differences between similar nodes. Also need to look at parent node possibilities.

Placed *D+B*, *traditional, frameworks* and s*upply chain* under a *procurement* parent node. This data is for context, as the procurement route influences the measurement practice.

Changed name of *existing practice* to *current measurement practice* to avoid any overlap or confusion with the *procurement* nodes.

As already identified, both *adapted SMM7* and *builder's quantities* nodes are very similar. Further inspection reveals that most respondents when referring to builder's quantities refer to it as being loosely based on SMM7. For the purposes of this research these nodes have been merged to a *builder's quantities* node. This is supported by an extract from the DM - CE/C/£M/M respondent who stated

"What is builder's quants? That is a big question because everybody's interpretation of builder's quants is different. We caveat it that it's SMM7 but it's also builder's quants because you are never going to pick up all of SMM7 in two weeks of taking a job on."

Communication node deleted. Closer examination of this showed that the few items of coded text could be placed under other nodes, particularly the *Cohesion* node, as this deals with face to face communication. May need to reinstate this on further examination of the *Cohesion*, *Structural Equivalence*, and *Threshold* nodes.

A parent node has been created for the *diffusion journey*. This was necessary to group the diffusion topics, and provide some clarity to the node structure. Care was taken not to force the data, and nodes have been left as individuals where required.

Deleted *positives* node and *negatives* node. All aspects of these nodes were coded in *attributes* so will revisit the attributes node and apply a finer coding of this node at a later stage.

Need to consider the rejection of NRM – was this passive or active rejection? How do I define these two terms?

Thresholds can operate at an individual level and at a system level – need to look at this.

Need to consider strong and weak ties in terms of the communication and influence on actors.

Cleaned up the nodes relating to NRM. The Current Practice node had some data that was relevant to more nodes, so this was recoded and cleaned up to be more reflective of the title.

Knowledge of NRM needs to be analysed and maybe split into good/poor/none and identify the source of this knowledge? This is an important aspect so some finer coding could benefit the analysis. Could also consider applying a constant grading to allow coding within other nodes, such as *influence, opinions, perceptions* etc.

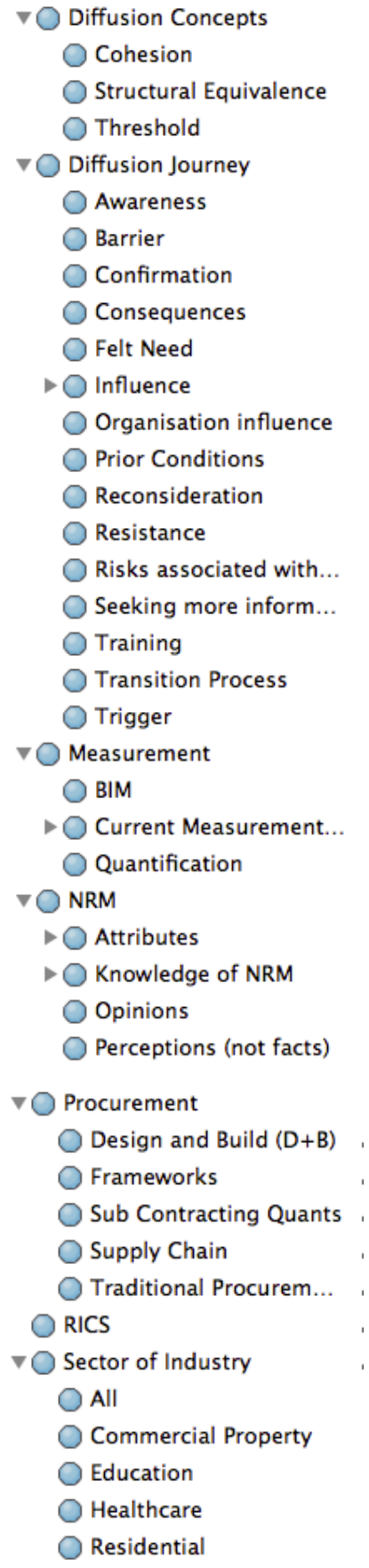
Trigger could be for adopt or reject – This data is stored as an attribute for each case, but this contains no details on the rejection as to whether it is passive or active.

18th August 2015

Fine coding continues. Essentially each node is now being looked through to see if it will benefit from a finer coding tree system. As some nodes do not contain vast amounts of data these will be left alone to allow a broader reading and analysis to take place. Need to avoid too fine coding as this could lose the comparative view of the data within the software.

Where finer coding is taking place this is being justified within the node memos which will be discussed in full during the analysis.

Current Nodes look as follows:



Screen shot 18th August 2015 showing current node structure

What can be seen here is that the overall structure is more hierarchical and that several key parent nodes have been developed from the initial list of nodes. The key headings are now *diffusion concepts, diffusion journey, measurement, NRM, procurement, RICS* and *sector of industry*. These contain the various child nodes, which will form part of the analysis chapter.

What is evident from these extracts is that the coding process went through several stages where each piece of coded text was carefully considered and placed in the appropriate node.