
# THE IMPACT OF TECHNOLOGICAL INNOVATION ON THE ROLE OF THE QUANTITY SURVEYOR IN INDUSTRY

**by**

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# COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE
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# ABSTRACT

Rapid advancements in information technology has created a variety of new construction-related software packages and applications that have a significant influence on the role of quantity surveying. The extent of these developments need to be determined, as well as the examination of mitigating influences, which might have an effect on technology usage. The main objectives of this study was to determine whether emergent new technologies duplicated the activities of traditional QSs, and what, if any, areas and services rendered by QSs might be affected if new software packages and applications were embraced. The study examined whether these new technologies were used by QSs in their firms and practices to advance the range of the services they rendered to the construction industry, and whether QSs were embracing their full potential.

This study used quantitative methods and utilised questionnaires as the survey instrument for data collection. Relevant previous studies on technology and its potential to affect operations in construction were researched to guide the research design and methods. The collected data were statistically analysed using the Statistical Package for the Social Sciences (SPSS) v 25.
A sample of 178 QSs were drawn from the Durban area who were self-employed QSs as well as QS professionals employed in industry. The Association of South African Quantity Surveyors (ASAQS) and the South African Council for Quantity Surveying Professionals (SACQSP) databases provided the contact information of registered QSs practicing in Durban, KwaZulu-Natal. QSs without professional affiliations were also surveyed.

The findings of the study sought to improve the services currently offered by QSs and the potential of technological advancements and developments. This research found that larger firms in terms of annual turnover, employed more QSs; barriers to new technology adoption created limitations on technology acceptance; and high performance expectancies increased the ease of the use of technology/effort expectancy and subsequent acceptance of new technological advances. Further, the study found that new construction-related software packages and applications did not duplicate and affect the roles, functions, activities and services of traditional QS in the construction sector and that QSs had in fact embraced new technology and the potential it offered. The study also found that the acceptance determinants of technology usage affect the adoption of new technology by QSs, and in particular, social influence and top management support were the primary determinants for user acceptance of new technology in the QS industry. The findings also suggest that qualification has emerged as the biggest agitator to determinants of technology use, and that social influence and top management support are the biggest proponents for user acceptance of new technology in the QS industry; and this requires further investigation.


KEYWORDS: Quantity surveying, technology acceptance, Software, Innovation

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **AO:** | Area of Operation |
| **ASAQS:** | Association of South African Quantity Surveyors |
| **Ba:** | Barriers |
| **Be:** | Benefit |
| **BIM:** | Building Information Modelling |
| **BoQ:** | Bills of Quantities |
| **EE:** | Effort Expectancy |
| **Exp:** | Experience |
| **IBM:** | Internal Business Machines |
| **IRC:** | Individual Resistance to Change |
| **IT:** | Information Technology |
| **LIMIT:** | Limitations |
| **MM:** | Measurement Methods |
| **NTA:** | New Technology Adoption |
| **PE:** | Performance Expectancy |
| **QS:** | Quantity Surveyor |
| **QSs:** | Quantity Surveyors |
| **Qual:** | Qualifications |
| **RICS:** | Royal Institute for Chartered Surveyors |
| **SACQSP:** | South African Council for Quantity Surveying Professionals |
| **SI:** | Social Influence |
| **SNE:** | Size in terms of Number of Permanent Employees |
| **SAT:** | Size in terms of Annual Turnover |
| **SPSS:** | Statistical Package for the Social Sciences |
| **TDS:** | Technology Driven Services |
| **TMS:** | Top Management Support |
| **TP:** | Technology Potential |
| **VU:** | Voluntariness of Use |

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# CHAPTER ONE

# INTRODUCTION

## 1.1. Introduction

Historically, in most construction projects, it is typically the Quantity Surveyor (QS) who determined the amount of work to be undertaken from the architects' drawings/plans, with full descriptions and quantities required of the material to be used in various construction activities. These descriptions and quantities for the entire project were contained in a document known as the Bills of Quantities (BoQ) (Odeyinka, 2009). Before the introduction of this comprehensive BoQ, each contractor and tradesman was required to develop their own particular BoQ. Over time, a consultant specialising in the production of BoQs came into being - namely a Quantity Surveyor. A single QS or QS firm compiled one BoQ document, which was then utilized by all project stakeholders as a means to manage the construction project finances and costs. The costs related to these services was shared between them (Othman & Mia, 2008). This development resulted in the current practice where the costs of the QS and resulting BoQ are borne by the client, the ultimate beneficiary of this arrangement. QSs are adept at dealing with all financial matters related to construction projects, from start to finish as well as being responsible, for example, for calculating the materials and labour used or to be used, preparing the legal and contract documentation and controlling all project-related costs (University, 2010). The QS produces a total shopping list essential for the built environment and project completion and preparation of final account (Rashid, Mustapa & Wahid, 2006).

Currently, QS functions involve numerous activities, which include the following traditional and evolved roles, namely:

**Traditional Roles:**

- Providing Approximate Cost Estimates;
- Advice on Procurement;
- Cost Planning;
- Measuring Items on Site;
- Preparing Bills of Quantities;
- Preparing Schedules of Works;
- Preparing Financial Statements;
- Controlling Costs Throughout Project; and

- Assessing and Negotiating Tenders.

**Evolved Roles:**

- Investment Appraisal;
- Analysis of Financial Risks;
- Project Planning;
- Contractual Dispute Resolution;
- Facilities Management;
- Project Management;
- Insurance Valuations;
- Providing Insolvency Services;
- Measuring Environmental Impact and Costs;
- Managing Maintenance Programmes; and
- Cash Flow Accounting Forecasts (Fanous, 2012).

It is these activities that distinguish the discipline of quantity surveying from that of simple "brick counting." (Moss 2004 as cited by Cunningham, 2014). Quantity surveyors may be described as the cost managers of construction, who are initially involved with the capital expenditure phase of a building or facility which comprises the feasibility, design and construction phases, as well as the extension, refurbishment, maintenance and final demolition of a facility. QSs give guidance on design costs and budgets, prepare bills of quantities, check tenders, prepare interim valuations and advise on the value of variations. The contract price/sum is more often than not based on a bill of quantities which quantifies, as far as possible, every aspect of the works. The work activities of a QS include getting involved in interdisciplinary work, such as process engineering, chemical engineering plants or oil rigs, and as such need to understand all aspects of construction over the whole life of a building or facility (RICS, 2015).

The rapid growth and development of comprehensive user-friendly technology for the construction industry that include estimating software present a possible threat to the traditional roles of the QS in the construction sector. For example, the core traditional role of estimating the amount of resources required for a building project or measure and quantify all elements of a project can now be automatically performed by various software systems (Fanous, 2012). Consequently QSs have had to re-examine and re-evaluate the scope and types of services that they provided in the past. These include services such as facilities management, development

management, supply chain management, strategic development and portfolio advice, insurance valuations and building surveying, construction law, and construction and project management (Frei & Mbachu, 2009). Rapid technological innovative practices assist embracing organizations to achieve competitive advantage while at the same time remaining relevant (Kulasekara, 2013). Further, technology has replaced the many mundane elements of traditional quantity surveying by automating or assisting in these tasks while removing human error as far as is possible and increasing efficiency and promoting collaboration (Zhou etal, 2012).

### 1.2. Problem statement

The dynamic and rapidly evolving world of IT and the consequent development of many new construction-related software packages and applications which will potentially have a significant influence on the role of quantity surveying in the overall construction process demand a response from quantity surveyors operating in the KwaZulu-Natal province of South Africa in terms of whether these developments are perceived as an advancement, opportunity or threat to the QS profession, the extent of which has as yet not been determined in terms of performance expectancy, effort expectancy, facilitating conditions, social influence, top management support, individual resistance to change and the effects of factors such as gender, age, and experience.

### 1.3. Hypothesis

- Many new construction-related software packages and applications duplicate and affect activities and services of traditional QSs.
- Many QSs view the advent of new technology as a threat to their roles and functions in the construction sector.
- QSs regard the new technology as an opportunity to advance the range of their services that they render the construction industry.
- QSs have not embraced the new technology and its potential to improve and expand their service delivery.
- Several factors affect the willingness to adopt new technology in QS firms and practices.

#### 1.3.1. Sub-hypotheses

- Performance expectancy affects the adoption of new technology by QSs
- Effort expectancy affects the adoption of new technology by QSs
- Facilitating conditions affect the adoption of new technology by QSs

- Social influence affects the adoption of new technology by QSs
- Top management support affects the adoption of new technology by QSs
- Individual resistance affects the adoption of new technology by QSs
- Gender affects the adoption of new technology by QSs
- Age affects the adoption of new technology by QSs
- Experience affects the adoption of new technology by QSs

### 1.4. Objectives

The primary objectives of the study are:

- To explore whether emergent new technologies duplicate the activities of traditional QSs.
- To determine the areas and services rendered by QSs that will be affected if new software packages and applications are embraced.
- To establish the extent of the perceived threat of technological changes to the roles and functions of QSs in construction.
- To examine whether the new technologies are used by QSs to advance the range of their services that they render the construction industry.
- To analyse the reasons why QSs are not embracing the potential that new technology offers.
- To examine the impact of performance expectancy, effort expectancy, facilitating conditions, social influence, top management support, individual resistance to change and other factors such as gender, age, and experience on the adoption of new technologies by QSs.

### 1.5. Methodology

The methodology to achieve the objectives of this research consist of:

- Data gathering.
- Data analysis and interpretation

The research adopted will be based on quantitative methods so that numerical data can be transformed into useable statistics and generalize results from a larger sample population. The sources of information will include workshop reports, books, seminars, newspapers, journals and newsletters. During the research, questionnaires will be the primary instrument to collect quantitative data because of the quantitative approach. The literature review will be from relevant previous studies on technology and its potential to affect operations in construction Collected data will be statistically analysed using the latest version of Statistical Package for

the Social Sciences (SPSS). The findings from this analysis will be discussed and compared with the literature reviewed. Conclusions will be drawn from the analysis and recommendations will be made derived from the findings of the study.

### 1.6. Limitations

- The sample will only include a representative sample of quantity surveyors practicing in KwaZulu Natal province;
- The study will be done over a limited time period of 18 months, from July 2016 to December 2017.

### 1.7. Assumptions

The study is based on the assumptions that:

- All participants in this study will give accurate and comprehensive responses to the issues around new technology that impact their work and practices;

and

- That respondents are aware of the range of new technology that exists and how it may affect the QS profession.

### 1.8. Ethical Considerations

To comply with internationally accepted ethical standards, no reference to actual names of individuals or companies will be recorded. In this way, no individual or company can be linked to particular research completed research instruments, thus ensuring anonymity. Respondents will not receive any monetary compensation in any manner or form for participation in this study. Quality assurance will be executed in the following manner:

- Accuracy of data capturing; and
- Accuracy in calculations.

### 1.9. Structure of the study

Chapter one introduces the research problem addressed by this study. It also sets out the hypotheses and research objectives evolving from the problem. This chapter briefly describes the literature and research methodology and notes assumptions, limitations and importance of the study to the construction project environment. The terms and abbreviations used in the study are also presented.

The second chapter reviews relevant literature and previous studies concerned with the historical development and sustainability of the QS discipline, range of services and impact/influence of the emergence of technological innovation.

Chapter three describes the research design and methodology employed to achieve the objectives of the study and test the various hypotheses.

Chapter Four presents the findings of the study after data analysis. Descriptive and inferential statistical analysis of the data demonstrates/confirms the trend relative to the uptake of technological innovation in the discipline.

Using literature to substantiate the findings, Chapter Five summarizes and concludes the study including hypotheses testing and draws inferences and conclusions with possible recommendations for further study.

**1.10. Summary**

This chapter contributes to the foundation of the thesis, portraying the range in QS services and the impact of technological innovation on the profession. The reason for the review is that QSs have not yet embraced new technology to the level that it needs to. In fact many QSs may view new technology adoption as a threat to their roles and functions. NTA has the potential to improve and expand service delivery of the profession, however several factors clearly emerge as hindering the uptake of NTA in the QS profession. These factors need to be analysed and investigated holistically so that solutions to these obstacles could be formulated; this will be conducted with the major aim being the evolution of the QS profession as well as securing its rightful place in the future of the construction industry.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1. Introduction

The motivation behind this literature review is to present a generic review of technological innovation on the role of the QS in industry. Technologies rapid advance has been especially impactful on the construction industry and on the roles of its professionals. The initial segment of this section illustrates a brief analysis of traditional roles undertaken by QS professionals and explores the effects of technological advancement on these roles. Thereafter, the opportunities as well as the challenges presented by the advent of NTA are reviewed. In conclusion, a review of associations between previous research in the form of the acceptance model and its mitigating influences are provided.

## 2.2. Traditional Roles

According to Ashworth (2010), and Ashworth, Hogg and Higgs (2013), traditional quantity surveying roles involve:

2.2.1. Single rate approximate estimation;

2.2.2. Cost planning;

2.2.3. Procurement advice;

2.2.4. Measurement and quantification;

2.2.5. Document preparation, especially bills of quantities;

2.2.6. Cost control during construction;

2.2.7. Interim valuations and payments;

2.2.8. Financial statements;

2.2.9. Final account preparation;

2.2.10. Settlement of contractual claims.

### 2.2.1. Single rate approximate estimation

QSs are involved in developing estimates for various purposes during the life cycle of a construction project. The single price rate technique alludes to the diverse techniques which rely on a solitary rate connected at the pre-design phase to create a surmised estimate with the restricted data accessible at this early phase of the planning stage. (Kirkham, 2007, as cited by Soutos & Lowe, 2011).

The most generically utilized estimation techniques are the unit, superficial and approximate techniques. Different techniques incorporate cube, storey enclosure, elemental cost examination, comparative assessments and interpolation techniques.
The decision of the technique utilized is regularly impacted by the data and time accessible, the skill of the surveyor and the sum and type of cost information accessible to him (Smith 1995b as cited by Soutos & Lowe, 2006).
The diverse techniques include:

**2.2.1.1. Unit method** - This strategy is regularly viewed as a method for establishing a correlation between structures so as to appease the design team that the expenses are justifiable in comparison to different structures of a comparative sort (Cartlidge, 2002).

**2.2.1.2. Cube method** – It used to be a technique broadly utilized by architects, they used to keep a cube book for estimating reasons; when the agreement was signed between the owner and the contractor, its expenses would be divided by the cubic content, then logged into the office costing book, and the cost of another occupation could then be controlled by figuring its volume and choosing a suitable rate from the book (Haron, 2015).

**2.2.1.3. Superficial method** - The cost of a building is ascertained similar to the cube technique; however, instead of volume, the area is utilized and the aggregate cost is then the result of the cumulative floor area of all the floors, multiplied by the unit rate per meter squared (Soutos & Lowe, 2006).

**2.2.1.4. Storey enclosure method** - This technique raises the value of the proposed structure in relation to the amount of storeys a building has; the total storey enclosure unit in the building are based on square meters; the product is then boosted by the unit rate from past comparable undertakings (Ibid).

**2.2.1.5. Approximate quantities** - Viewed as the most dependable and precise technique for estimation, providing there's adequate data to utilize, and, that the surveyor is adequately experienced, quick estimation can be conducted fast utilizing composite rates and this would reduce time (Cartlidge, 2002).

**2.2.1.6. Elemental cost analysis** - This procedure developed on the premise of correlating the estimation of a proposed structure with other finished structures so as to ensure its feasibility. (Kirkham, 2007, as cited by Soutos & Lowe, 2011).

**2.2.1.7. Comparative estimates method** - This technique depends on the price of components for built structures linking comparable categories while instituting price changes for every one of them by implementing changes in materials and constructional strategies (Soutos & Lowe, 2006).

**2.2.1.8. Interpolation method** - Interpolation method is based on the same idea as the comparative estimates method with the difference that the cost per meter square is given for the whole building rather than elements of it (Ibid).

### 2.2.2. Cost planning

Elemental cost planning is the breakdown of the cost limit into cost targets for each element of the building. It provides a statement of how the design team proposes to distribute the available budget among the elements of the building, and a frame of reference from which to develop the design and maintain cost control (BCIS, 2009 as cited by Song, 2014).

Expense forecasting including asset evaluation, life-cycle pricing and price analysis demonstrates supervising the cost of a venture so that the offered price is within the parameters of the initial estimate. Cost planning alludes to assigning a value to money on a project (Othman & Mia, 2008). Efficient price forecasting grew in urgency, ever since the depression that occurred in the year 2000 (Matipa, Cunningham, & Naik, 2010).

### 2.2.3. Procurement advice

QSs develop significant parts of the tender documents that needs to be utilized by contractors in the tender process, overseeing and mediating tenders and finally in tender awards (Mbachu, 2015). Procurement can be separated into two primary choices, price ahead of time strategies and cost-repayment techniques. Many other procurement techniques are utilized which are based on cost influences, the impact of cost and time, and customer's needs and spending plans. Therefore, the QS may endorse multi-procurement strategies which also empowers the customer to oversee the impacts of cost and cost, while proceeding to permit space for managed plans, advancement, successful expert administration and contractor inclusion. Crucial to this technique, is the prompt procurement of reports which will sanction the acquisition of the

primary contractor who will supervise the assigned sub - contractors; although the key to this strategy is common comprehension and an intimate working connection between all part players. The QS plays an imperative undertaking in the completion of the development (Ashworth, 2004 as cited by Beukes, 2012).

### 2.2.4. Measurement and quantification

Measurement and quantification alludes to the computation of the quantities of the work products that must be finished to complete a venture utilizing specifications and drawings as contribution and in addition unit value calculation of measured work products (Ogunsina, Ugochukwu & Udoye, 2015).

### 2.2.5. Document preparation

A BoQ is a document or a “book” prepared by the QS, consisting of a comprehensive account of the entire list of items and processes required for construction. Every one of these items contains a full summary of workmanship, material and labour needed for the work process and its accompanying quantity (Rashid, Mustapa & Wahid, 2006). It is essentially arranged with the specification, list of drawings, and form of tender and preliminary bill creating a tender document. The start of the QS profession is traced back to England to early 1800’s, and the term "Quantity Surveyor" was coined in 1859. The BoQ also surfaced in the 1800s, shortly after the Industrial revolution; initially QSs represented master tradesmen, measuring the work after completion, good for use in making payments to staff as well as the preparation of final accounts for the client to claim for payment (ASAQS, 2006). Each contractor had to produce precise estimates for the development value, required for submitting a bid or tender, which was produced by measuring and quantifying the amount required of all materials and labour needed to finish the construction, described as preparing a BoQ for the project. This created multiple duplications of effort, as each contractor prepared their own individual BoQ for the same project, utilising quantities from the architect's drawings. It was more economical to employ one surveyor who measured the work and prepared the one set of BoQ for the entire project and its role players. Once prepared, the potential contractors price the BoQ with calculated rates per unit for each measurable item and then submit these as tenders to compete for the development. The QS cost will be shared between them or the successful contractor will pay the surveyor and include the payment in their bids (Rashid, Mustapa & Wahid, 2006). The BoQ remains the document in use with the exception of a few small adjustments as well as the fact

that the client now pays for this service. NT has transformed this lengthy procedure to a more efficient automated one (Ibid).

### 2.2.6. Cost control during construction

A decent cost control and auditing framework provides the customer with a full oversight of all expenses as well as warning him of potential budgetary overruns.

The two goals for cost control and auditing remain, an estimation of the ramifications of the possible changes, as well as that of such changes on the total contract cost (Architectural, 2006). Cost control exists to assure that the customer secures great quality and benefits (Seeley, 1997 as cited by Gee, 2010). Cost control should be actioned constantly over the whole development. The QS is the professional that controls the cost of the development in the post-contract phase. He does this by observing any variations to the agreement, executing a budgetary control framework and accounting on the development position status on a month to month premise, which is set up by the QS to give an account of the monetary status of the development, keeping in mind that appropriate monetary control necessitates continuous cost accounting (Gee, 2010).

QSs are accountable for undertaking the costing of works of a development. Other roles include cost control and construction supervision. Hiew & Ng (2017) determined that as soon as a variation order is given, pricing of works must occur; forming a part of a rigorous cost control routine. Later in the build, when time is limited, less costly decisions need to be utilised; here the QS needs to recommend cheaper trade-offs to variations which would assist in final account preparation (Bakar, 2016). Tradition prescribes that devising a spending plan features a three stage budgetary design (Ferry, 2003) affect the procedure constructively (Kinney and Soubiran, 2004 as cited by Matipa, Kelliher & Keane, 2008) analysing fulfilment of the outline and simplifying the development scheme; supplying fundamentals for cost engineering, usability investigation, and model changes; creating model construction plans; and illumination of planning procedures and accompanying issues. Step two: pricing projections and supervision of the model procedures. This comprises of creation of the guideline; determination of an acceptable outcome; and price supervision of the construction plan. Step three: price supervision of the acquisition and development phases (Matipa, Kelliher & Keane, 2008).

### 2.2.7. Interim valuations and payments

This involves the checking of the primary contractor’s claims for any inadequacies such as; any increases in the costs of labour, raw materials, fees, additions and taxes.

This can also involve, the application of cost modification change formulas to totals contained in the interim valuation (Sui Pheng, 2013). A QS will develop the interim valuations when required by the architect who reasons them to be necessary in order to ascertain the amount in an interim certificate (Bakar, 2016).

### 2.2.8. Financial statements

Once construction starts, it is the job of the QS/estimator to constantly review and communicate a customer's financial injection into a development, this particular format is called a financial statement (FS) (Olatunji, 2012). QSs produce these statements on a monthly or quarterly basis together with the total cost of the project when finished. The QS has to check financial implications of changes plus other modifications to the build (Cartlidge, 2002).

### 2.2.9. Final account preparation

A final account is a report that outlines every item which determined the costs of the project including the computation of the final project development cost (Gee, 2010).

Final accounts and the resolution of contractual disagreements alludes to computation and payment of the applicable equity surplus outstanding at the completion of a development. Generally contractors will present claims if the computed amount is not equivalent to the work done, which will be examined by the QS. The QS will be called upon to give advice and act as mediators in disagreements (Othman & Mia, 2008).

Final account development shows the connection between development budgets and costs. Additionally, they control temporary stipends, floats, and funds set aside for emergencies as well as contract supervision. The role that information technology plays is insignificant; this is due to the high level of human contact required in the quality assessment process of the final account preparation (Olatunji, 2012).

### 2.2.10. Settlement of contractual claims

Seeley (1997 as cited by Sabitu Oyegoke, 2006) characterizes a claim as a petition or demand by the contractor as compensation for outlay or damage he has endured or as an avoidance strategy to not pay the reduced and calculated damages. A claim is said to happen when the normal work process is delayed. A claim is a complex and troublesome issue which requires professional arbitration in order to get to the root of the matter. According to Ashworth (1991) a project is successful if the building is delivered at the right time, at the appropriate price and

quality standards, and provides the client with a high level of satisfaction (Sabitu Oyegoke, 2006). One important factor that will influence the achievement of those standards and discourage dispute is the type of procurement method sort (Ibid). The QS has to gain and utilise efficient arbitration abilities, when settling contractual claims (Hiew & Ng, 2007).

### 2.3. Evolving Roles

Following the potential demise of bills of quantities additional and potential new roles evolved and include the following, namely:

- Investment appraisal;
- Advice on cost limits and budgets;
- Whole life costing;
- Value management;
- Risk analysis;
- Insolvency services;
- Cost engineering services;
- Subcontract administration;
- Environmental services measurement and costing;
- Technical auditing;
- Planning and supervision;
- Valuation for insurance purposes;
- Project management;
- Facilities management;
- Administering maintenance programs; and
- Advice on contractual disputes (Ibid).

Other classifications have referred to the roles as being traditional (six roles) (Ashworth, 2010), evolved (ten roles) (Frei and Mbachu, 2009) and emerging (five roles) (Fanous, 2012) with the traditional roles being regarded as the most important (Sonson and Kulatunga, 2014). The list under each classification in order of importance is:

**Traditional role**

- Quantification and costing of construction works;
- Project financial control and reporting;
- Procurement and tendering;

- Contract practice;
- Cost planning; and
- Construction technology and environmental services.

**Evolved role**

- Valuation (property, rental, etc.);
- Contract administration;
- Consultancy services;
- Project management;
- Insurance;
- Facilities management;
- Risk management;
- Management and dispute resolution procedures;
- Development/investment appraisal; and
- Research methodologies and techniques.

In this list of issues, the increased use of technologies to improve efficiency and effectiveness of QSs relative to many of them is possible. However, the primary concern is that there are still many that have to be done the traditional way involving QSs directly with their professional skillset. The challenge is to get QSs to embrace the opportunities that technologies present and focus on those other opportunities that allow them to demonstrate their skill and value to the construction and property sectors.

## 2.4. Opportunities

NTA in the form of various propriety software packages provides the opportunity to immediately produce measurements gained instantaneously out of an electronic design, which is usually a prolonged process. QSs need to be completely mindful of the effect that NTA could have on their immediate and eventual functions (Song, 2014). Two dimensional space (2D) refers to the traditional approach given to construction drawings depicting length and breadth to buildings; three dimensional space (3D) exist to show geometrical representation or the length, breadth and depth of an element in space; while four dimensional space (4D) includes the element of time in an extra layer of a 3D model (Van Oosterom & Stoter, 2010). The use of NTA in the construction sector fosters a creative, cooperative atmosphere. Its multi-faceted

disposition promotes designing in countless dimensions, which is termed ‘nD BIM’, involving multiple layers of information within the same model. These include 3D - object model, 4D - time, five dimensional layer (5D) - cost, six dimensional layer (6D) - facility management, seven dimensional layer (7D) - sustainability and eight dimensional layer (8D) – health and safety. A variety of professionals use information from the smart 3D designs. NTA affords QSs and owners opportunities that include system integration as well as increasing the benefits offered (Harrison, 2015 as cited by Boon & Prigg, 2012). In addition, NTA offers the added potential for QS to broaden their offerings to the owners or clients. According to the National Bim Survey (2012), measurement might be computerised, but the expertise of the QS will still be required. This is an added opportunity for the QS to provide more information to the owner (Paine & Marasini, 2013).

NTA s potential can be characterized as:

- Improved construction effectiveness;
- Augmented ability for construction companies regarding lowered model preparation durations;
- Practically eradicating calculation and model conformity flaws;
- Supplying added assistance for clients and contractors such as visualisation for conceptual design, rapid and accurate quantity take-off and estimating, data for monitoring and managing production and erection (Bavafa, 2015).

The added opportunities of NTA provide increased cooperation and fusion, and QSs need to focus on client gratification and increased duration of project effectiveness is now the focal point and as a result of this focus, construction companies are developing greater composure and cooperation directly attributed to NTA (Ballesty et al., 2007, Eastman et al., 2011). NTA has brought added dimensions for estimators. Their growth in future roles will also include BIM project management, technique visualisation, virtuality and amplified reproduction (Olatunji, 2012). Augmented reality (AR) is a new computer-based application, designed to simplify on-site 4D construction organisations through interconnecting with 3D construction plans and accompanying building information data. NTA in the form of augmented reality (AR) produces possibilities that fast-tracks growth in 4D AR management that involve all members of the project team. AR also provides the possibility to increase function and job

output in the construction sector. NTA would also offer scope for comment and development (Moore, 2013).

As a result of using 3D computer-aided design (CAD), the QS enjoys many benefits, with the most noticeable benefit, being the implementation of electronic quantities. This along with the potential of high productivity, results in 80% of time being saved in tenders' preparation, estimates of budget and cost planning (Smith, 2002). Increased NTA also brings with it increased complexity, as QSs using 3D CAD BoQs need to be careful to share data correctly, as it could result in major losses (Viljoen, 2012).

### 2.5. Challenges

A major challenge revolves around ownership of the model – architects had ownership before (Goldswain, 2016). Now each stakeholder can give input directly into the 3D CAD model produced by the architect. New forms of contract or agreement will have to be developed in this new environment to protect the interests of all parties (Gyarteng, 2014). Although the construction sector is generally conventional and resistant to change, studies indicate that QSs may be the most conventional in terms of new technology adoption The refusal to advance and re-design procedures with regards to new technology advancement will impact negatively on QSs evolution. In a survey investigating the regular processes of Australian QS professionals in firms, spanning a period of six years, targeting attitudes as well as usage of NTAs respondents felt that leaders of many firms were not inspired enough to change and re-engineer processes in order to take ful1 advantage of technological advances because they were too concerned with immediate ratification. Other respondents commented that this was the case due to companies being run by elderly leaders ready for retirement and were therefore not up to the challenge of the benefits of NTA even though this remains crucial for the future of the profession. The unavailability of an established industry median forces companies to develop their own unsynchronized methods in terms of NTA. This approach greatly reduces the positive impact of NTA on the QS profession, as unsynchronized advancement utilises software that is not in sync with those utilised by other companies. Also, the small mark ups on services offered by QSs does not assist NTA at all. Adequate experience in QS as a basic is vital. New employees require sufficient in service training. It is this experience that is vital to the longevity of the QS profession as NTA increases (Smith, 2002).

For technological advances to be accepted by QS practices, there needs to be a tangible benefit coupled with a willingness to embrace these. This may result in some of these traditional roles as described, becoming more efficiently executed, some being done simultaneously and others discontinued. Providing it is accepted that there are benefits in embracing QS technology in QS practices, it then becomes important to understand why there is resistance to such technology.

### 2.6. Acceptance Models

According to (Venkatesh etal, 2003), who in a study examined eight models of acceptance based on acceptance theory. The results of this study suggested that six constructs were important to consider when trying to introduce new technologies and systems. Providing these six factors are taken into account satisfactorily, resistance to NTA can be greatly reduced, namely

- Performance expectancy (PE);
- Effort expectancy (EE);
- facilitating conditions (FC);
- Social influence (SI);
- Top management support (TMS); and
- Individual resistance to change (Disabilities).

The key elements of the final (Venkatesh etal, 2003) acceptance model are briefly described below.

#### 2.6.1. Performance Expectancy

PE is described as the degree to which a specific innovation will help QSs achieve benefits in occupation execution; it embodies anticipated benefits, additional inspiration, work competency, preferred support and results forecasts. The theory behind PE is that it impacts on QSs adoption of new technology (Venkatesh etal, 2003), PE has a marked constructive impact on QSs intention to use an information technology (Sargent, 2012).

#### 2.6.2. Effort Expectancy

EE alludes to the ease of use attached to utilizing an innovation (Ibid). Ease of use is described as the extent that a QS trusts that utilizing a specific system would be free of physical and

mental exertion (Moore & Benbasat, 1991). EE suggests a constructive impact on PE (Sung etal, 2015).

### 2.6.3. Facilitating Conditions

FC is described as the level to which a user believes that adequate organizational support structures are in place to support usage of the system, as a result, FC will have a constructive impact on QSs willingness toward NTA and usage (Sargent, 2012). It came to light that FC was identified as impacting QS decisions in adopting NTAs (Lu, Yu, & Liu, 2005).

### 2.6.4. Social Influence

SI describes the level to which a QS observes that critical role players expect utilization of new technology, SI will have a constructive impact on QSs willingness toward NTA and usage (Sargent, 2012) (Wang, 2009).

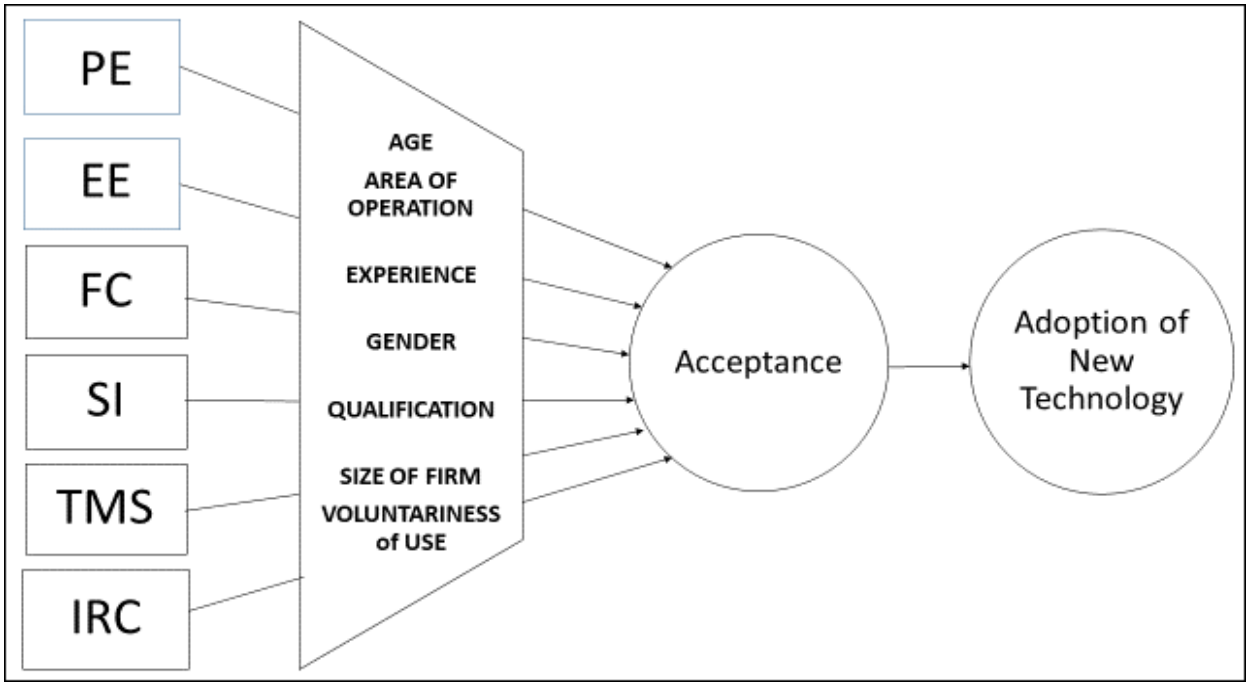
### 2.6.5. Top Management Support

TMS in terms of usage approval and encouragement is required if QSs are to receive and make use of innovations (Peansupap & Walker, 2005); this includes supervisors committing resources toward innovations with regards to expenses and possibilities, and also looking into arrangements, observing outcomes and encouraging the supervision issues required with coordinating the innovation with the supervision procedure of the organization (Young, 2008). TMS also supports better client execution, impacts positive client recognitions and enhances the general innovation selection take-up (Dong, Neufeld & Higins, 2009). Furthermore, TMS surfaced as one of the biggest empowering agents on advancement execution in construction firms (Gambatese & Hallowell, 2011).

### 2.6.6. Individual Resistance to Change

Individual RTC is defined as an individual's frame of mind to resist change and anticipate reactions to specify change (Oreg, 2003). Described as an innate aspect of the organisational development procedure, an individual's resistance to change takes place as a result of the adjustment from the known to the unknown (Bovey & Hede, 2001). In attempting to understand RTC, the following observations were considered; because people are different, they exhibit different reactions, ranging from resisting or adopting new technology implementation. Further exploration of research will be useful to discover why some people are more inclined than others to try to implement and use new technologies (Roberson, Collins, & Oreg, 2005). A

comparison of the six elements in a previous study, showed that individual resistance to change had the weakest influence on acceptance of change in technology by QSs (Haupt, 2016). It is likely that the influence of performance expectancy, effort expectancy, facilitating conditions, social influence, top management support and individuals resistance to change will be moderated by the mitigating influences of age, experience, gender, qualification, size of firm




and voluntariness of use, such that the effects will impact on NTA (Venkatesh etal, 2003). Individuals have many distinguishing attributes, which are, age, computer self-efficacy, gender and level of education, and these may have a sizeable impact on users' acceptance of social media marketing (Mulero, 2012); additionally, experience and voluntariness of use; were identified as factors that impact on the four key constructs that affect usage intention and behaviour (Arning & Ziefle, 2009).

**FIGURE 1 –Adapted User Acceptance Model** (Venkatesh etal, 2003)

### 2.7. Mitigating Influences / Demographic Profile

#### 2.7.1. Age

Age influence is where people of differing ages analyses facts in dissimilar ways which directly impacts NTA; the more mature a person, the more vulnerable they are to the physical aspects of ageing (Chen & Chan, 2011). Similarly, older people are less likely to have computer experience, be less open to change, and consequently, be more susceptible to computer anxiety (Igbaria, 1990 as cited by Abbasi, 2015), which reduces NTA among older or more mature participants.

### 2.7.2. Area of Operation

Intuitively, whether the firm or practice is a small local one, provincial operation, national or multinational one is likely to impact on the acceptance of new technology in a quantity surveying firm or practice.

### 2.7.3. Experience

(Venkatesh etal, 2003) found that experience in using technology serves as a critical factor in determining technology acceptance (Porter & Donthu, 2006). The differences between experienced and inexperienced users with regards to NTA was found to be substantial, as this impacted on users' perceived ease of use and usefulness (Moore & Benbasat, 1991).

### 2.7.4. Gender

Gender is a factor in technology acceptance, according to Mulero (2012); women find social media marketing simpler to use than their male counterparts. However, males tend to use technology more frequently than women. This finding is further supported by Li (2011) who found that the gender-based difference is attributed to the approach each sex has to NTA, as women see the social value and usefulness of technology to be higher than men do, but find it more difficult to use than men, only because men and women see and use technology differently (Ford etal., 1996; Venkatesh and Davis, 2000; Adamson and Shine, 2003; Faja and Trimi, 2008 as cited by Li & Lai, 2011).

### 2.7.5. Qualification

Qualification or level of schooling has an influence on NTA. Employees with no formal qualification, generally created management issues regarding inefficient use of technology (Nguyen, 2009). Professional qualification has a sizeable impact on perceived usefulness and users attitudes towards NTA. A higher professional qualification produces more favourable usefulness and attitudes toward NTA (Dharmarajan & Gangadharan, 2013).

### 2.7.6. Size of firm

The size of firm is yet another demographic that influences NTA; described in terms of an organization's turnover and or number of employees employed, it remains one of the most important determining factors of NTA; the larger the firm, the greater the tendency to action NTA (Ghobakhloo, 2011).

### 2.7.7. Voluntariness of use

Voluntariness of use is defined as “the degree to which, use of the innovation is perceived as being voluntary, or of free will” (Moore and Benbasat, 1991, p. 195 as cited by Donaldson, 2011), and was found to be a significant predictor of behavioural intention (Donaldson, 2011).

## 2.8. Chapter Summary

This chapter discussed both the traditional and evolving roles of the QS, the introduction of technology including both the opportunities and challenges that QSs face, the six constructs of the technology user acceptance model, influence mitigating conditions. The research methodology will be discussed in the next chapter.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1. Introduction

The research methodology provides a review of research techniques used in this thesis. This chapter then presents data on the respondents, where, how and who they were, as well as the standards used for their incorporation in the thesis. The chosen research design is then portrayed, together with the purposes behind this decision. The next step, illustrates the research instrument that was utilised, and the subsequent reasoning for such. Thereafter, the methods used for the evaluation of this data is also discussed. Finally, the ethical issues utilised are then examined.

## 3.1. Research Design

Research alludes to an exploration for wisdom and can also be characterised as a logical and deliberate exploration for relevant data on a particular subject matter. The literal translation of the word research means, a cautious examination or request for new data across all avenues of knowledge (Kothari, 2004). Research design can be characterized as a structure adopted by analysts that provide solutions to their questions. It is important to set up a work design or outline, prior to gathering or analysing data. Research design alludes to the system or structure of a research. Blakstad & Knudsen (2008) characterized research design as the framework of experimental tasks, and stated that there are both diverse interests and deficiencies for each research design. (Bakar, 2016).

## 3.2. Research Approach

Four optional research approaches exist, namely logical theoretical research, participatory action research, qualitative observational research, and quantitative experimental research.

### 3.2.1. Qualitative Approach

The qualitative survey focuses on the way in which society uses alternative ways of embracing complex real world issues, and is able to incorporate a variety of opinions by studying general conduct in a regular everyday environment, therefore exploitation of inconsistencies did not exist. The emphasis was on information that could not be conveyed with arithmetic's, as well

as on definitions and explanations, which could not translate into the creation of unique hypotheses.

There are five types of qualitative approaches, namely:

- Narrative research - researching the existence of a person. Advantages encompass the capability to vocalise and approve the encounters of individuals. Disadvantages include the fact that narrative is very labour intensive (Moriarty, 2011).

- Phenomenology - Lester (1998) noticed that phenomenology relates to circumstances beyond a person's control (Husserl, 1983 as cited by Hossain, 2015). Phenomenology actually implies the investigation of experiences (Education, 2010). The advantages are that it produces a profound comprehension of an experience; understanding of basic encounters is important to related professions and policies; involves an efficient method of information accumulation; assists in creating an organized approach to new analysts (Pinnegar & Daynes, 2006). Disadvantages include the fact that phenomenology can be challenging to grasp; this method is harsh, basic, and regular; a novice analyst has to find a tutor in order to adopt this approach (Speziale, Streubert and Carpenter, 2011).

- Grounded theory – includes the continuous description and union of groupings of content obtained from reports, and is composed from the procedure of grouping recognition, synthesis and its output (Willig, 2013). Advantages include the fact that it abstains from making suppositions; receives a more impartial perspective of human activity in a social setting (Simmons, 2006); creates a system to produce an awareness of social experiences which isn't predetermined or pre-hypothetically created with current speculations and ideal models (Engward, 2013); and it's also appropriate for examining social procedures that have invited limited previous study consideration (Milliken, 2010). Disadvantages are that the grounded theory neglects to diagnose the commitment of the analyst while blurring his information development and understanding (Bryant & Charmaz, 2007); techniques tend to create excessive information, which is problematic to oversee; problematic for novice analysts to use; lack of guidelines for the understanding of groupings (Milliken, 2010).

- Ethnography - learning from the study of humans and their culture. Advantages include the portrayal of a gaudy, ordered image of a particular situation; results are established on communities' lives; valuable when research has complicated themes; and ethnography can be used for studies that require a prolonged term. Disadvantages are that its very taxing on the researcher; ethnography deals with narration; results are difficult to duplicate; and are not greatly developed (Gulten, 2014).

- Case study - A case study is a thorough investigation from various points of view of the multifaceted and exclusive nature of a specific undertaking, approach, foundation, program or framework in a live setting (Simons 2009 as cited by Moriarty, 2011). Case studies are also not used to test theories, but rather theories might be created from case studies (Flyvbjerg, 2006). Advantages include case study's capacity to manage a full assortment of proof, inclusive of reports, objects, meetings and research (Merriam, 1988), as well as being a capable method of describing the project to an external audience. Yin (1994) introduced four functions:

1. To clarify multiple unconventional practical relationships;
2. To depict the genuine setting in which the mediation has happened;
3. To depict the interference itself; and
4. To investigate the circumstances in which the interference being assessed has ambiguous results (Tellis, 1997). Disadvantages are that its tedious to gather data, to arrange and examine it and for in-depth analysis of data (Anderson, 2010).

#### 3.2.1.1. Qualitative Research Methods

There are a variety of instruments utilized in research. Qualitative research incorporates interviews, focus groups (Wilkinson & Birmingham, 2003), observation and document review (Mason, 2002).

1. Interviews - described as a discussion between two individuals, and includes an arrangement of suppositions and acceptances about the circumstance which are ordered. Interviews are used as a method for collecting valuable data about a particular theme. The interview method is adopted when alternative research techniques are unsuitable, for instance, it is impractical to expect respondents with low literacy levels to finish a long survey. Advantages include importance of gathering knowledge and background into a subject, participants are able to portray what is critical to them, convenient for collecting

references and information. Disadvantages are that interviews are not a simple alternative, it is prone to favouritism, absorbs a lot of time, costly in comparison to other techniques and can be viewed as invasive to survey participants (Anderson, 2010).

2. Focus groups – discussions are planned beforehand by a group of people who will form a panel (interviewers); the interviewees will be seated opposite the panel, and interviewees are expected to answer whatever questions are put to them by the panel. The panel's members have some idea of what counts as positive or negative responses to each of their discussion points, and interviewees are required to provide answers to these. Advantages include Advantages include fast and simple to set up, Group elements can give helpful data that individual information accumulation does not produce, helpful in gathering knowledge into a subject where its problematic via their information gathering strategies (Anderson, 2010). Disadvantages encompass the fact that most individuals end up feeling that they did not freely express themselves, comprehension of panels questions are not fully absorbed due to setup, process is stressful, participants feel isolated, responses are criticised, rivalry between interviewees and process is not transparent (Wilkinson & Birmingham, 2003).

3. Observation – alludes to information creation techniques that involve analysts intricately engaging in live research surroundings with the goal of direct monitoring and understanding of the various facets linked to these surroundings (Mason, 2002). Advantages encompass the gathering of information where and when an experience or project is occurring, it does not depend on an individual's eagerness to supply data, and focuses on an individual's actions. Disadvantages include its vulnerability to observer bias, individuals performances are staged as they are aware of being observed - Hawthorne impact, and this technique does not provide more clarity on why individuals act the way they do (Anderson, 2010).

4. Document Review - an extensive technique for social analysis, contributing significant and fitting information via a wide range of methods inclusive of the Internet. Examples of information gained from existing documents include acts of parliament; bank statements and the internet (Mason, 2002). Advantages are is its comparatively cheap, reliable pool of foundation data, low-key, highlights undisclosed background information, and identifies gaps overlooked in other methods. Disadvantages include concerns that data might be

inappropriate, chaotic, and inaccessible or outdated, biased, fragmented, and tedious to collate and audit (Anderson, 2010).

### 3.2.2. Quantitative Approach

The quantitative survey focusses on employment of methods that explain how everyday regularities can be interpreted and accepted through generic legislation, embracing complex real world issues by specific description of the planned processes which negates external interferences and exploitation of dependant inconsistencies; however, exploitation of independent inconsistencies does occur. The emphasis was on information that could be conveyed with statistics and numbers as well as on cause and effect, which does not create, instead, it used samples to evaluate a hypotheses, which meant that the research method had to be pre-planned (Hancock, 2007).

There are four main types of quantitative research designs (Grand Canyon, 2017):

1. Descriptive – a descriptive design seeks to describe the current status of a variable or phenomenon. The researcher does not begin with a hypothesis, but typically develops one after the data is collected, and data collection is mostly observational in nature.
2. Correlational - a correlational design explores the relationship between variables using statistical analyses. However, it does not look for cause and effect and therefore, is also mostly observational in terms of data collection.
3. Quasi-experimental - a Quasi-Experimental Design (often referred to as Causal-Comparative) seeks to establish a cause-effect relationship between two or more variables. The researcher does not assign groups and does not manipulate the independent variable. Control groups are identified and exposed to the variable. Results are compared with results from groups not exposed to the variable.
4. Experimental - Experimental Designs, often called true experimentation, use the scientific method to establish cause-effect relationship among a group of variables in a research study. Researchers make an effort to control for all variables except the one being manipulated (the independent variable). The effects of the independent variable on the dependent variable are collected and analysed for a relationship (Ibid).

Information gathering techniques allude to instruments used to gather information, of which examples include interviews and questionnaires (Leedy & Ormrod, 2001).

1. Interviews - quantitative research interviews are more organized than for qualitative research. In an organized interview, the analyst will only solicit a standard set of inquiries. Types of interviews include face to face, computer assisted telephone interviewing (CAPI) and telephone interviews.
    1.1. Telephone interviews - advantages include it being less tedious, less costly, analyst is able to access individuals who have a landline phone, higher reaction rate than the mail questionnaires, can be completely electronic, saving preparation time. Disadvantages are the reaction rate isn't as high as face-to-face, the specimen might be one-sided.
    1.2. Face-to-face interviews - advantages include allowances for relationships between the researcher and participants and improve collaboration, produces the most efficient reaction rates, promotes clarification of responses. Disadvantages are not practical for bigger samples, as well as it can be tedious and costly.
    1.3. Computer assisted personal interviewing (CAPI) - is a type of personalised interviewing, where the researcher takes a laptop for data entry for instantaneous input onto the system. Advantages include time saved in information preparation and no need to carry hard copies. Disadvantages are costly to initiate and the researcher must possess IT skills (Leedy & Ormrod, 2001).

2. Questionnaires – questionnaires are described as an information gathering technique which is composed of multiple statements, questions and other stimuli that illicit information collection from participants. Created by Sir Francis Galton, the primary methods of targeting respondents via the questionnaire technique are personal contact, group of focus interview, email-based questionnaires, telephone interview (Abawi, 2013). Advantages included the fact that the supervision of data was relatively inexpensive, this simplified the collection of large volumes of data even when it traversed a wide geography; surveys also lower the risk bias, as all respondents can be asked identical questions; the majority of respondents were already familiar with surveys, ensuring ease of use. Due to the impersonal nature of surveys, respondents tended to be more receptive to using surveys as opposed to interviews; the collection and calculation of results was made simple and quick, as questions were manipulated to encourage closed or specific answers (Asante, 2016). Disadvantages of the survey questionnaire approach are; the questionnaire will be standardized, as such, there was no room for further explanations, necessary for clarification purposes; it was possible to have had some of the questions as open-ended, which produced too much of information and affected processing time; survey respondents

could respond carelessly if the survey was too long, also, if respondents felt that their honest opinions prejudiced them, they then answered questions in such a manner which was not entirely transparent (Milne, 1999). This research used the quantitative approach.

### 3.3. Research Methods

Research Methodology is described as an efficient approach to tackling an issue. It is the discipline of examining the experimentation process and refers to the strategies by which researchers approach the task of depicting, clarifying and anticipating experience. The purpose of research methodology is to provide the work design of research (Rajasekar, Philominathan & Chinnathambi 2006). The research methodology is an important precursor to research organisation. Careful thought should be given to the research outcome with respect to the adoption of research techniques (Adnan, 2011 as cited by Bakar, 2016).

The questionnaire survey approach was used, as it is often used to gather data on attitudes and behaviour; surveys were also very useful when it came to descriptive designs that did not require any experiments and stuck to reality, which was the case in this research (Mathers, 2007 ). Quantitative information was provided by questionnaires, which presented objective information for investigation. Respondents were provided with a generic cover letter, furnishing them with research specifics and their required input.

### 3.4. Instrument Design

Precise and orderly information accumulation is fundamental to managing logical research. Information accumulation enables gathering of data about research objects, depending on research technique, types of information gathering embodied; observation, documents review, measuring, questioning, or a mix of various strategies (Abawi, 2013). Research instruments are the mechanisms for information gathering, and the effectiveness of a research greatly hinges on the suitability of the instrument selected (Annum, 2017). The questionnaire was devised to analyse the argument highlighted in the research objectives hypotheses.

With reference to technological innovation and its impact on the role of the QS in industry, a series of questions were devised to analyse these distinct hypotheses. The questionnaire was devised following an analysis of the research relevant to the domain in which QS professionals were supposed to be knowledgeable. The instrument design centred around the adapted user acceptance model of new technology, based on a foundation in data framework, brain research and behavioural science, which clarified the fluctuation in individuals' aims to utilize

innovation. (E.g. Davis etal 1989; Taylor and Todd 1995b; Venkatesh and Davis 2000 as cited by Venkatesh etal, 2003).

All participants were required to submit their assessment of technology and roles and the impact of this to the profession. The literature and anecdotal evidence formed the basis of the questions pertaining to technological innovation. All respondents were asked to rate their perception of the impact of technological innovation on the various roles of the QS in industry. The reasons behind why QSs may not be readily adopting technology were issues measured as well. The benefits of technology adoption and the barriers to technology innovation were also probed. These are all issues that have been highlighted in the literature. Factors that determine technology usage as well as the barriers to technology acceptance were also gauged. The literature review formed the basis of this section of the questionnaire.

The instrument questions made use of a Level of agreement Likert-Type Scale Response Anchors (Vagias, 2006), and was a mixture of open ended and closed ended questions. Great care was taken to ensure that questionnaire statements/questions were clear, properly phrased, sensitive or embarrassing questions were avoided, and speculative questions were also averted. The instrument is made up of two types of questions, namely open ended and closed ended questions:

Open Ended Questions:

- Refers to questions that do not contain prearranged reactions, require opinions and have more than one answer. Open ended questions are utilised to promote greater dialect usage, recognizes that numerous answers can exist for one issue, and promotes open responses.
- The instrument contains does not contain any open ended questions.

Close Ended Questions:

- Generally exist as multiple choice questions. Closed ended questions permit a set amount of answers, ruling out the offering of extra data; they involve awareness and a decision among answer choices. Used for more prominent accuracy, consistency, less demanding review for the respondent, simpler classification and examination (Ibid).
- The instrument contains five closed questions, designed to obtain responses to indicate their level of agreement on factors or influence of technology adoption to QS; benefits of technology to QS; barriers of technology to QS; determinants of technology use;

knowledge and experience of technology, software and innovation; of technology on quantity surveying. (Abawi, 2013).

### 3.5. Population and sample

#### 3.5.1. Population

Parahoo (1997) characterizes a population as community from which information can be gathered (as cited by Slevin & Sines, 2000). Population can be further defined as the total number of components meeting the standards for investigation in a research (Burns and Grove, 2010).

#### 3.5.2. Sample and sampling method

A sample is defined as a limited segment of a measurable populace whose peculiarities are studied in order to learn about the whole (Webster, 1985 cited by Mugo, 2002). In the case of people, it can be characterized as a group or groups of participants chosen from a bigger populace when conducting a survey. There are essentially three groups of samples;

- Convenience sampling - analysts choose participants that are free and accessible and will be able to participate for that specific time (Flick, 2008).
- Random sampling - a method of selecting a sample (random sample) from a statistical population in such a way that every possible sample that could be selected has a predetermined probability of being selected. Under random sampling, each member of the subset carries an equal opportunity of being chosen as a part of the sampling process; and
- Judgement sampling - varies in the way in which the basic units are selected and is derived as a result of the vigilance of somebody familiar with the qualities of the populace (Mugo, 2002).

Judgemental sampling is also known as purposive sampling. Purposive sampling is composed of seven categories, which are unique to their own investigative objective (Crossman, 2017):

- homogeneous purposive sample;
- maximum variation/heterogeneous purposive sample;
- extreme/deviant case sampling;
- typical case sampling;
- expert sampling;

- critical case sampling; and
- total population sampling.

This research opted for random sampling method. The standards for consideration in this research included the population of QSs in the Durban area of Kwa Zulu Natal registered with QS professional bodies include 126 members from the South African Council for the Quantity Surveying Profession (SACQSP), 19 nineteen members from Association of South African Quantity Surveyors (ASAQS), and 33 members from the Royal Institute of Chartered Surveyors (RICS), totalling 178 members. This population is small enough to comprise the whole sample. A total of 109 out of the 178 targeted sample size responded to the surveys.

### 3.6. Instrument Administration

Questionnaires were emailed directly to participants. An appeal was made to QS professionals working in the industry to assist in the research, as they had a direct stake in the outcome of the research. Participants who responded early were then targeted to assist further by recommending other QS professionals / colleagues in order to increase responses. The data was collected over a period of two months.

#### 3.6.1. Data collection and analysis

One hundred and seventy eight quantity surveyors either employed or practicing for themselves in the Durban area of the KwaZulu-Natal province of South Africa were surveyed about their views of the impact of technological innovation on the role of the QS in industry. The sample of QSs were drawn using the South African Council for the Quantity Surveying Profession (SACQSP) database. The use of emailing respondents was adopted.

The data was collected via quantitative questionnaire surveys comprising of several sections such as knowledge and experience of technology, benefits, barriers and readiness. Almost all questions took the form of statements around the various themes which required a scaled response of agreement. Descriptive statistics were derived using the latest version of IBM SPSS and presented including measures of central tendency and dispersion.

### 3.6.2. Follow-up techniques:

The database of email addresses was from SACQSP, ASAQS, RICS and QS professionals either working or self-employed. For the first month, questionnaires were emailed to these databases every fortnight. In the second month, participants were emailed or and telephoned weekly. In survey research, response rate, also known as completion rate or return rate, is the number of people who answered the survey divided by the number of people in the sample. It is usually expressed in the form of a percentage. Initial responses were relatively slow, and totalled approximately ten (35.8%) responses per week, for the second month, due to the combined effort of emails and telephone calls, this number rose to approximately 18 (64.2%) per week. The total response rate was 109 out of 178 which represents 61% of the sample population (Shah, 2011).

## 3.7. Chapter Summary

This chapter outlined the research approach which was discussed in several sections. The population and sample size was identified as well as the sampling method. The background to the research instrument design was developed, and data analysis criteria identified. Early response individuals in organisations was used to promote survey completions with staff member. Use of easier survey input methods were adopted e.g. survey monkey. The next chapter will focus exclusively on data analysis.

# CHAPTER FOUR

# RESEARCH FINDINGS & ANALYSIS

## 4.1. Introduction

Information is accumulated utilising numerous procedures and techniques. Information in isolation has no benefit until it is analysed and effectively deciphered so that conclusions may be drawn. Researchers typically analyse gathered data so that patterns and general perspectives of respondents can be distinguished which could then be projected beyond the objective populace.

## 4.2. Profile of Respondents

**Table 1. Profile of Respondents**

| Variable | Sample (n = 108) | | |
|---|---|---|---|
| Age | Minimum | 21 years | |
| | Maximum | 65 years | |
| | Median | 31 years | |
| Gender | Male | 74 | 68.5% |
| | Female | 34 | 31.5% |
| Qualifications | Cert. | 1 | 0.9% |
| | Dip/deg. | 13 | 11.9% |
| | HD/Hon | 88 | 80.7% |
| | Masters | 7 | 6.4% |
| Experience | Minimum | 1 year | |
| | Maximum | 45 years | |
| | Median | 6 years | |
| Area Of Operation (n=98) | W.Cape | 1 | 0.9% |
| | E.Cape | 2 | 1.8% |
| | KZN | 90 | 82.6% |
| | Mpumalanga | 2 | 1.8% |
| | Gauteng | 3 | 2.8% |
| Size in terms of Annual T/O (n=43) | Minimum | R500,000,000 | |
| | Maximum | R350,000 | |
| | Median | R5,000,000 | |
| Size in terms of Number Permanent | Minimum | 150 employees | |
| | Maximum | 1 employee | |
| | Median | 8 employees | |

| | | |
|---|---|---|
| **Employees (n=75)** | | |
| **Voluntariness Of Use (n=108)** | **Yes** | 104 |
| | **No** | 4 |

The results from Table 1 show that the median age of participants was 31 years, ranging from 21 years to 65 years. The majority of respondents were male (68.5%). Most respondents, (80.7%) possessed a higher diploma or honours degree qualification. The median working experience as QSs' was six years, ranging from 1 year to 45 years. Almost all QS's area of operation was KZN (82.6%), and the majority of QS firms had a median annual turnover of R500,000, ranging from R350,000 to R5,000,000. Most QS firms' size in terms of number of employees over the last three years was a median of eight staff, ranging from one to 150. Finally, the overall majority of QSs (104) considered themselves open to new technological advances.

### 4.3. Reliability

Cronbach Alpha was developed by Lee Cronbach in 1951 to provide a measure of the internal consistency of a test or scale; it is expressed as a number between 0 and 1. The Cronbach Alpha statistic which is greater than the rule-of-thumb 0.70 for acceptable internal scale consistency. Cronbach's standard guideline for internal uniformity is as follows, namely if the reliability coefficient is less than and equal to 0.9 = excellent; less than 0.9, but more than and equal to 0.8 = good; less than 0.8, but more than and equal to 0.7 = acceptable; less than 0.7, but more than and equal to 0.6 = questionable; less than 0.6, but more than and equal to 0.5 = poor; less than 0.5 = unacceptable (Cronbach, 1951).

### 4.4. Categorisation of scales

In order to simplify the interpretation of the mean responses to the various statements presented to respondents using the 5-point scale the following categories were used (Al-Damen, 2017), namely:

- 1 to 2.33 = Low (L) level of agreement or satisfaction;
- 2.34 to 3.66 = Medium (M) level of agreement or satisfaction and;
- 3.67 to 5 = High (H) level of agreement or satisfaction.

### 4.5. Descriptive Statistics

Table 2 illustrates the results and factor loadings of the eight constructs; technology potential (TP), limitations (LIMIT), technology driven services (TDS), measurement methods (MM), benefits (Be), barriers (Ba), and mitigating influences, separated into the separate components, such as age, gender, qualification (Qual), experience (Exp), area of operation (AO), size in terms of annual turnover (SAT), size in terms of number of permanent employees (SNE), and voluntariness of use (VU) (dependant variables & components), which contribute to determinants of technology use (DTU), further separated into, performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), top management support (TMS), and individual resistance to change (IRC) (independent variables &components). The IBM SPSS tools used, involved; dimension reduction, factor analysis, with Eigen values > 1, Varimax rotation, as well as suppressing small coefficients to an absolute value of below 0.30.

**Table 2. Factors / Influence affecting Quantity Surveying**

| Constructs | Description | Research Items Used | Cor. Item to Total | Item Loadings |
|---|---|---|---|---|
| DTU | Performance Expectancy | PE | 0.182 | 0.710 |
| | Effort Expectancy | EE | 0.323 | 0.813 |
| | Social Influence | SI | 0.234 | 0.708 |
| | Facilitating Conditions | FC | 0.344 | 0.683 |
| | Top Management Support | TMS | 0.380 | 0.612 |
| | Individual Resistance to Change | IRC | 0.048 | 0.339 |
| TP | Cost estimation can be improved | TP1 | 0.337 | 0.667 |
| | Technology increases program certainty at the tender stage | TP2 | 0.508 | 0.786 |
| | Technology reduces the amount of variations during the construction phase | TP3 | 0.626 | 0.927 |
| | Technological developments can streamline the procurement process | TP4 | 0.514 | 0.892 |
| LIMIT | QS practices are too small to embrace technology | LIMIT1 | 0.595 | 0.710 |
| | Financial and time commitment from small practices is too large | LIMIT2 | 0.650 | 0.813 |
| | Upfront costs are too high | LIMIT3 | 0.629 | 0.708 |
| | Additional costs of training make technology prohibitive | LIMIT4 | 0.572 | 0.683 |
| | There is no client demand | LIMIT5 | 0.444 | 0.612 |
| | There are problems with legal ownership of information | LIMIT6 | 0.440 | 0.339 |
| | Roles and responsibilities of quantity surveyors will change | LIMIT7 | 0.452 | 0.367 |
| | There is a scarcity of available training | LIMIT8 | 0.308 | 0.315 |
| TDS | Procurement advice can be executed using technology alone | TDS1 | 0.639 | 0.648 |
| | Measurement and quantification can be executed using technology alone | TDS2 | 0.644 | 0.493 |
| | Document preparation can be executed using technology alone | TDS3 | 0.755 | 0.688 |

| | | | | |
|---|---|---|---|---|
| | Cost control during construction can be executed using technology alone | TDS4 | 0.821 | 0.878 |
| | Interim valuations and payments can be executed using technology alone | TDS5 | 0.804 | 0.862 |
| | Financial statements can be executed using technology alone | TDS6 | 0.709 | 0.556 |
| | Final account preparation can be executed using technology alone | TDS7 | 0.793 | 0.791 |
| | Settlement of contractual claims can be executed using technology alone | TDS8 | 0.647 | 0.582 |
| MM | Unit method can be executed using technology alone | MM1 | 0.786 | 0.755 |
| | Cube method can be executed using technology alone | MM2 | 0.886 | 0.836 |
| | Superficial method can be executed using technology alone | MM3 | 0.834 | 0.816 |
| | Storey enclosure method can be executed using technology alone | MM4 | 0.766 | 0.828 |
| | Approximate quantities can be executed using technology alone | MM5 | 0.824 | 0.806 |
| | Elemental cost analysis can be executed using technology alone | MM6 | 0.627 | 0.546 |
| Be | Improved efficiency | Be1 | 0.278 | - |
| | Accurate measurement | Be2 | 0.407 | 0.718 |
| | Co-ordination of all design information | Be2 | 0.524 | 0.831 |
| | Visual aid | Be4 | 0.444 | 0.811 |
| | Cost plan production | Be5 | 0.586 | 0.645 |
| | Automatic schedule/program production | Be6 | 0.490 | 0.579 |
| | Cost effective | Be7 | 0.413 | 0.929 |
| | Standardization of routine tasks | Be8 | 0.526 | 0.837 |
| Ba | Removed need for a quantity surveyor | Ba1 | 0.448 | 0.787 |
| | Liability concerns | Ba2 | 0.392 | 0.874 |
| | High cost/extra capital investment | Ba3 | 0.606 | 0.637 |
| | Less familiarity with project | Ba4 | 0.699 | 0.797 |
| | Lack of software application interfaces | Ba5 | 0.750 | 0.838 |
| | Software complexity | Ba6 | 0.695 | 0.831 |
| | Lack of standards | Ba7 | 0.628 | 0.823 |
| | Threat to services conventionally provided by quantity surveyors | Ba8 | 0.566 | 0.640 |
| | Age | Age | 0.224 | 0.496 |
| | Gender | Gender | 0.089 | 0.699 |
| | Qualifications | Qual | 0.301 | 0.700 |
| | Experience | Exp | 0.212 | 0.544 |
| | Area of operation | AO | 0.273 | 0.756 |
| | Size in terms of annual turnover | SAT | 0.304 | 0.872 |
| | Size in terms of number of permanent employees | SNE | 0.288 | 0.872 |
| | Voluntariness of use | VU | 0.269 | 0.715 |

Table 3 presents the scale and subsequent ranking according to mean and standard deviations. Scale categorization was calculated using the 5-point Likert scale questionnaire survey, where respondents were asked to indicate their level of agreement with 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. Their responses were then ranked in descending order within each construct.

**Table. 3. – Descriptive Statistics**

| | Description | Research Items Used | Mean | Std. Dev. | Scale | Ranking |
|---|---|---|---|---|---|---|
| DTU | Individual Resistance to Change | DTU6 | 3.337 | 1.319 | Medium | 1 |
| | Social Influence | DTU3 | 3.058 | 1.105 | Medium | 2 |
| | Top Management Support | DTU5 | 3.000 | 1.380 | Medium | 3 |
| | Facilitating Conditions | DTU4 | 2.683 | 0.968 | Medium | 4 |
| | Effort Expectancy | DTU2 | 2.279 | 0.970 | Low | 5 |
| | Performance Expectancy | DTU1 | 2.154 | 1.147 | Low | 6 |
| TP | Cost estimation can be improved | TP1 | 3.856 | 0.696 | Medium | 1 |
| | Technological developments can streamline the procurement process | TP4 | 3.385 | 0.938 | Medium | 2 |
| | Technology increases program certainty at the tender stage | TP2 | 3.144 | 0.726 | Medium | 3 |
| | Technology reduces the amount of variations during the construction phase | TP3 | 2.606 | 0.933 | Medium | 4 |
| LIMIT | Upfront costs are too high | LIMIT3 | 3.453 | 1.122 | Medium | 1 |
| | Additional costs of training make technology prohibitive | LIMIT4 | 3.255 | 1.130 | Medium | 2 |
| | Financial and time commitment from small practices is too large | LIMIT2 | 2.981 | 1.163 | Medium | 3 |
| | There is a scarcity of available training | LIMIT8 | 2.953 | 1.099 | Medium | 4 |
| | There are problems with legal ownership of information | LIMIT6 | 2.849 | 1.067 | Medium | 5 |
| | Roles and responsibilities of quantity surveyors will change | LIMIT7 | 2.632 | 1.090 | Medium | 6 |
| | There is no client demand | LIMIT5 | 2.557 | 0.957 | Medium | 7 |
| | QS practices are too small to embrace technology | LIMIT1 | 2.208 | 1.119 | Medium | 8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| TDS | Financial statements can be executed using technology alone | TDS6 | 2.663 | 1.212 | Medium | 1 |
| | Measurement and quantification can be executed using technology alone | TDS2 | 2.635 | 1.278 | Medium | 2 |
| | Document preparation can be executed using technology alone | TDS3 | 2.462 | 1.157 | Medium | 3 |
| | Procurement advice can be executed using technology alone | TDS1 | 2.404 | 1.057 | Medium | 4 |
| | Final account preparation can be executed using technology alone | TDS7 | 2.356 | 1.174 | Medium | 5 |
| | Cost control during construction can be executed using technology alone | TDS4 | 2.308 | 1.124 | Low | 6 |
| | Interim valuations and payments can be executed using technology alone | TDS5 | 2.279 | 1.065 | Low | 7 |
| | Settlement of contractual claims can be executed using technology alone | TDS8 | 2.096 | 0.990 | Low | 8 |
| MM | Elemental cost analysis can be executed using technology alone | MM6 | 2.514 | 1.128 | Medium | 1 |
| | Approximate quantities can be executed using technology alone | MM5 | 2.495 | 1.153 | Medium | 2 |
| | Storey enclosure method can be executed using technology alone | MM4 | 2.400 | 1.043 | Medium | 3 |
| | Cube method can be executed using technology alone | MM2 | 2.314 | 1.050 | Low | 4 |
| | Superficial method can be executed using technology alone | MM3 | 2.314 | 1.050 | Low | 5 |
| | Unit method can be executed using technology alone | MM1 | 2.267 | 1.068 | Low | 6 |
| | Improved efficiency | Be1 | 4.477 | 5.289 | High | 1 |
| | Visual aid | Be4 | 3.935 | 0.914 | High | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Be | Co-ordination of all design information | Be2 | 3.776 | 0.828 | High | 3 |
| | Accurate measurement | Be2 | 3.645 | 0.893 | Medium | 4 |
| | Automatic schedule/program production | Be6 | 3.645 | 0.914 | Medium | 5 |
| | Standardization of routine tasks | Be8 | 3.607 | 0.866 | Medium | 6 |
| | Cost plan production | Be5 | 3.542 | 0.850 | Medium | 7 |
| | Cost effective | Be7 | 3.383 | 0.928 | Medium | 8 |
| Ba | High cost/extra capital investment | Ba3 | 3.402 | 1.189 | Medium | 1 |
| | Software complexity | Ba6 | 3.065 | 1.215 | Medium | 2 |
| | Lack of software application interfaces | Ba5 | 3.047 | 1.208 | Medium | 3 |
| | Less familiarity with project | Ba4 | 2.944 | 1.148 | Medium | 4 |
| | Lack of standards | Ba7 | 2.850 | 1.164 | Medium | 5 |
| | Liability concerns | Ba2 | 2.822 | 1.330 | Medium | 6 |
| | Threat to services conventionally provided by quantity surveyors | Ba8 | 2.617 | 1.146 | Medium | 7 |
| | Removed need for a quantity surveyor | Ba1 | 1.972 | 1.209 | Low | 8 |

### 4.5.1. Determinants of Technology Usage (DTU)

Four of the six (67%) DTUs had medium levels of agreement relative to the acceptance determinants for use of technology by QSs', namely:

- ☐ Individual resistance to change (IRC) (mean = 3.337);
- ☐ Social influence (SI) (mean = 3.058);
- ☐ Top management support (TMS) (mean = 3.000); and
- ☐ Facilitating conditions (FC) (mean = 2.683).

There were low levels of agreement relative to the remaining acceptance determinants for use of technology by QSs, namely:

- ☐ Effort expectancy (EE) (mean = 2.279); and
- ☐ Performance expectancy (PE) (mean = 2.154).

The levels of agreement suggest that QSs were unconvinced about the influence or impact of these determinants on their acceptance of new technological advancements in their organizations.

### 4.5.2. Technology Potential (TP)

Only one of the six (16.7%) DTUs had high levels of agreement relative to the acceptance determinants for use of technology by QSs, namely:

- Cost estimation can be improved (CE) (mean = 3.856).

There were medium levels of agreement with the remaining statements about the potential of technology adoption in their firms, namely:

- Technological developments can streamline the procurement process (mean = 3.385);
- Technology increases program certainty at the tender stage (mean = 3.144); and
- Technology reduces the amount of variations during the construction phase (mean = 2.606.

Although participants agreed that cost estimation can be improved, their responses to the three remaining statements (medium levels of agreement) suggested they had neutral sentiments about the potential of technology adoption in their organizations.

### 4.5.3. Limitations (LIMIT)

There were medium levels of agreement with seven of the eight (88%) statements about limitations for use of technology by QSs, namely

- Upfront costs are too high (mean = 3.453);
- Additional costs of training make technology prohibitive (mean = 3.255);
- Financial and time commitment from small practices is too large (mean = 2.981);
- There is a scarcity of available training, cost estimation can be improved (mean = 2.953);
- There are problems with legal ownership of information (mean = 2.849);
- Roles and responsibilities of quantity surveyors will change (mean = 2.632); and
- There is no client demand (mean = 2.557).

There was low level of agreement relative to the remaining statement about limitations for use of technology by QSs, namely:

- QS practices are too small to embrace technology (mean = 2.208).

Participants responses to the seven statements (medium level of agreement), indicated that they had in the main neutral sentiments about the limitations to technology adoption in the QS firms they were associated with.

### 4.5.4. Technology Driven Services (TDS)

Five of the eight (62.5%) TDSs' had medium levels of agreement relative to the statements about technology driven services in their QSs firms, namely:

- ☐ Financial statements can be executed using technology alone (mean = 2.663);
- ☐ Measurement and quantification can be executed using technology alone (mean = 2.635);
- ☐ Document preparation can be executed using technology alone (mean = 2.462);
- ☐ Procurement advice can be executed using technology alone (mean = 2.404); and
- ☐ Final account preparation can be executed using technology alone (mean = 2.356).

There were low levels of agreement relative to the remaining statements about technology driven services in their QSs firms, namely:

- ☐ Cost control during construction can be executed using technology alone (mean = 2.308);
- ☐ Interim valuations and payments can be executed using technology alone (mean = 2.279); and
- ☐ Settlement of contractual claims can be executed using technology alone (mean = 2.096).

The majority of respondents had neutral sentiments about technology driven services being implemented or offered by their QS firms.

### 4.5.5. Measurement Methods (MM)

Three of the six (50.0%) statements had medium levels of agreement relative to methods of measurement being executed by technology alone, namely:

- ☐ Elemental cost analysis can be executed using technology alone (mean = 2.514);
- ☐ Approximate quantities can be executed using technology alone (mean = 2.495); and
- ☐ Storey enclosure method can be executed using technology alone (mean = 2.400).

There were low levels of agreement relative to the remaining methods of measurement being executed by technology alone, namely:

- ☐ Cube method can be executed using technology alone (mean = 2.314);
- ☐ Superficial method can be executed using technology alone (mean = 2.314); and
- ☐ Unit method can be executed using technology alone (mean = 2.267).

Participants were unconvinced that measurement methods could be executed using technology alone in their QS firms and practices.

### 4.5.6. Benefits (Be)

Three of the eight (37.5%) statements had high levels of agreement relative to the benefits of the use of technology by QSs in their firms and practices, namely:

- ☐ Improved efficiency (mean = 4.477);
- ☐ Visual aid (mean = 3.935); and
- ☐ Co-ordination of all design information (mean = 3.776).

There were medium levels of agreement relative to the remaining benefits of the use of technology by QSs in their firms and practices, namely:

- ☐ Automatic schedule/program production (mean = 3.645);
- ☐ Standardization of routine tasks (mean = 3.607);
- ☐ Cost plan production (mean = 3.542); and
- ☐ Cost effective (mean = 3.383).

In the main, participants recognized some of the benefits while having neutral sentiments about others.

### 4.5.7. Barriers (Ba)

Seven of the eight (87.5%) statements had medium levels of agreement relative to the barriers that would affect the use of technology in QS firms, namely:

- ☐ High cost/extra capital investment (mean = 3.402);
- ☐ Software complexity (mean = 3.065);
- ☐ Lack of software application interfaces (mean = 3.047);
- ☐ Less familiarity with project (mean = 2.944);
- ☐ Lack of standards (mean = 2.850);
- ☐ Liability concerns (mean = 2.822); and
- ☐ Threat to services conventionally provided by quantity surveyors improved efficiency (mean = 2.617).

There was low level of agreement relative to the remaining barrier that would affect the use of technology in QS firms, namely:

- ☐ Removed need for a quantity surveyor (mean = 1.972).

In the main, participants had neutral sentiments about the barriers to technology adoption in their firms and practices.

### 4.6. Adapted Acceptance Model

Figure 2 shows the relationships the relationships between the different independent and dependant variables.

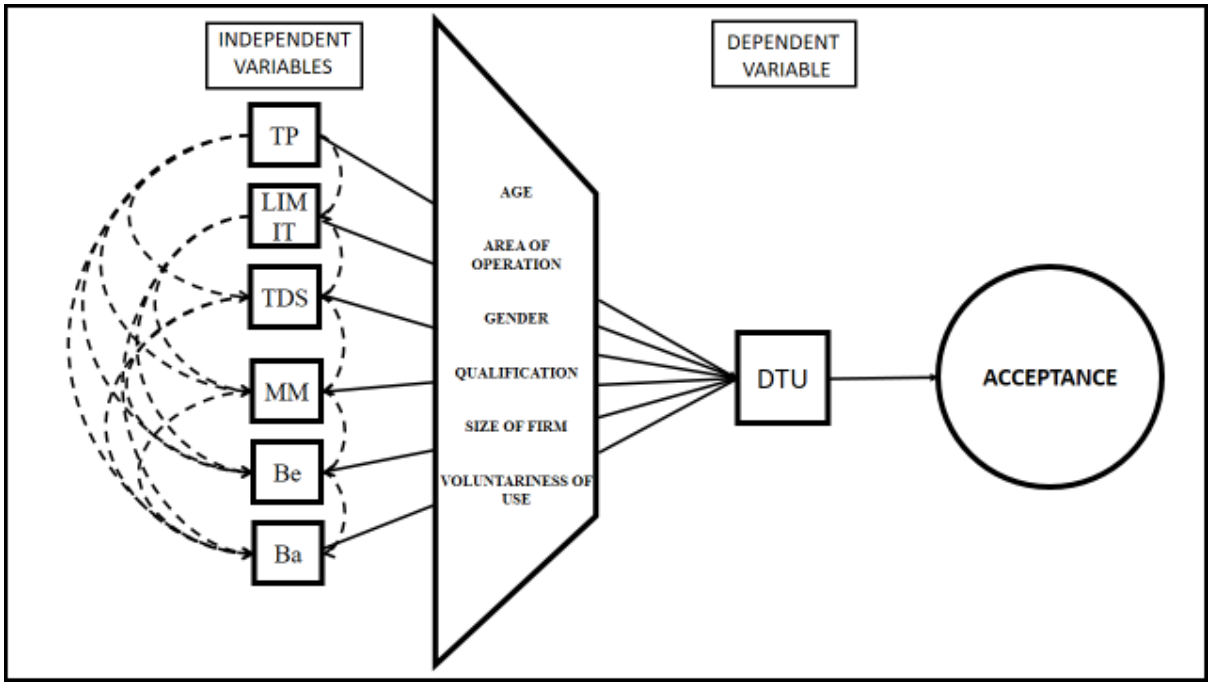



**Figure 2. – EVOLVED USER ACCEPTANCE MODEL**

**Independent Variables**

- TP Technology Potential
- LIMIT Limitations
- TDS Technology Driven Services
- MM Measurement Methods
- Be Benefits construct
- Ba Barriers construct

**Dependent Variables**

- DTU Determinants of Technology Usage

QSs remain unconvinced about the influence or impact of the determinants of technology usage on their acceptance of new technological advancements in their organizations; they were undecided about the potential of technology adoption in their organizations. QSs were not clear about the limitations to technology adoption in the QS firms they were associated with; they also remained unconvinced about technology driven services being implemented or offered by their QS firms. Participants were unconvinced that measurement methods could be executed

using technology alone in their QS firms and practices. In the main, participants recognized some of the benefits, even though they were undecided about the others; they were also not clear about the barriers to technology adoption in their firms and practices.

**TABLE 4. Instrument Measurement Analysis**

| Constructs | Description | Research Items Used | Cor. Item to Total | Cronbachs α Value | C.R. | AVE | Item Loadings |
|---|---|---|---|---|---|---|---|
| DTU | Performance Expectancy | PE | 0.182 | | | | 0.710 |
| | Effort Expectancy | EE | 0.323 | | | | 0.813 |
| | Social Influence | SI | 0.234 | | | | 0.708 |
| | Facilitating Conditions | FC | 0.344 | | | | 0.683 |
| | Top Management Support | TMS | 0.380 | | | | 0.612 |
| | Individual Resistance to Change | IRC | 0.048 | | | | 0.339 |
| TP | Cost estimation can be improved | TP1 | 0.337 | 0.726 | 0.725 | 0.669 | 0.667 |
| | Technology increases program certainty at the tender stage | TP2 | 0.508 | | | | 0.786 |
| | Technology reduces the amount of variations during the construction phase | TP3 | 0.626 | | | | 0.927 |
| | Technological developments can streamline the procurement process | TP4 | 0.514 | | | | 0.892 |
| LIMIT | QS practices are too small to embrace technology | LIMIT1 | 0.595 | 0.808 | 0.699 | 0.357 | 0.710 |
| | Financial and time commitment from small practices is too large | LIMIT2 | 0.650 | | | | 0.813 |
| | Upfront costs are too high | LIMIT3 | 0.629 | | | | 0.708 |
| | Additional costs of training make technology prohibitive | LIMIT4 | 0.572 | | | | 0.683 |
| | There is no client demand | LIMIT5 | 0.444 | | | | 0.612 |
| | There are problems with legal ownership of information | LIMIT6 | 0.440 | | | | 0.339 |
| | Roles and responsibilities of quantity surveyors will change | LIMIT7 | 0.452 | | | | 0.367 |
| | There is a scarcity of available training | LIMIT8 | 0.308 | | | | 0.315 |
| | Procurement advice can be executed using technology alone | TDS1 | 0.639 | | | | 0.648 |
| | Measurement and quantification can be executed using technology alone | TDS2 | 0.644 | | | | 0.493 |
| | Document preparation can be executed using technology alone | TDS3 | 0.755 | | | | 0.688 |
| | Cost control during construction can be executed using technology alone | TDS4 | 0.821 | | | | 0.878 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| TDS | Interim valuations and payments can be executed using technology alone | TDS5 | 0.804 | 0.912 | 0.687 | 0.490 | 0.862 |
| | Financial statements can be executed using technology alone | TDS6 | 0.709 | | | | 0.556 |
| | Final account preparation can be executed using technology alone | TDS7 | 0.793 | | | | 0.791 |
| | Settlement of contractual claims can be executed using technology alone | TDS8 | 0.647 | | | | 0.582 |
| MM | Unit method can be executed using technology alone | MM1 | 0.786 | 0.933 | 0.765 | 0.595 | 0.755 |
| | Cube method can be executed using technology alone | MM2 | 0.886 | | | | 0.836 |
| | Superficial method can be executed using technology alone | MM3 | 0.834 | | | | 0.816 |
| | Storey enclosure method can be executed using technology alone | MM4 | 0.766 | | | | 0.828 |
| | Approximate quantities can be executed using technology alone | MM5 | 0.824 | | | | 0.806 |
| | Elemental cost analysis can be executed using technology alone | MM6 | 0.627 | | | | 0.546 |
| Be | Improved efficiency | Be1 | 0.278 | 0.861 | 0.669 | 0.522 | - |
| | Accurate measurement | Be2 | 0.407 | | | | 0.718 |
| | Co-ordination of all design information | Be2 | 0.524 | | | | 0.831 |
| | Visual aid | Be4 | 0.444 | | | | 0.811 |
| | Cost plan production | Be5 | 0.586 | | | | 0.645 |
| | Automatic schedule/program production | Be6 | 0.490 | | | | 0.579 |
| | Cost effective | Be7 | 0.413 | | | | 0.929 |
| | Standardization of routine tasks | Be8 | 0.526 | | | | 0.837 |
| Ba | Removed need for a quantity surveyor | Ba1 | 0.448 | 0.861 | 0.778 | 0.613 | 0.787 |
| | Liability concerns | Ba2 | 0.392 | | | | 0.874 |
| | High cost/extra capital investment | Ba3 | 0.606 | | | | 0.637 |
| | Less familiarity with project | Ba4 | 0.699 | | | | 0.797 |
| | Lack of software application interfaces | Ba5 | 0.750 | | | | 0.838 |
| | Software complexity | Ba6 | 0.695 | | | | 0.831 |
| | Lack of standards | Ba7 | 0.628 | | | | 0.823 |
| | Threat to services conventionally provided by quantity surveyors | Ba8 | 0.566 | | | | 0.640 |
| | Age | Age | 0.224 | | | | 0.496 |
| | Gender | Gender | 0.089 | | | | 0.699 |
| | Qualifications | Qual | 0.301 | | | | 0.700 |
| | Experience | Exp | 0.212 | | | | 0.544 |
| | Area of operation | AO | 0.273 | | | | 0.756 |
| | Size in terms of annual turnover | SAT | 0.304 | | | | 0.872 |

| | | | | | |
|---|---|---|---|---|---|
| | Size in terms of number of permanent employees | SNE | 0.288 | | 0.872 |
| | Voluntariness of use | VU | 0.269 | | 0.715 |

Table 4 illustrates the instrument measurement model, factor and reliability analyses including Cronbachs alpha and corrected item-to-total correlations, composite reliability (CR), convergent validity, average variance extracted (AVE) and discriminant validity which should be less than the square root of AVE. The reliability statistics are also shown.

The Cronbach's alpha co-efficient for the scaled responses of each of the constructs ranges from. 0.547 to 0.933 which suggests that there is an acceptable degree of internal consistency for the scales used for all the constructs, namely a Cronbach Alpha statistic which is greater than the rule-of-thumb 0.70 for acceptable internal scale consistency, except for DTU (0.547).

### 4.7. Tests of Normality

**TABLE 5. Normality**

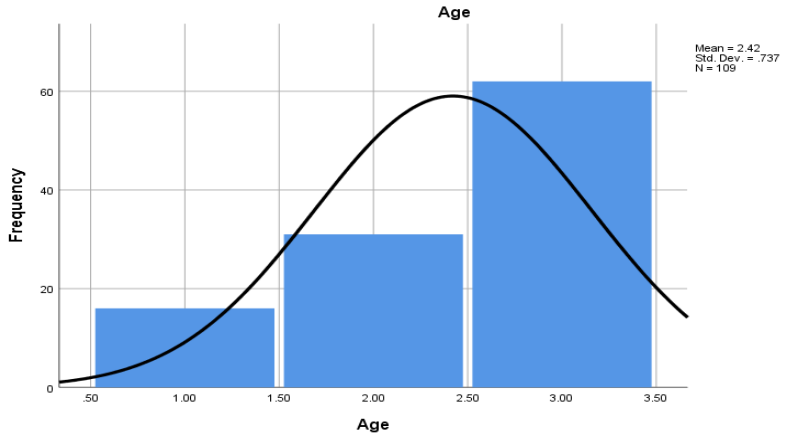
| Tests of Normality[c,d,e,f,g,h,i,j,k,l,m,n] | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
| Component | | Statistic | df | Sig. | Statistic | df | Sig. |
| TP | 2.979 | 0.736 | 7 | 0.546 | 1.179 | 8 | 0.227 |
| LIMIT | 2.877 | 0.274 | 5 | 0.077 | 0.832 | 6 | 0.418 |
| TDS | 2.537 | 0.293 | 5 | 0.057 | 0.824 | 13 | 0.321 |
| MM | 2.718 | 0.281 | 6 | 0.038 | 0.844 | 7 | 0.404 |
| Be | 3.627 | 0.298 | 6 | 0.049 | 0.817 | 6 | 0.379 |
| Ba | 2.793 | 0.294 | 4 | 0.082 | 0.823 | 4 | 0.372 |
| Age | 2.000 | 0.224 | 34 | 0.013 | 0.870 | 34 | 0.023 |
| Gender | 2.000 | 0.262 | 34 | 0.010 | 0.845 | 34 | 0.004 |
| Qual | 2.000 | 0.223 | 34 | 0.007 | 0.861 | 34 | 0.263 |
| Exp | 2.000 | 0.227 | 34 | 0.008 | 0.861 | 34 | 0.020 |
| AO | 2.000 | 0.243 | 34 | 0.006 | 0.849 | 34 | 0.039 |
| SAT | 2.000 | 0.243 | 34 | 0.006 | 0.849 | 34 | 0.022 |
| SNE | 2.000 | 0.224 | 34 | 0.004 | 0.862 | 34 | 0.091 |
| VU | 2.000 | 0.229 | 34 | 0.005 | 0.859 | 34 | 0.011 |
| a. Lilliefors Significance Correction | | | | | | | |

A significance (p) level of 0.05 was chosen, meaning that normal >0.05 and for not normal p<0.05. Therefore, if p<0.05, then the null hypothesis is rejected and there is evidence that the data tested are not from a normally distributed population; in other words, the data are not normal and the Spearman, non-parametric test must be used for correlation. On the contrary, if

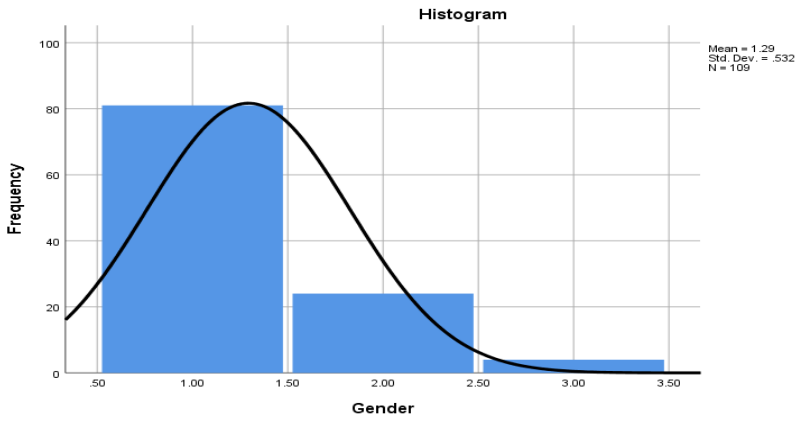
the *p*-value is greater than the chosen alpha level, then the null hypothesis that the data came from a normally distributed population cannot be rejected and the Pearson parametric correlation must be used.

Eight of the fourteen components (TP, LIMIT, TDS, MM, Be, Ba, Qual, and SNE) showed a significance of p>0.05. The null-hypothesis of this test is that the components for the evolved user acceptance model (TP, LIMIT, TDS, MM, Be, Ba, Qual, and SNE) are normally distributed and as such cannot be rejected. These results are shown in Table 5.

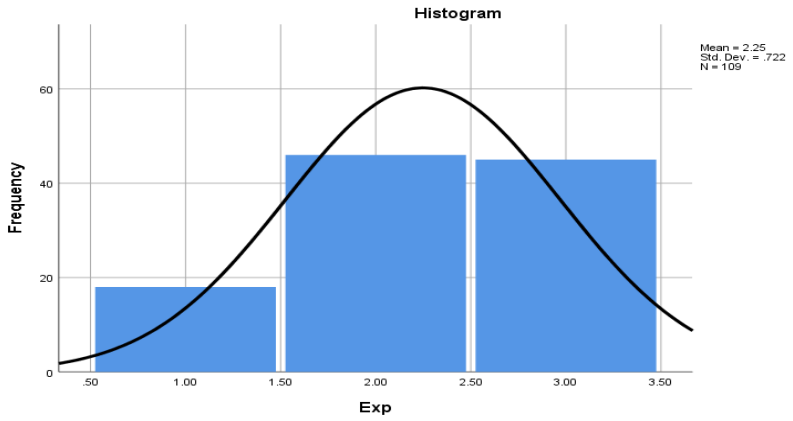
**Histogram 1. Age**



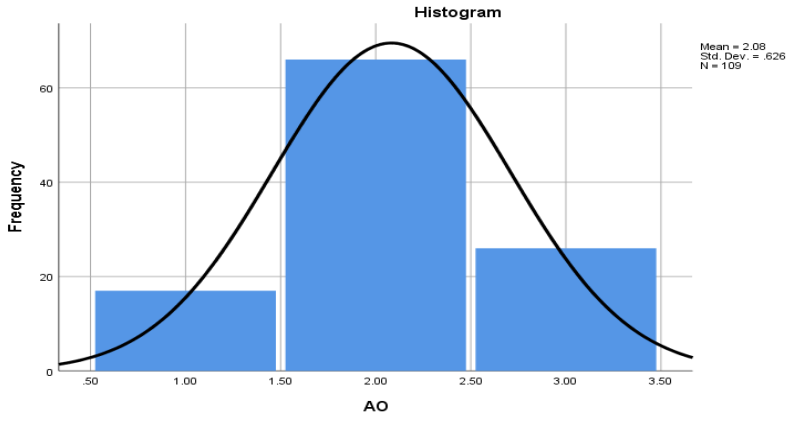

**Histogram 2. Gender**



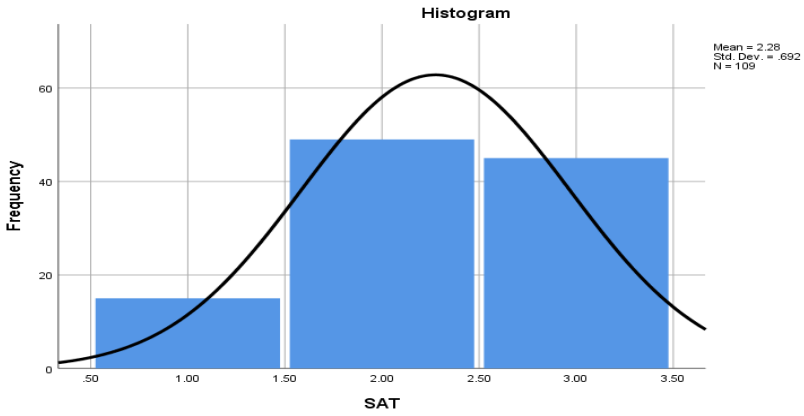
## Histogram 3. Exp



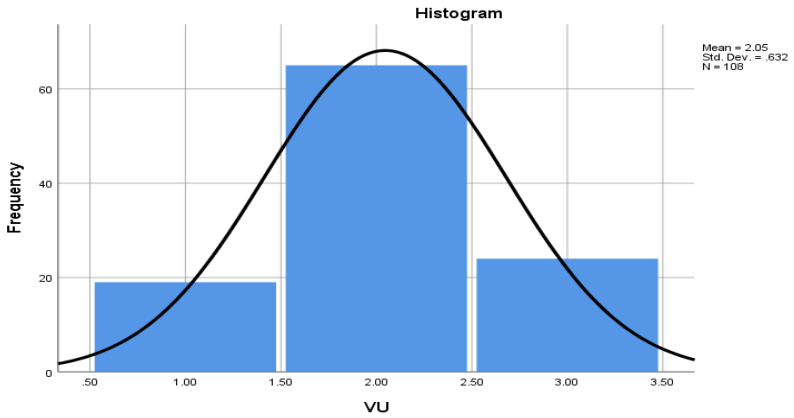

## Histogram 4. AO




## Histogram 5. SAT



**Histogram 6. VU**




Histograms 1 to 6 illustrate AO, SAT, SNE and VU, providing proof that they were in fact normally distributed. Their significance levels, p>0.05, denoting 'normal' distributions.

### 4.8. Bivariate Distribution

The components of DTU all showed a significance p>0.05. Therefore, Pearson parametric correlation (normal >0.05) was utilised to predict the levels of significance between the components of DTU (PE, EE, SI, FC, TMS and IRC) (dependant variables) and TP, LIMIT, TDS, MM, Be, and Ba and the components that also have an effect on DTU; Age, Gender, Qualification (Qual), Experience (Exp), Area of operation (AO), Size in terms of annual turnover (SAT), Size in terms of number of permanent employees (SNE), and Voluntariness of use (VU) (independent variables), as well as between TP, LIMIT, TDS, MM, Be, Ba, Age, Gender, Qual, Exp, AO, SAT, SNE, and VU (independent variables), and between PE, EE, SI, FC, TMS and IRC (dependant variables), investigating the correlation between each construct or and components. DTU & MI were separated into their various components; DTU - PE, EE, SI, FC, TMS as dependant variables and IRC; and MI - Age, Gender, Qual, Exp, AO, SAT, SNE, and VU, dependant variables; magnifying exactly where the significant correlations are, so that further exploration can be undertaken. The coefficient is located between -1> r < +1 standard of either a perfect negative or a. perfect positive correlation i.e. exact straight line and level of significance between the constructs and components. According to Cohen's conventions to interpret effect size, a correlation coefficient of 0.10 is thought to represent a weak or small association; a correlation coefficient of 0.30 is considered a moderate correlation; and a correlation coefficient of 0.50 or larger is thought to represent a strong or large correlation. A significance (p) level of 0.05 was chosen, meaning that p>0.05 means that

the correlation is not statistically significant as opposed to a $p<0.05$, which suggests that the correlation is statistically significant.

The various correlations are discussed as follows in terms of their statistical significance as shown in Table 6.

### 4.8.1. SNE vs SAT

- ☐ correlation coefficient is positive (0.636); and
- ☐ the significance is (0.000).

The correlation between SNE and SAT indicates a strong positive correlation between SNE and SAT (0.636), (when SNE increases SAT increases proportionately and vice versa). It is statistically significant (0.000), as there is evidence to suggest a strong correlation exists in the population.

Therefore, the larger the firm or practice in terms of annual turnover, the greater the size firm or practice will be in terms of number of permanent employees.

### 4.8.2. Ba vs LIMIT

- ☐ correlation coefficient is positive (0.566); and
- ☐ the significance is (0.000).

The finding shows that the correlation between Ba and LIMIT indicates a strong positive correlation between Ba and LIMIT (0.566), (when Ba increases LIMIT increases proportionately and vice versa). It is statistically significant (0.000), as there is evidence to suggest a large correlation exists in the population.

Therefore, the greater the barriers to new technology, the greater the limitations to acceptance of new technological advances.

### 4.8.3. PE vs EE

- ☐ correlation coefficient is positive (0.509); and
- ☐ the significance is (0.000).

The finding shows that the correlation between PE and EE indicates a strong positive correlation between PE and EE (0.509), (when PE increases EE increases proportionately and vice versa). It is strongly statistically significant (0.000), as there is evidence to suggest a large correlation exists in the population. Therefore, the greater the performance expectancy, the greater the ease of use of technology and acceptance of new technological advances.

## TABLE 6. Correlations between Constructs

| Correlations | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **PE** | **EE** | **SI** | **FC** | **TMS** | **IRC** | **TP** | **LIMIT** | **TDS** | **MM** | **Be** | **Ba** | **Age** | **Gender** | **Qual** | **Exp** | **AO** | **SAT** | **SNE** | **VU** |
| **PE** | Pearson Correlation | 1 | | | | | | | | | | | | | | | | | | | |
| | Sig. (2-tailed) | | | | | | | | | | | | | | | | | | | | |
| | N | 108 | | | | | | | | | | | | | | | | | | | |
| **EE** | Pearson Correlation | .509** | 1 | | | | | | | | | | | | | | | | | | |
| | Sig. (2-tailed) | .000 | | | | | | | | | | | | | | | | | | | |
| | N | 108 | 108 | | | | | | | | | | | | | | | | | | |
| **SI** | Pearson Correlation | .098 | .107 | 1 | | | | | | | | | | | | | | | | | |
| | Sig. (2-tailed) | .315 | .270 | | | | | | | | | | | | | | | | | | |
| | N | 107 | 107 | 108 | | | | | | | | | | | | | | | | | |
| **FC** | Pearson Correlation | .116 | .131 | .184 | 1 | | | | | | | | | | | | | | | | |
| | Sig. (2-tailed) | .238 | .181 | .059 | | | | | | | | | | | | | | | | | |
| | N | 106 | 106 | 106 | 107 | | | | | | | | | | | | | | | | |
| **TMS** | Pearson Correlation | .110 | .111 | .251** | .336** | 1 | | | | | | | | | | | | | | | |
| | Sig. (2-tailed) | .258 | .255 | .009 | .000 | | | | | | | | | | | | | | | | |
| | N | 108 | 108 | 108 | 107 | 109 | | | | | | | | | | | | | | | |
| **IRC** | Pearson Correlation | -.228* | .044 | .006 | .101 | .165 | 1 | | | | | | | | | | | | | | |
| | Sig. (2-tailed) | .018 | .653 | .950 | .304 | .088 | | | | | | | | | | | | | | | |
| | N | 107 | 107 | 107 | 106 | 108 | 108 | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TP** | Pearson Correlation | .047 | .063 | -.081 | .011 | .095 | -.115 | 1 | | | | | | | | | | | | | |
| | Sig. (2-tailed) | .636 | .528 | .418 | .913 | .339 | .246 | | | | | | | | | | | | | | |
| | N | 103 | 103 | 103 | 102 | 104 | 103 | 104 | | | | | | | | | | | | | |
| **LIMIT** | Pearson Correlation | .036 | .069 | .215* | .107 | .001 | -.027 | .049 | 1 | | | | | | | | | | | | |
| | Sig. (2-tailed) | .716 | .486 | .028 | .279 | .996 | .784 | .630 | | | | | | | | | | | | | |
| | N | 105 | 105 | 105 | 104 | 106 | 105 | 101 | 106 | | | | | | | | | | | | |
| **TDS** | Pearson Correlation | .118 | .128 | -.067 | -.134 | .031 | .039 | .142 | -.138 | 1 | | | | | | | | | | | |
| | Sig. (2-tailed) | .237 | .198 | .501 | .176 | .753 | .691 | .161 | .167 | | | | | | | | | | | | |
| | N | 103 | 103 | 103 | 104 | 104 | 104 | 99 | 101 | 104 | | | | | | | | | | | |
| **MM** | Pearson Correlation | .028 | .052 | -.063 | -.176 | .013 | .107 | .059 | .009 | .656** | 1 | | | | | | | | | | |
| | Sig. (2-tailed) | .775 | .601 | .528 | .076 | .893 | .277 | .562 | .927 | .000 | | | | | | | | | | | |
| | N | 104 | 104 | 104 | 103 | 105 | 104 | 100 | 103 | 101 | 105 | | | | | | | | | | |
| **Be** | Pearson Correlation | -.042 | -.003 | -.204* | -.244* | -.110 | -.140 | .131 | -.171 | .272** | .196* | 1 | | | | | | | | | |
| | Sig. (2-tailed) | .667 | .973 | .036 | .012 | .259 | .151 | .189 | .083 | .006 | .047 | | | | | | | | | | |
| | N | 106 | 106 | 106 | 105 | 107 | 106 | 102 | 104 | 102 | 103 | 107 | | | | | | | | | |
| **Ba** | Pearson Correlation | .016 | .087 | .170 | .210* | .011 | .088 | -.091 | .566** | -.110 | .210* | -.173 | 1 | | | | | | | | |
| | Sig. (2-tailed) | .874 | .375 | .081 | .032 | .914 | .370 | .361 | .000 | .270 | .033 | .078 | | | | | | | | | |
| | N | 106 | 106 | 106 | 105 | 107 | 106 | 102 | 104 | 102 | 103 | 105 | 107 | | | | | | | | |
| **Age** | Pearson Correlation | .012 | -.133 | .052 | .123 | .045 | .013 | -.153 | .217* | -.284** | -.137 | .120 | .245* | 1 | | | | | | | |
| | Sig. (2-tailed) | .904 | .170 | .592 | .207 | .646 | .893 | .121 | .025 | .003 | .162 | .218 | .011 | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | 108 | 108 | 108 | 107 | 109 | 108 | 104 | 106 | 104 | 105 | 107 | 107 | 109 | | | | | | | |
| **Gender** | Pearson Correlation | .019 | -.045 | -.109 | .051 | .084 | -.089 | .269** | .030 | .106 | -.080 | .082 | -.144 | -.012 | 1 | | | | | | |
| | Sig. (2-tailed) | .842 | .642 | .263 | .603 | .386 | .357 | .006 | .759 | .285 | .420 | .402 | .139 | .902 | | | | | | | |
| | N | 108 | 108 | 108 | 107 | 109 | 108 | 104 | 106 | 104 | 105 | 107 | 107 | 109 | 109 | | | | | | |
| **Qual** | Pearson Correlation | -.025 | -.015 | .282** | .191* | .335** | .032 | .230* | .305** | .050 | -.082 | -.122 | .196* | .113 | .165 | 1 | | | | | |
| | Sig. (2-tailed) | .801 | .882 | .003 | .049 | .000 | .743 | .019 | .002 | .613 | .408 | .211 | .044 | .242 | .089 | | | | | | |
| | N | 107 | 107 | 107 | 106 | 108 | 107 | 103 | 105 | 103 | 104 | 106 | 106 | 108 | 108 | 108 | | | | | |
| **Exp** | Pearson Correlation | .116 | .017 | .100 | -.005 | -.080 | -.030 | -.039 | -.077 | -.025 | -.070 | .116 | .139 | .080 | .050 | .231* | 1 | | | | |
| | Sig. (2-tailed) | .232 | .857 | .302 | .961 | .410 | .761 | .694 | .432 | .801 | .479 | .234 | .152 | .407 | .606 | .016 | | | | | |
| | N | 108 | 108 | 108 | 107 | 109 | 108 | 104 | 106 | 104 | 105 | 107 | 107 | 109 | 109 | 108 | 109 | | | | |
| **AO** | Pearson Correlation | .051 | .057 | -.089 | -.044 | -.117 | .000 | .052 | .203* | -.245* | .102 | -.010 | .435** | .185 | -.073 | .022 | .344** | 1 | | | |
| | Sig. (2-tailed) | .603 | .559 | .362 | .656 | .225 | 1.000 | .599 | .036 | .012 | .300 | .922 | .000 | .054 | .448 | .820 | .000 | | | | |
| | N | 108 | 108 | 108 | 107 | 109 | 108 | 104 | 106 | 104 | 105 | 107 | 107 | 109 | 109 | 108 | 109 | 109 | | | |
| **SAT** | Pearson Correlation | .044 | -.008 | .329** | .027 | .133 | -.072 | -.034 | .083 | .039 | .001 | -.031 | -.022 | .151 | .080 | .181 | -.045 | -.010 | 1 | | |
| | Sig. (2-tailed) | .650 | .932 | .001 | .786 | .169 | .458 | .732 | .399 | .696 | .989 | .749 | .823 | .116 | .407 | .061 | .642 | .916 | | | |
| | N | 108 | 108 | 108 | 107 | 109 | 108 | 104 | 106 | 104 | 105 | 107 | 107 | 109 | 109 | 108 | 109 | 109 | 109 | | |
| **SNE** | Pearson Correlation | .117 | .071 | .186 | .036 | .204* | -.003 | -.142 | .162 | -.076 | -.091 | -.091 | .144 | .099 | .128 | .079 | -.095 | .104 | .636** | 1 | |
| | Sig. (2-tailed) | .226 | .466 | .053 | .710 | .033 | .972 | .152 | .096 | .446 | .354 | .351 | .139 | .308 | .184 | .416 | .325 | .283 | .000 | | |
| | N | 108 | 108 | 108 | 107 | 109 | 108 | 104 | 106 | 104 | 105 | 107 | 107 | 109 | 109 | 108 | 109 | 109 | 109 | 109 | |
| **VU** | Pearson Correlation | -.024 | .034 | -.071 | -.126 | -.257** | -.009 | -.033 | .257** | -.167 | -.061 | .004 | .303** | .179 | -.069 | .155 | .221* | .348** | .014 | .052 | 1 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sig. (2-tailed) | .803 | .725 | .464 | .197 | .007 | .927 | .743 | .008 | .092 | .538 | .965 | .002 | .064 | .480 | .111 | .021 | .000 | .885 | .597 | |
| | N | 107 | 107 | 107 | 106 | 108 | 107 | 103 | 106 | 103 | 104 | 106 | 106 | 108 | 108 | 107 | 108 | 108 | 108 | 108 | 108 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | | | | | | | | | | | | | | |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | | | | | | | | | | | | | | | | | |

### 4.8.4. PE vs IRC

- ☐ correlation coefficient is negative (-0.228); and
- ☐ the significance is (0.018).

The finding shows that the correlation between IRC and PE indicates a small negative correlation between IRC and PE (-0.228), (when IRC increases PE decreases proportionately and vice versa). It is statistically significant (0.018), as there is evidence to suggest a small correlation exists in the population.

Therefore, the greater the performance expectancy, the less likely for an individual to resist change and improving acceptance of technological advances.

### 4.8.5. TMS vs FC

- ☐ correlation coefficient is positive (0.336); and
- ☐ the significance is (0.009).

The finding shows that the correlation between TMS and FC indicates a moderate positive correlation between TMS and FC (0.336), (when TMS increases FC increases proportionately and vice versa). It is statistically significant (0.009), as there is evidence to suggest a moderate correlation exists in the population.

Therefore, the greater the top management support, the more likely that adequate organisational structures will be put in place to facilitate and support usage of technology increasing the acceptance of new technological advances into the firm or practice.

#### 4.8.6. PE vs IRC

- ☐ correlation coefficient is negative (-0.228); and
- ☐ the significance is (0.018).

The finding shows that the correlation between IRC and PE indicates a small negative correlation between IRC and PE (-0.228), (when IRC increases PE decreases proportionately and vice versa). It is statistically significant (0.018), as there is evidence to suggest a small correlation exists in the population.

Therefore, the greater the performance expectancy, the less likely for an individual to resist change and improving acceptance of technological advances.

#### 4.8.7. TMS vs FC

- ☐ correlation coefficient is positive (0.336); and
- ☐ the significance is (0.009).

The finding shows that the correlation between TMS and FC indicates a moderate positive correlation between TMS and FC (0.336), (when TMS increases FC increases proportionately and vice versa). It is statistically significant (0.009), as there is evidence to suggest a moderate correlation exists in the population.

Therefore, the greater the top management support, the more likely that adequate organisational structures will be put in place to facilitate and support usage of technology increasing the acceptance of new technological advances into the firm or practice.

#### 4.8.8. TMS vs SI

- ☐ correlation coefficient is positive (0.252); and
- ☐ the significance is (0.009).

The finding shows that the correlation between TMS and SI indicates a small positive correlation between TMS and SI (0.252), (when TMS increases SI increases proportionately and vice versa). It is statistically significant (0.000), as there is evidence to suggest a small correlation exists in the population.

Therefore, the greater the top management support for increasing the use of technology and acceptance of new technological advances, the greater the social influence within the firm or practice.

#### 4.8.9. SAT vs SI

- ☐ correlation coefficient is positive (0.329); and
- ☐ the significance is (0.001).

The finding shows that the correlation between SAT and SI indicates a moderate positive correlation between SAT and SI (0.329), (when SAT increases SI increases proportionately and vice versa). It is strongly statistically significant (0.001), as there is evidence to suggest a moderate correlation exists in the population.

Therefore, the larger the firm in terms of annual turnover, the greater the social influence within the firm or practice and acceptance of technological advances.

### 4.8.10. Qual vs SI

- ☐ correlation coefficient is positive (0.282); and
- ☐ the significance is (0.003).

The finding shows that the correlation between Qual and SI indicates a small positive correlation between Qual and SI (0.282), (when Qual increases SI increases proportionately and vice versa). It is strongly statistically significant (0.003), as there is evidence to suggest a small correlation exists in the population.

Therefore, the higher the qualification of the QS, the greater the social influence within the firm or practice, and acceptance of new technological advances.

### 4.8.11. LIMIT vs SI

- ☐ correlation coefficient is positive (0.215); and
- ☐ the significance is (0.028).

The finding shows that the correlation between LIMIT and SI indicates a small positive correlation between LIMIT and SI (0.215), (when LIMIT increases SI increases proportionately and vice versa). It is statistically significant (0.028), as there is evidence to suggest a small correlation exists in the population.

Therefore, the greater the limitations imposed on technological innovation, the greater the likelihood that social influence will have to grow.

### 4.8.12. Qual vs TMS

- ☐ correlation coefficient is positive (0.335); and
- ☐ the significance is (0.000).

The finding shows that the correlation between Qual and TMS indicates a moderate positive correlation between Qual and TMS (0.335), (when Qual increases TMS increases proportionately and vice versa). It is strongly statistically significant (0.000), as there is evidence to suggest a moderate correlation exists in the population.

Therefore, the more qualified the QS the greater the top management support which will influence acceptance of technological advances.

### 4.8.13. Qual vs LIMIT

- ☐ correlation coefficient is positive (0.305); and
- ☐ the significance is (0.002).

The finding shows that the correlation between Qual and LIMIT indicates a moderate positive correlation between Qual and LIMIT (0.305), (when Qual increases LIMIT increases proportionately and vice versa). It is statistically significant (0.002), as there is evidence to suggest a moderate correlation exists in the population.

Therefore, the more qualified a QS is, the more likely that acceptance of new technology advances will be limited.

### 4.8.14. Qual vs TP

- ☐ correlation coefficient is positive (0.245); and
- ☐ the significance is (0.011).

The finding shows that the correlation between Qual and TP indicates a small positive correlation between Qual and TP (0.234), (when Qual increases TP increases proportionately and vice versa). It is statistically significant (0.011), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the more qualified the QS is, the greater the likelihood that technology potential increases.

### 4.8.15. Qual vs Exp

- ☐ correlation coefficient is positive (0.231); and
- ☐ the significance is (0.016).

The finding shows that the correlation between Qual and Exp indicates a small positive correlation between Qual and Exp (0.231), (when Qual increases Exp increases proportionately and vice versa). It is statistically significant (0.016), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the more qualified the QS, the more likely that experience with technology will increase.

### 4.8.16. AO vs Ba

- ☐ correlation coefficient is positive (0.435); and

- ☐ the significance is (0.000).

The finding shows that the correlation between AO and Ba indicates a moderate positive correlation between AO and Ba (0.435), (when AO increases Ba increases proportionately and vice versa). It is statistically significant (0.000), as there is evidence to suggest a moderate correlation exists in the population.

Therefore, the greater the area of operation, the greater the barriers are likely to be to acceptance of new technological advances.

### 4.8.17. Exp vs AO

- ☐ correlation coefficient is positive (0.344); and
- ☐ the significance is (0.000).

The finding shows that the correlation between Exp vs AO indicates a moderate positive correlation between Exp vs AO (0.344), (when Exp increases OA increases proportionately and vice versa). It is statistically significant (0.000), as there is evidence to suggest a moderate correlation exists in the population.

Therefore, the greater the range of experience of the QSs, the greater the likelihood of a larger area of operation.

### 4.8.18. AO vs TDS

- ☐ correlation coefficient is positive (-0.245); and
- ☐ the significance is (0.012).

The finding shows that the correlation between AO vs TDS indicates a small negative correlation between AO vs TDS (-0.245), (when AO increases TDS decreases proportionately and vice versa). It is statistically significant (0.012), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the greater the area of operation, the greater the range of technological driven services that will be offered by the firm or practice, which impacts the adoption of new technological advances.

### 4.8.19. VU vs AO

- ☐ correlation coefficient is positive (0.348); and
- ☐ the significance is (0.000).

The finding shows that the correlation between VU and AO indicates a moderate positive correlation between VU and AO (0.348), (when VU increases AO increases proportionately and

vice versa). It is statistically significant (0.000), as there is evidence to suggest a moderate correlation exists in the population.

Therefore, the more the voluntary use of new technology is permitted in the firm, the greater the likelihood that the area of operation will have to grow.

### 4.8.20. VU vs Ba

- ☐ correlation coefficient is positive (0.303); and
- ☐ the significance is (0.002).

The finding shows that the correlation between VU and Ba indicates a moderate positive correlation between VU and Ba (0.303), (when VU increases Ba increases proportionately and vice versa). It is statistically significant (0.002), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the more the voluntary use of new technology is permitted in the firm, the greater the likelihood that there will be barriers to acceptance of new technological advances.

### 4.8.21. VU vs TMS

- ☐ correlation coefficient is negative (-0.257); and
- ☐ the significance is (0.007).

The finding shows that the correlation between VU and TMS indicates a small negative correlation between VU and TMS (-0.257), (when VU increases TMS decreases proportionately and vice versa). It is strongly statistically significant (0.007), as there is evidence to suggest a small correlation exists in the population.

Therefore, the more a QS feels that use of technology is voluntary the less likely there will be top management support for acceptance of technological advances.

### 4.8.22. VU vs LIMIT

- ☐ correlation coefficient is positive (0.257); and
- ☐ the significance is (0.008).

The finding shows that the correlation between VU and LIMIT indicates a weak positive correlation between VU and LIMIT (0.257), (when VU increases LIMIT increases proportionately and vice versa). It is statistically significant (0.008), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the more the voluntary use of new technology is permitted in the firm, the greater the likelihood that acceptance will be limited.

#### 4.8.23. VU vs Exp

- ☐ correlation coefficient is positive (0.221); and
- ☐ the significance is (0.021).

The finding shows that the correlation between VU and Exp indicates a small positive correlation between VU and Exp (0.221), (when VU increases Exp increases proportionately and vice versa). It is statistically significant (0.021), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the greater the voluntary use of new technology is permitted in the firm, the greater the range of experience the QSs have to possess.

#### 4.8.24. Age vs TDS

- ☐ correlation coefficient is negative (-0.284); and
- ☐ the significance is (0.003).

The finding shows that the correlation between Age and LIMIT indicates a weak negative correlation between Age and TDS (-0.284), (when Age increases TDS decreases proportionately and vice versa). It is statistically significant (0.003), as there is evidence to suggest a small correlation exists in the population.

Therefore, the older the QS, the less likely that technology driven services will grow.

#### 4.8.25. Age vs Ba

- ☐ correlation coefficient is positive (0.245); and
- ☐ the significance is (0.011).

The finding shows that the correlation between Age and Ba indicates a small positive correlation between Age and Ba (0.245), (when Age increases Ba increases proportionately and vice versa). It is statistically significant (0.011), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the greater the age of the QS, the more likely that barriers to technology adoption will increase.

#### 4.8.26. Age vs LIMIT

- ☐ correlation coefficient is positive (0.217); and
- ☐ the significance is (0.025).

The finding shows that the correlation between Age and LIMIT indicates a moderate positive correlation between Age and LIMIT (0.217), (when Age increases LIMIT increases

proportionately and vice versa). It is statistically significant (0.025), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the older the QS, the more likely that limitations to technology adoption will increase.

### 4.8.27. MM vs TDS

- ☐ correlation coefficient is positive (0.656); and
- ☐ the significance is (0.000).

The finding shows that the correlation between MM and TDS indicates a strong positive correlation between MM and TDS (0.656), (when MM increases TDS increases proportionately and vice versa). It is statistically significant (0.000), as there is evidence to suggest a strong correlation exists in the population.

Therefore, the more the measurement methods dependent on technology increases, the greater the scope for technology driven services that will increase acceptance of new technological advances.

### 4.8.28. Be vs TDS

- ☐ correlation coefficient is positive (0.272); and
- ☐ the significance is (0.006).

The finding shows that the correlation between Be and TDS indicates a small positive correlation between Be and TDS (0.272), (when Be increases TDS increases proportionately and vice versa). It is statistically significant (0.006), as there is evidence to suggest a small correlation exists in the population.

Therefore, the more visible and tangible the benefits of new technological advances the greater the scope for and range of technology driven services, increasing acceptance of new technological advances.

### 4.8.29. FC vs Be

- ☐ correlation coefficient is negative (-0.244); and
- ☐ the significance is (0.012).

The finding shows that the correlation between Be and FC indicates a small negative correlation between Be and FC (-0.244), (when Be increases FC decreases proportionately and vice versa). It is statistically significant (-0.244), as there is evidence to suggest a small correlation exists in the population.

Therefore, the greater the facilitating conditions the greater the likelihood of benefits of new technology being recognized and acceptance of new technological advances growing.

### 4.8.30. Gender vs TP

- ☐ correlation coefficient is positive (0.269); and
- ☐ the significance is (0.006).

The finding shows that the correlation between Gender and TP indicates a small positive correlation between Gender and TP (0.269), (when Gender increases TP increases proportionately and vice versa). It is statistically significant (0.006), as there is evidence to suggest a small correlation exists in the population.

Therefore, the gender of the QS will affect the technological potential within the firm or practice, thereby impacting the potential of technology acceptance.

### 4.8.31. AO vs TDS

- ☐ correlation coefficient is negative (-0.245); and
- ☐ the significance is (0.012).

The finding shows that the correlation between AO vs TDS indicates a small negative correlation between AO vs TDS (-0.245), (when AO increases TDS decreases proportionately and vice versa). It is statistically significant (0.012), as there is evidence to suggest a weak correlation exists in the population.

Therefore, the greater the area of operation, the less likely the range of technological driven services within the firm.

## 4.9. Regression

Regression assesses how well the independent variables explain the dependent variable. Two linear regression models were run utilising only the significant relationship derived from correlations. Linear regression was used because a visual inspection of normal probability plots (P-P plots) showed that the variables visibly shared a linear relationship and are suitable for regression analysis.

**The Model summary**' table provides information about the regression line's ability to account for the total variation in the dependent variable. For model summary we interpret the Adjusted R Square.

**Anova** table /analysis of variance, is a statistical method in which the variation in a set of observations is divided into distinct components. The key focus in Anova is the F test. The null hypothesis means that the model has ‘no’ explanatory power, which means that all the coefficients on the independent variable’s (IV) = 0. Measure whether the IV can predict the

dependant variable (DV), $p < 0.05$ for the model to be of value, if $p > 0.05$, there isn't any need to produce the coefficients table.

**The Coefficients Table** provides information about the relationship between the IV's and the DV's through the coefficients. By default, the null for the T statistic in regression is that the coefficient for the IV = 0, i.e. the IV does not help predict the DV.

**TABLE 7. Qual vs SI**

| Model Summary[b] | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .282[a] | .080 | .071 | 1.05315 |
| a. Predictors: (Constant), Qual | | | | |
| b. Dependent Variable: SI | | | | |

- ☐ The adjusted R square = 0.071, and
- ☐ 7.1% of the total variability in SI is explained by Qual.
- ☐ The R square = 0.080, and
- ☐ R square over estimates the total variability by 0.9%.

**TABLE 8. Qual vs SI**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 10.083 | 1 | 10.083 | 9.091 | .003[b] |
| | Residual | 116.459 | 105 | 1.109 | | |
| | Total | 126.542 | 106 | | | |
| a. Dependent Variable: SI | | | | | | |
| b. Predictors: (Constant), Qual | | | | | | |

- ☐ There is evidence ($p < 0.003$) to reject the null, the model has explanatory power, and
- ☐ Qualification affects social influence significantly.

A multiple linear regression was calculated to predict SI (component of the dependant variable) based on (significant factors from the correlation analysis). Qual (component of the independent variable), investigating the degree to which Qual impacts / predicts SI as shown in Tables 7 and 8. The adjusted R square is 0.071, which means that 7.1% of the total variability in SI is explained by Qual, also, the regression value was significant ($p=0.003$), as $p<0.05$, the null is rejected. Qual has explanatory power on SI.

**TABLE 9. SAT vs SI**

| Model Summary[b] | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .329[a] | .108 | .100 | 1.03652 |
| a. Predictors: (Constant), SAT | | | | |
| b. Dependent Variable: SI | | | | |

- ☐ The adjusted R square = 0.100, and
- ☐ 10.0% of the total variability in SI is explained by SAT.
- ☐ The R square = 0.108, and
- ☐ R square over estimates the total variability by 0.8%.

**TABLE 10. SAT vs SI**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 13.782 | 1 | 13.782 | 12.828 | .001[b] |
| | Residual | 113.884 | 106 | 1.074 | | |
| | Total | 127.667 | 107 | | | |
| a. Dependent Variable: SI | | | | | | |
| b. Predictors: (Constant), SAT | | | | | | |

- ☐ There is evidence ($p < 0.003$) to reject the null, the model has explanatory power, and
- ☐ Size in terms of annual turnover influences social influence significantly.

A multiple linear regression was calculated to predict SI (component of the dependant variable) based on (significant factors from the correlation analysis). SAT (component of the independent variable), investigating the degree to which SAT impacts / predicts SI as shown in Tables 9 and 10. The adjusted R square is 0.100, which means that 10.0% of the total variability in SI is explained by SAT, also, the regression value was significant ($p=0.001$), as $p<0.05$, the null is rejected. SAT has explanatory power on SI.

**TABLE 11. LIMIT vs SI**

| Model Summary[b] | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .215[a] | .046 | .037 | 1.08241 |
| a. Predictors: (Constant), LIMIT | | | | |
| b. Dependent Variable: SI | | | | |

- ☐ The adjusted R square = 0.037, and
- ☐ 3.7% of the total variability in SI is explained by LIMIT.
- ☐ The R square = 0.046, and
- ☐ R square over estimates the total variability by 0.9%.

**TABLE 12. LIMIT vs SI**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 5.857 | 1 | 5.857 | 4.999 | .028[b] |
| | Residual | 120.677 | 103 | 1.172 | | |
| | Total | 126.533 | 104 | | | |
| a. Dependent Variable: SI | | | | | | |
| b. Predictors: (Constant), LIMIT | | | | | | |

- ☐ There is evidence ($p < 0.003$) to reject the null, the model has explanatory power, and
- ☐ Limitations influences social influence significantly.

A multiple linear regression was calculated to predict SI (component of the dependant variable) based on (significant factors from the correlation analysis). LIMIT (component of the independent variable), investigating the degree to which LIMIT impacts / predicts SI as shown in Tables 11 and 12. The adjusted R square is 0.037, which means that 3.7% of the total variability in SI is explained by LIMIT, also, the regression value was significant ($p=0.003$), as $p<0.05$, the null is rejected. LIMIT has explanatory power on SI.

**TABLE 13. SAT & Qual vs SI**

| Model Summary[b] | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .397[a] | .158 | .142 | 1.01234 |
| a. Predictors: (Constant), SAT, Qual | | | | |
| b. Dependent Variable: SI | | | | |

- ☐ The adjusted R square = 0.142, and
- ☐ 14.2% of the total variability in SI is explained by SAT & Qual.
- ☐ The R square = 0.158, and
- ☐ R square over estimates the total variability by 1.6%.

**TABLE 14. SAT & Qual vs SI**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 19.959 | 2 | 9.979 | 9.737 | .000[b] |
| | Residual | 106.583 | 104 | 1.025 | | |
| | Total | 126.542 | 106 | | | |
| a. Dependent Variable: SI | | | | | | |
| b. Predictors: (Constant), SAT, Qual | | | | | | |

- ☐ There is evidence ($p < 0.003$) to reject the null, the model has explanatory power, and
- ☐ Size in terms of annual turnover and qualification influences social influence significantly.

A multiple linear regression was calculated to predict SI (component of the dependant variable) based on (significant factors from the correlation analysis). SAT & Qual (components of the independent variable), investigating the degree to which SAT & Qual impacts / predicts SI as shown in Tables 13 and 14. The adjusted R square is 0.142, which means that 14.2% of the total variability in SI is explained by SAT & Qual, also, the regression value was significant ($p=0.003$), as $p<0.05$, the null is rejected. SAT & Qual has explanatory power on SI. Therefore the individual relationships (18.8%) have greater influence than the combination (14.2%).

**TABLE 15. Qual vs TMS**

| Model Summary[b] | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .335[a] | .112 | .104 | 1.30049 |
| a. Predictors: (Constant), Qual | | | | |
| b. Dependent Variable: TMS | | | | |

- ☐ The adjusted R square = 0.104, and
- ☐ 10.4% of the total variability in TMS is explained by Qual.
- ☐ The R square = 0.112, and
- ☐ R square over estimates the total variability by 0.8%.

**TABLE 16. Qual vs TMS**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 22.688 | 1 | 22.688 | 13.414 | .000[b] |
| | Residual | 179.275 | 106 | 1.691 | | |
| | Total | 201.963 | 107 | | | |

| |
|---|
| a. Dependent Variable: TMS |
| b. Predictors: (Constant), Qual |

- ☐ There is evidence ($p < 0.003$) to reject the null, the model has explanatory power, and
- ☐ Qualification influences total management support significantly.

A multiple linear regression was calculated to predict TMS (component of the dependant variable) based on (significant factors from the correlation analysis). Qual (component of the independent variable), investigating the degree to which Qual impacts / predicts TMS as shown in Tables 15 and 16. The adjusted R square is 0.104, which means that 10.4% of the total variability in TMS is explained by Qual, also, the regression value was significant ($p=0.003$), as $p<0.05$, the null is rejected. Qual has explanatory power on TMS.

**TABLE 17. VU vs TMS**

| Model Summary[b] | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .257[a] | .066 | .057 | 1.33388 |
| a. Predictors: (Constant), VU | | | | |
| b. Dependent Variable: TMS | | | | |

- ☐ The adjusted R square = 0.057, and
- ☐ 5.7% of the total variability in TMS is explained by VU.
- ☐ The R square = 0.066, and
- ☐ R square over estimates the total variability by 0.9%.

**TABLE 18. VU vs TMS**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 13.364 | 1 | 13.364 | 7.511 | .007[b] |
| | Residual | 188.599 | 106 | 1.779 | | |
| | Total | 201.963 | 107 | | | |
| a. Dependent Variable: TMS | | | | | | |
| b. Predictors: (Constant), VU | | | | | | |

- ☐ There is evidence ($p < 0.003$) to reject the null, the model has explanatory power, and
- ☐ Voluntary use influences total management support significantly.

A multiple linear regression was calculated to predict TMS (component of the dependant variable) based on (significant factors from the correlation analysis). VU (component of the

independent variable), investigating the degree to which VU impacts / predicts TMS as shown in Tables 17 and 18. The adjusted R square is 0.057, which means that 5.7% of the total variability in TMS is explained by VU, also, the regression value was significant (p=0.003), as p<0.05, the null is rejected. VU has explanatory power on TMS.

**TABLE 19. VU & Qual vs TMS**

| Model Summary[b] | | | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .462[a] | .213 | .198 | 1.23607 |
| a. Predictors: (Constant), VU, Qual | | | | |
| b. Dependent Variable: TMS | | | | |

- ☐ The adjusted R square = 0.198, and
- ☐ 19.8% of the total variability in TMS is explained by VU.
- ☐ The R square = 0.213, and
- ☐ R square over estimates the total variability by 1.5%.

**TABLE 20. VU & Qual vs TMS**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 43.063 | 2 | 21.532 | 14.093 | .000[b] |
| | Residual | 158.899 | 104 | 1.528 | | |
| | Total | 201.963 | 106 | | | |
| a. Dependent Variable: TMS | | | | | | |
| b. Predictors: (Constant), VU, Qual | | | | | | |

- ☐ There is evidence (p < 0.003) to reject the null, the model has explanatory power, and
- ☐ Voluntary use and qualification influences total management support significantly.

A multiple linear regression was calculated to predict TMS (component of the dependant variable) based on (significant factors from the correlation analysis). VU & Qual (component of the independent variable), investigating the degree to which VU & Qual impacts / predicts TMS as shown in Tables 19 and 20. The adjusted R square is 0.198, which means that 19.8% of the total variability in TMS is explained by VU & Qual, also, the regression value was significant (p=0.003), as p<0.05, the null is rejected. VU & Qual has explanatory power on TMS. Therefore in combination (19.8%), they have a greater influence than individually (16.1%).

A summary of all regression results are shown in Table 23 below.

## Table 21. Total Variance Explained

| Total Variance Explained | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Initial Eigenvalues | | | Rotation Sums of Squared Loadings | | | Variable Percentages | | | | | |
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | PE | SI% | FC | TMS | SAT & Qual | VU & Qual |
| **PE** | 2.699 | 13.493 | 13.493 | 1.421 | 7.107 | 7.107 | | | | | | |
| **EE** | 2.501 | 12.503 | 25.995 | 1.046 | 5.232 | 12.339 | | | | | | |
| **SI** | 1.928 | 9.638 | 35.633 | 1.035 | 5.174 | 17.513 | | | | | **14.2%** | |
| **FC** | 1.639 | 8.193 | 43.826 | 1.030 | 5.150 | 22.664 | | | | | | |
| **TMS** | 1.509 | 7.545 | 51.371 | 1.018 | 5.091 | 27.755 | | | | | | **19.8%** |
| **IRC** | 1.400 | 7.000 | 58.372 | 1.018 | 5.091 | 32.846 | **4.3%** | | | | | |
| **TP** | 1.192 | 5.961 | 64.333 | 1.018 | 5.089 | 37.935 | | | | | | |
| **LIMIT** | 1.156 | 5.780 | 70.113 | 1.016 | 5.079 | 43.013 | | **3.7%** | | | | |
| **TDS** | .970 | 4.849 | 74.962 | 1.013 | 5.067 | 48.081 | | | | | | |
| **MM** | .798 | 3.991 | 78.953 | 1.013 | 5.065 | 53.146 | | | | | | |
| **Be** | .748 | 3.742 | 82.695 | 1.010 | 5.050 | 58.196 | | | **5.0%** | | | |
| **Ba** | .651 | 3.256 | 85.951 | 1.009 | 5.047 | 63.242 | | | | | | |
| **Age** | .573 | 2.863 | 88.814 | 1.006 | 5.031 | 68.273 | | | | | | |
| **Gender** | .525 | 2.627 | 91.441 | 1.000 | 4.998 | 73.271 | | | | | | |
| **Qual** | .448 | 2.240 | 93.680 | .996 | 4.980 | 78.251 | | **7.1%** | | **10.4%** | | |
| **Exp** | .340 | 1.702 | 95.382 | .993 | 4.964 | 83.216 | | | | | | |
| **AO** | .290 | 1.448 | 96.830 | .991 | 4.956 | 88.171 | | | | | | |
| **SAT** | .250 | 1.251 | 98.081 | .981 | 4.905 | 93.076 | | **10%** | | | | |
| **SNE** | .234 | 1.168 | 99.249 | .905 | 4.527 | 97.604 | | | | | | |
| **VU** | .150 | .751 | 100.000 | .479 | 2.396 | 100.000 | | | | **5.7%** | | |

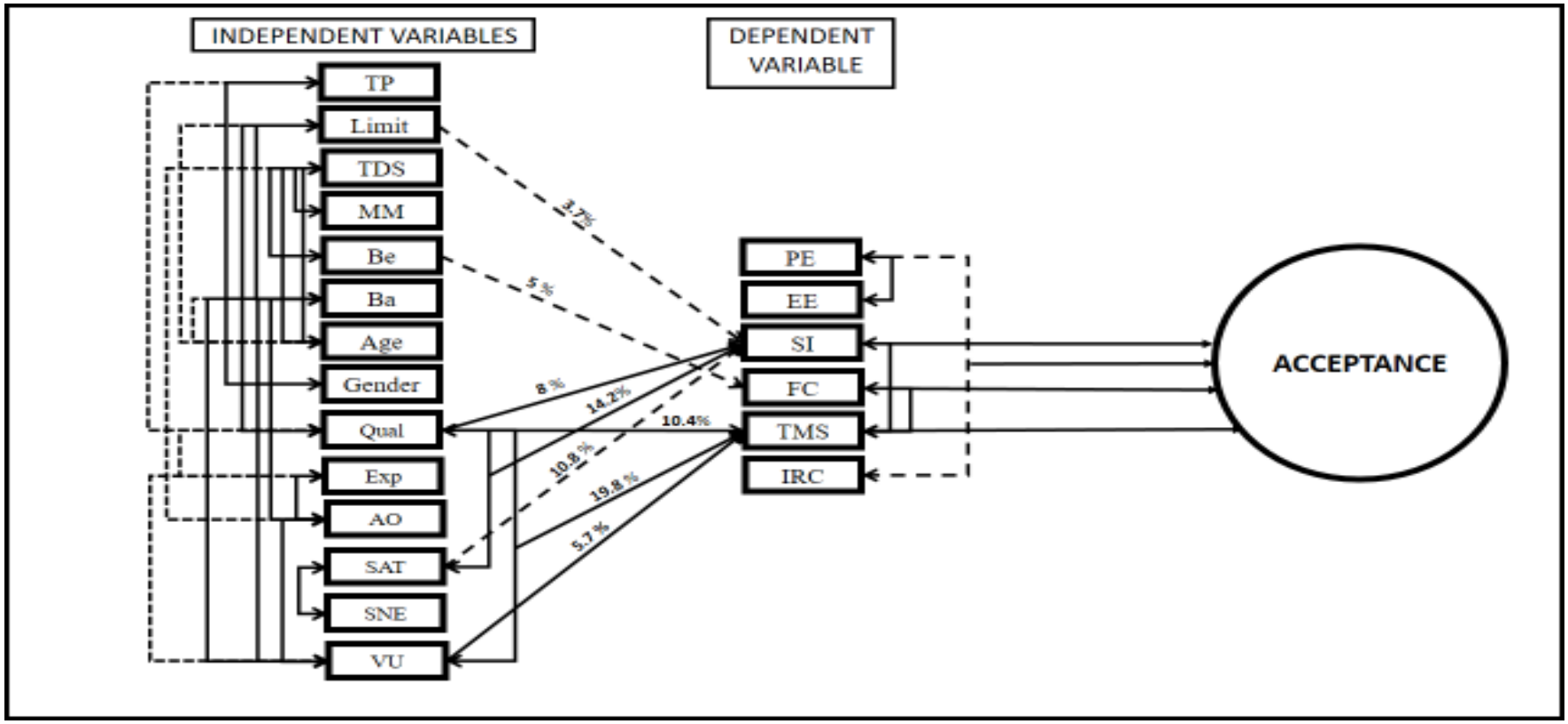



**Figure 3. Developed User Acceptance Model**

Figure 3 illustrates significant relationships only derived from Table 6 namely correlation between significant constructs. The solid lines between EE vs PE, TMS vs SI, TMS vs FC, MM vs TDS, Be vs TDS, Ba vs LIMIT, Age vs TDS, Gender vs TP, Qual vs SI, SAT vs SI, Qual vs TMS, VU vs TMS, Qual vs LIMIT, AO vs Ba, AO vs Exp, SNE vs SAT, VU vs LIMIT, VU vs Ba, and VU vs AO; depict strong correlations with significance levels $p<0.01$. The relationship between IRC vs PE, LIMIT vs SI, and Be vs FC is weak Age vs LIMIT, Age vs Ba, Qual vs TP, Exp vs Qual, AO vs TDS, and VU vs EXP, represented by broken lines, show correlations with significance levels, $p>0.01$. The dependant variables interact / impact on Acceptance significantly at SI, FC, TMS, and PE vs IRC (solid line).

Figure 3 also illustrates results arrived at from the regression analysis via the model summary and Anova Tables 6 to 21. These show the strength of the relationships in percentages only between the independent and the dependant variables, namely:

- Qual & Vu vs TMS = 19.8%;
- Qual & SAT vs SI = 14.2%;
- SAT vs SI = 10.0%;
- Qual vs TMS = 10.4%;
- Qual vs SI = 7.1%;
- VU vs TMS = 5.7%;
- Be vs FC = 5.0%; and
- LIMIT vs SI = 3.7%

### 4.10. Chapter Summary

Chapter Four analysed the data from the questionnaire survey by utilising SPSS v 23, and a series of tests were undertaken. The profile of the sample was processed to provide a deeper insight into the respondents. Cronbach Alpha and factor analysis was conducted in order to work with stronger groupings for a more concise result. Descriptive statistics were presented in order to clearly identify the more prominent statements of responses, so that we could analyse them further. This directed the research toward an evolved acceptance model explain visually the various inter relationships of the constructs developed from the questionnaire via analyses. The correlations between the independent and dependent variables separated the stronger relationships from the initial variables that were responsible for technology acceptance. These stronger relationships were further analysed to produce the regression models which zoned in on the emerged fact that qualification was the strongest variable that correlated with determinants of technology usage, which could then effectively propagate NTA.

# CHAPTER FIVE

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1. Introduction

Chapter five concludes the study and summarizes the key findings and suggests areas for further research.

## 5.2. The Problem Statement

The problem statement driving the study was:

The accelerated growth of Information technology has an effect on construction-related software packages and applications, creating an impact on the role of the quantity surveyor in industry, and this demands a response from quantity surveyors operating in the KwaZulu-Natal province of South Africa in terms of whether these developments are perceived as an advancement, opportunity or threat to the QS profession, the extent of which has as yet not been determined in terms of performance expectancy, effort expectancy, facilitating conditions, social influence, top management support, individual resistance to change and the effects of factors such as gender, age, and experience.

## 5.3. Hypotheses

The hypotheses to be tested in this study were:

- **H1**

Many new construction-related software packages and applications duplicate and affect activities and services of traditional QSs.

- **H2**

Many QSs view the advent of new technology as a threat to their roles and functions in the construction sector.

- **H3**

QSs regard the new technology as an opportunity to advance the range of their services that they render the construction industry.

- **H4**

QSs have not embraced the new technology and its potential to improve and expand their service delivery.

Several factors affect the willingness to adopt new technology in QS firms and practices.

### 5.3.1. Sub-hypotheses

The sub-hypotheses to be tested in this study were:

- **SH1**

Performance expectancy affects the adoption of new technology by QSs.

- **SH2**

Effort expectancy affects the adoption of new technology by QSs.

- **SH3**

Facilitating conditions affect the adoption of new technology by QSs.

- **SH4**

Social influence affects the adoption of new technology by QSs.

- **SH5**

Top management support affects the adoption of new technology by QSs.

- **SH6**

Individual resistance affects the adoption of new technology by QSs.

- **SH7**

Gender affects the adoption of new technology by QSs.

- **SH8**

Age affects the adoption of new technology by QSs.

- **SH9**

Experience affects the adoption of new technology by QSs.

## 5.4. Objectives

The primary objectives of the study are:

- To explore whether emergent new technologies duplicate the activities of traditional QS.
- To determine the areas and services rendered by QS that will be affected if new software packages and applications are embraced.
- To establish the extent of the perceived threat of technological changes to the roles and functions of QS in construction.
- To examine whether the new technologies are used by QS to advance the range of their services that they render the construction industry.
- To analyse the reasons why QS are not embracing the potential that new technology offers.
- To investigate the impact of performance expectancy, effort expectancy, facilitating conditions, social influence, top management support, individual resistance to change and other factors such as gender, age, and experience on the adoption of new technologies by QS.

### 5.5. Hypothesis Testing

- **H1: Many new construction-related software packages and applications duplicate and affect activities and services of traditional QS.**

The majority of QSs disagreed that any of the unit method, cube method, superficial method, storey enclosure method, approximate quantities, elemental cost analysis, comparative estimates method, and that interpolation method could have been executed with technology alone.

Therefore the hypothesis that many new construction-related software packages and applications duplicate and affect activities and services of traditional QSs is rejected.

- **H2: Many QSs view the advent of new technology as a threat to their roles and functions in the construction sector.**

The majority of QS disagreed (64.5%) that technology was a threat to the services conventionally provided by QSs.

Therefore the hypothesis that many QSs view the advent of new technology as a threat to their roles and functions in the construction sector is rejected.

- **H3: QSs regard the new technology as an opportunity to advance the range of their services that they render the construction industry.**

In this study the majority of QSs agreed that technology automated taking off and that BoQ production was important. They also agreed that technology increased the efficiency of quantity surveying. QSs strongly agreed that adoption of technology software reduced the time to produce BoQs. The majority of QSs were neutral with regards to whether technological innovations promoted collaboration between stakeholders. QSs were also neutral about the barrier of new technology acceptance by QSs being a threat to services conventionally provided by QS.

Therefore the hypothesis that QSs regard new technology as an opportunity to advance the range of their services that they render the construction industry cannot be rejected.

- **H4: QSs have not embraced new technology and its potential to improve and expand their service delivery.**

The majority of QSs were neutral about whether they resisted the introduction and adoption of new technology. Most QSs considered themselves open to the introduction and adoption of new technology to quantity surveying despite the threats that it might present.

Therefore the hypothesis that QSs have not embraced the new technology and its potential to improve and expand their service delivery is rejected.

- **H5: Several factors affect the willingness to adopt new technology in QS firms and practices.**

The majority of QSs agreed that technological advances required new skills and knowledge. They also agreed that financial and time commitment from small practices were too large; that upfront costs were too high, and that additional costs of training made new technology adoption prohibitive. QSs strongly disagreed that QS practices were too small to embrace new technology; that there were problems with legal ownership of information; and that their roles and responsibilities had changed. Further, they were neutral about there being no client demand and a scarcity of available appropriate training.

Therefore the hypothesis that several factors affect the willingness to adopt new technology in QS firms and practices cannot be rejected.

### 5.6. Sub - Hypothesis Testing

- **SH1: Performance expectancy affects the adoption of new technology by QS.**

Most QSs held that performance expectancy was significant as a determinant of the use of technology in QS practices and therefore influenced the adoption of technology. Performance expectancy significantly impacted on an individual's resistance to change and improved technology acceptance. Performance expectancy also impacted on effort expectancy and increased technology acceptance

Therefore the sub-hypothesis that performance expectancy affects the adoption of new technology by QSs cannot be rejected.

- **SH2: Effort expectancy affects the adoption of new technology by QSs.**

Most QSs responded that effort expectancy was significant as a determinant to the use of technology in QS practices.

Therefore the hypothesis that effort expectancy affects the adoption of new technology by QS cannot be rejected.

- **SH3: Facilitating conditions affect the adoption of new technology by QSs.**

Most QSs considered facilitating conditions to be significant as a determinant to the use of technology in QS practices.

Therefore the hypothesis that facilitating conditions affects the adoption of new technology by QS cannot be rejected.

- **SH4: Social influence affects the adoption of new technology by QSs.**

The majority of QSs were neutral about facilitating conditions as a most significant and significant determinant to the use of technology in QS practices, however 28.7% of QSs considered facilitating conditions to be both insignificant and least significant.

Therefore the hypothesis that social influence affects the adoption of new technology by QSs is rejected.

- **SH5: Top management support affects the adoption of new technology by QSs.**

The majority of QSs responded that top management support affected the adoption of new technology by QSs. However, 38.5% of QSs considered top management support as both insignificant and least significant.

Therefore the hypothesis that top management support affects the adoption of new technology by QSs cannot be rejected.

- **SH6: Individual resistance affects the adoption of new technology by QSs.**

The study found that most QSs regarded individual resistance as being insignificant relative to the adoption of new technology by their forms or practices.

Therefore the hypothesis that individual resistance affects the adoption of new technology by QSs is rejected.

- **SH7: Gender affects the adoption of new technology by QSs.**

The overall majority of QSs reported that gender affected the adoption of new technology by QS firms and practices.

Therefore the hypothesis that gender affects the adoption of new technology by QS cannot be rejected.

- **SH8: Age affects the adoption of new technology by QS.**

Most QSs considered age to affect the adoption of new technology by QS firms and practices.

Therefore the hypothesis that age affects the adoption of new technology by QS cannot be rejected.

- **SH9: Experience affects the adoption of new technology by QS**

Most respondents viewed experience as affecting the adoption of new technology by QS.

Therefore the hypothesis that experience affects the adoption of new technology by QS cannot be rejected.

### 5.7. Conclusion

In the main, results as shown in chapter four, depict the existence of strong relationships between effort expectancy and performance expectancy; top management support and social influence facilitating conditions, qualifications and voluntariness of use; technology driven services and measurement methods, benefits, and age; qualifications and social influences and limitations; barriers and limitations, area of operation and voluntariness of use; gender and technology potential; size in terms of annual turnover and social influence, size in terms of number of employees; area of operation and experience and voluntariness of use; and voluntariness of use and limitations.

In summary, the study found that the larger the firm or practice in terms of annual turnover, the greater the likelihood that the number of permanent employees; the greater the barriers to new technology, the greater the probability of limitations to acceptance of new technological advances; and when the performance expectancy was greater, the possibility of ease of use of technology/effort expectancy and acceptance of new technological advances was also potentially greater.

Further, the study found that new construction-related software packages and applications did not duplicate and affect the roles, functions, activities and services of traditional QS in the construction sector; and QSs had embraced new technology and its potential to improve and

expand their service delivery. The study also found that the acceptance determinants of QS; performance expectancy; effort expectancy; facilitating conditions; and top management support affected the adoption of new technology by QSs. However, the acceptance determinants, social influence; and individual resistance did not affect the adoption of new technology by QSs. Additionally, the mitigating influence components; qualifications, age, gender, area of operation, experience and size of the firm or practice affected to varying degrees the adoption of new technology by QSs.

### 5.8. Recommendations / Further Testing:

It is apparent from the findings of this research, as shown in chapter 4, that several factors exist that can affect technology acceptance by quantity surveyors. It is imperative to embark on further studies in order to investigate in greater detail with a larger sample across all provinces in South Africa to determine whether these same relationships manifest themselves, their comparative strength and impact on technology adoption. For example, it would be important to establish whether social influence and top management support are universally the major drivers of user acceptance of new technology in the QS industry.

There were relationships which were unexpected which need further investigation such as, for example, the relationship between limitations imposed on technological innovation and social influence and that between voluntariness of use and top management support to establish whether they were universal and if so what the underlying reasons might be. The relationship and their impact in the broader South African context need to be further examined of mitigating factors such as age, experience, firm's size and areas of operation and the determinants of technology adoption and use.

Further, the finding that QSs in this study claimed that new construction-related software packages and applications did not duplicate nor affect their roles as QSs in the industry needs further study to determine which particular software packages and applications were in use and what aspects of QS they were designed to target. Such a study would more definitively provide insight into these claims.

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# Appendix A – Ethical Approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

5 October 2017

**Mr Sanjivi Naidoo 216075681**
**School of Engineering**
**Howard College Campus**

**Dear Mr Naidoo**

**Protocol reference number: HSS/1599/017M**
**Project title: The impact of technological innovation on the role of the quantity surveyor in industry**

**Full Approval – Expedited Application**

In response to your application received 1 September 2017, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

**Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.**

**PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.**

**The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.**

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

**Dr Shamila Naidoo (Deputy Chair)**
**Humanities & Social Sciences Research Ethics Committee**

**/pm**

cc Supervisor: Prof Theo C Haupt
cc Academic Leader Research: Professor C Trois
cc. School Administrator: Ms N Dlamini

# Appendix B – Informed Consent

# UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

**APPLICATION FOR ETHICS APPROVAL**
**For research with human participants**

## INFORMED CONSENT RESOURCE TEMPLATE

**Information Sheet and Consent to Participate in Research**

Date: 02 August 2017

Greeting: Dear Colleague

My name is Sanjivi Naidoo (Mr.), an MSc Construction Management candidate from the Construction Studies discipline in the School of Engineering, College of Agriculture, Engineering and Science, UKZN, sanjnaidoo@gmail.com, sanjivi@mut.ac.za, 0794933782, and 0318199316.

You are being invited to consider participating in a study that involves research on the impact of technological innovation on the role of the quantity surveyor in industry. The aim and purpose of this research is to determine the influence that technology has on the role of quantity surveying in the overall construction process. It is important to collate responses from quantity surveyors in terms of whether these developments are perceived as an advancement, opportunity or threat to the QS profession, the extent of which has as yet not been determined The study is expected to involve 100 quantity surveyors, operating in the KwaZulu-Natal province of South Africa. It will involve the following procedures; the samples of QSs will be drawn using the database of The South African Council for the Quantity Surveying Profession (SACQSP). The use of emailing respondents will be adopted, via attached surveys. The duration of your participation if you choose to participate will be no more than 15 minutes. The study is funded by my employer, Mangosuthu University of Technology. We hope that the study will create the following benefits; awareness of the many benefits that new technology offers, and therefore realise or re-think the value offered and kick start the improvement of new technology uptake by the profession. These benefits include; improved efficiency, accurate measurement, co-ordination of all design information, visual aid, cost plan production, automatic schedule/program production and cost-effective standardization of routine tasks.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number HSS/1599/017M).
In the event of any problems or concerns/questions you may contact the researcher at (sanjnaidoo@gmail.com) or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

**HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION**
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557- Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

This survey is designed to determine the extent to which the quantity surveying discipline has been impacted by technology and innovation. Participation is both voluntary and anonymous, as well as at no cost to you and may be withdrawn at any point; further, there will be no penalty or loss incurred.

**CONSENT**

I _____ (Name) have been informed about the study entitled **the impact of technological innovation on the role of the quantity surveyor in industry** by Mr. S Naidoo.

I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at sanjnaidoo@gmail.com.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

**HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION**
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 - Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

_____ _____

**Signature of Participant** **Date**


**THE IMPACT OF TECHNOLOGICAL INNOVATION ON THE ROLE OF THE QUANTITY SURVEYOR IN INDUSTRY**

Thank you for taking the time to complete this questionnaire. Your input is of great value and will be used in understanding technology and its effects on the QS profession.

Your anonymity is of utmost importance and therefore all responses in this questionnaire will remain completely confidential.

Please email the completed questionnaire to the following email address: sanjnaidoo@gmail.com

**Interviewer Contact Details:**
**Telephone (Cell):** 0794933782
**Email Address:** sanjnaidoo@gmail.com

# Appendix C – Survey Questionnaire


**THE IMPACT OF TECHNOLOGICAL INNOVATION ON THE ROLE OF THE QUANTITY SURVEYOR IN INDUSTRY**

Thank you for taking the time to complete this questionnaire. Your input is of great value and will be used in understanding technology and its effects on the QS profession.

Your anonymity is of utmost importance and therefore all responses in this questionnaire will remain completely confidential.

Please email the completed questionnaire to the following email address: sanjnaidoo@gmail.com

**Interviewer Contact Details:**
**Telephone (Cell):** 0794933782
**Email Address:** sanjnaidoo@gmail.com


This survey is designed to determine the extent to which the quantity surveying discipline has been impacted by technology and innovation.

Participation is both voluntary and anonymous, as well as at no cost to you and you may withdraw at any point. Further, there will be no penalty or loss incurred

1. Please indicate your level of agreement with each of the following statements about technology and quantity surveying with 1 = strongly disagree and 5 = strongly agree:

| No | Factor/Influence | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | Technological developments are only for architects and designers | | | | | |
| 2 | Information and Communication Technologies (ICT) are too expensive | | | | | |
| 3 | Technology potentially removes many mundane elements of traditional quantity surveying | | | | | |
| 4 | Technology automates taking off and BoQ production | | | | | |
| 5 | Software reduces the time to produce BoQs | | | | | |
| 6 | Technology removes human errors from quantity surveying | | | | | |
| 7 | Technology increases efficiency of quantity surveying | | | | | |
| 8 | Technological innovations promote collaboration between stakeholders | | | | | |
| 9 | Cost estimation can be improved | | | | | |
| 10 | Technology increases program certainty at the tender stage | | | | | |
| 11 | Technology reduces the amount of variations during the construction phase | | | | | |
| 12 | Technological developments can streamline the procurement process | | | | | |
| 13 | Technology enhances life cycle costing data provision to clients | | | | | |
| 14 | Technological advances require new skills and knowledge | | | | | |
| 15 | QS practices are too small to embrace technology | | | | | |
| 16 | Financial and time commitment from small practices is too large | | | | | |
| 17 | Upfront costs are too high | | | | | |
| 18 | Additional costs of training make technology prohibitive | | | | | |
| 19 | There is no client demand | | | | | |
| 20 | There are problems with legal ownership of information | | | | | |
| 21 | Roles and responsibilities of quantity surveyors will change | | | | | |
| 22 | There is a scarcity of available training | | | | | |
| 23 | Technology allows the quantity surveyor to focus on strategic activities | | | | | |
| 24 | Quantity surveyors resist the introduction and adoption of new technology | | | | | |
| 25 | Organizational inertia prevents the adoption of new technology | | | | | |
| 26 | Single rate approximate estimation can be executed using technology alone | | | | | |
| 27 | Cost planning can be executed using technology alone | | | | | |
| 28 | Procurement advice can be executed using technology alone | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 29 | Measurement and quantification can be executed using technology alone | | | | | |
| 30 | Document preparation can be executed using technology alone | | | | | |
| 31 | Cost control during construction can be executed using technology alone | | | | | |
| 32 | Interim valuations and payments can be executed using technology alone | | | | | |
| 33 | Financial statements can be executed using technology alone | | | | | |
| 34 | Final account preparation can be executed using technology alone | | | | | |
| 35 | Settlement of contractual claims can be executed using technology alone | | | | | |
| 36 | Unit method can be executed using technology alone | | | | | |
| 37 | Cube method can be executed using technology alone | | | | | |
| 38 | Superficial method can be executed using technology alone | | | | | |
| 39 | Storey enclosure method can be executed using technology alone | | | | | |
| 40 | Approximate quantities can be executed using technology alone | | | | | |
| 41 | Elemental cost analysis can be executed using technology alone | | | | | |
| 42 | Comparative estimates method can be executed using technology alone | | | | | |
| 43 | Interpolation method can be executed using technology alone | | | | | |

2. To what extent do you agree with the following benefits of technology to quantity surveyors with 1 = strongly disagree and 5 = strongly agree.

| | **Benefit** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| 1 | Improved efficiency | | | | | |
| 2 | Accurate measurement | | | | | |
| 3 | Co-ordination of all design information | | | | | |
| 4 | Visual aid | | | | | |
| 5 | Cost plan production | | | | | |
| 6 | Automatic schedule/program production | | | | | |
| 7 | Cost effective | | | | | |
| 8 | Standardization of routine tasks | | | | | |

3. To what extent do you agree that the following are barriers of technology acceptance to quantity surveyors with 1 = strongly disagree and 5 = strongly agree.

| | **Barriers** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| 1 | Removed need for a quantity surveyor | | | | | |
| 2 | Liability concerns | | | | | |
| 3 | High cost/extra capital investment | | | | | |
| 4 | Less familiarity with project | | | | | |
| 5 | Lack of software application interfaces | | | | | |
| 6 | Software complexity | | | | | |
| 7 | Lack of standards | | | | | |
| 8 | Threat to services conventionally provided by quantity surveyors | | | | | |

4. Rank the following in terms of their significance in determining the use of technology in quantity surveying practices with 1 = most significant and 5 = least significant.

| **Determinants of technology usage** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Performance expectancy<br>(degree to which a particular technology will help individuals attain gains in job performance) | | | | | |
| Effort expectancy<br>(degree of ease associated with use of the system) | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Social influence<br>(degree to which an individual perceives that important others believe he or she should use the new system) | | | | | |
| Facilitating conditions<br>(degree to which an individual believes that organizational and technical infrastructure exists to support use of the system) | | | | | |
| Top management support | | | | | |
| Individual resistance to change | | | | | |

5. To what extent do you expect the following to impact technology acceptance by quantity surveyors with 1 = no impact, 2=some impact and 3 = major impact.

| | **Mitigating Influences** | **1** | **2** | **3** |
|---|---|---|---|---|
| 1 | Age | | | |
| 2 | Gender | | | |
| 3 | Qualifications | | | |
| 4 | Experience | | | |
| 5 | Area of operation | | | |
| 6 | Size in terms of annual turnover | | | |
| 7 | Size in terms of number of permanent employees | | | |
| 8 | Voluntariness of use | | | |

6. How many years have you been practicing / practiced as a quantity surveyor?

_____

7. What is your age?

_____

8. Do you consider your practice/firm to be technology ready?

| | |
|---|---|
| Yes | |
| No | |

9. How do you rate your knowledge and experience of technology, software and innovation with 1 = very low and 5 = very high?

| | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Knowledge | | | | | |
| Experience | | | | | |

10. Do you consider yourself open to the introduction and adoption of new technology to quantity surveying despite the threats that it might present?

| | |
|---|---|
| Yes | |
| No | |

11. What best describes your highest qualification achieved?
Select only ONE box.

| Qualification | Place ticks below |
|---|---|
| Matriculation exemption | |
| Certificate | |

| | |
|---|---|
| Diploma / Degree | |
| Higher Diploma / BTech / Honours | |
| Masters | |
| Doctorate | |
| Other (please specify) | |

12. Indicate your area of operation (where you do or get most of your work), Select only ONE box.

| Province | Place ticks below |
|---|---|
| Northern Cape | |
| Western Cape | |
| Eastern Cape | |
| Kwazulu-Natal | |
| Free State | |
| Mpumalanga | |
| Limpopo | |
| North West | |
| Gauteng | |

13. What is the average annual turnover of your firm/practice in Rand value over the last 3 years?

_____

14. State the average number of permanent staff employed in your company over the last 3 years.

_____

15. Please select your gender:

| | |
|---|---|
| MALE | |
| FEMALE | |

# Appendix D – Data Summary and Key Analysis

## Descriptives

| Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| Q1.1 | 109 | 1.0 | 5.0 | 1.761 | 1.0265 |
| Q1.2 | 108 | 1.0 | 5.0 | 3.176 | 1.1342 |
| Q1.3 | 109 | 1.0 | 5.0 | 3.220 | 1.1969 |
| Q1.4 | 108 | 1.0 | 5.0 | 3.426 | 1.1777 |
| Q1.5 | 109 | 1.0 | 5.0 | 4.119 | 1.0517 |
| Q1.6 | 108 | 1.0 | 5.0 | 2.750 | 1.1771 |
| Q1.7 | 105 | 1.0 | 5.0 | 3.848 | .9383 |
| Q1.8 | 108 | 1.0 | 5.0 | 3.519 | .9617 |
| Q1.9 | 106 | 1.0 | 5.0 | 3.849 | .8484 |
| Q1.10 | 107 | 1.0 | 5.0 | 3.150 | .9596 |
| Q1.11 | 109 | 1.0 | 4.0 | 2.606 | .9331 |
| Q1.12 | 109 | 1.0 | 5.0 | 3.376 | 1.0522 |
| Q1.13 | 108 | 1.0 | 5.0 | 3.352 | .8998 |
| Q1.14 | 108 | 1.0 | 5.0 | 3.759 | .9655 |
| Q1.15 | 109 | 1.0 | 5.0 | 2.211 | 1.1228 |
| Q1.16 | 109 | 1.0 | 5.0 | 3.000 | 1.1547 |
| Q1.17 | 109 | 1.0 | 5.0 | 3.450 | 1.1425 |
| Q1.18 | 109 | 1.0 | 5.0 | 3.284 | 1.1311 |
| Q1.19 | 108 | 1.0 | 5.0 | 2.565 | .9597 |
| Q1.20 | 108 | 1.0 | 5.0 | 2.852 | 1.0662 |
| Q1.21 | 109 | 1.0 | 5.0 | 2.651 | 1.0919 |
| Q1.22 | 108 | 1.0 | 5.0 | 2.954 | 1.0970 |
| Q1.23 | 109 | 1.0 | 5.0 | 3.642 | .8663 |
| Q1.24 | 109 | 1.0 | 5.0 | 2.642 | 1.1265 |

| | | | | | |
|---|---|---|---|---|---|
| Q1.25 | 109 | 1.0 | 5.0 | 3.193 | 1.1585 |
| Q1.26 | 109 | 1.0 | 5.0 | 2.807 | .9951 |
| Q1.27 | 107 | 1.0 | 5.0 | 2.636 | 1.0675 |
| Q1.28 | 108 | 1.0 | 5.0 | 2.370 | 1.0554 |
| Q1.29 | 106 | 1.0 | 5.0 | 2.651 | 1.2727 |
| Q1.30 | 109 | 1.0 | 5.0 | 2.523 | 1.1674 |
| Q1.31 | 108 | 1.0 | 5.0 | 2.361 | 1.1394 |
| Q1.32 | 107 | 1.0 | 5.0 | 2.318 | 1.0781 |
| Q1.33 | 109 | 1.0 | 5.0 | 2.679 | 1.2009 |
| Q1.34 | 109 | 1.0 | 5.0 | 2.394 | 1.1865 |
| Q1.35 | 108 | 1.0 | 5.0 | 2.139 | 1.0181 |
| Q1.36 | 109 | 1.0 | 5.0 | 2.330 | 1.1060 |
| Q1.37 | 109 | 1.0 | 5.0 | 2.339 | 1.0560 |
| Q1.38 | 109 | 1.0 | 5.0 | 2.358 | 1.0587 |
| Q1.39 | 109 | 1.0 | 5.0 | 2.440 | 1.0491 |
| Q1.40 | 105 | 1.0 | 5.0 | 2.495 | 1.1530 |
| Q1.41 | 109 | 1.0 | 5.0 | 2.578 | 1.1571 |
| Q1.42 | 109 | 1.0 | 5.0 | 2.495 | 1.1436 |
| Q1.43 | 109 | 1.0 | 5.0 | 2.450 | .9669 |
| Q2.1 | 108 | 2.0 | 58.0 | 4.481 | 5.2640 |
| Q2.2 | 107 | 2.0 | 5.0 | 3.645 | .8929 |
| Q2.3 | 109 | 2.0 | 5.0 | 3.761 | .8266 |
| Q2.4 | 109 | 1.0 | 5.0 | 3.917 | .9242 |
| Q2.5 | 109 | 2.0 | 5.0 | 3.514 | .8673 |
| Q2.6 | 109 | 2.0 | 5.0 | 3.624 | .9208 |
| Q2.7 | 108 | 1.0 | 5.0 | 3.370 | .9332 |
| Q2.8 | 109 | 2.0 | 5.0 | 3.587 | .8736 |

| | | | | | |
|---|---|---|---|---|---|
| Q3.1 | 109 | 1.0 | 5.0 | 1.982 | 1.2017 |
| Q3.2 | 109 | 1.0 | 5.0 | 2.817 | 1.3205 |
| Q3.3 | 109 | 1.0 | 5.0 | 3.404 | 1.1950 |
| Q3.4 | 109 | 1.0 | 5.0 | 2.945 | 1.1372 |
| Q3.5 | 109 | 1.0 | 5.0 | 3.046 | 1.1971 |
| Q3.6 | 109 | 1.0 | 5.0 | 3.064 | 1.2040 |
| Q3.7 | 109 | 1.0 | 5.0 | 2.853 | 1.1613 |
| Q3.8 | 107 | 1.0 | 5.0 | 2.617 | 1.1463 |
| Q4.1 | 108 | 1.0 | 5.0 | 2.148 | 1.1341 |
| Q4.2 | 108 | 1.0 | 5.0 | 2.296 | .9595 |
| Q4.3 | 108 | 1.0 | 5.0 | 3.056 | 1.0923 |
| Q4.4 | 107 | 1.0 | 5.0 | 2.692 | .9944 |
| Q4.5 | 109 | 1.0 | 5.0 | 2.982 | 1.3675 |
| Q4.6 | 108 | 1.0 | 5.0 | 3.333 | 1.3042 |
| Q5.1 | 109 | 1.0 | 3.0 | 2.422 | .7365 |
| Q5.2 | 109 | 1.0 | 3.0 | 1.294 | .5323 |
| Q5.3 | 108 | 1.0 | 3.0 | 2.000 | .6698 |
| Q5.4 | 109 | 1.0 | 3.0 | 2.248 | .7221 |
| Q5.5 | 109 | 1.0 | 3.0 | 2.083 | .6255 |
| Q5.6 | 109 | 1.0 | 3.0 | 2.275 | .6922 |
| Q5.7 | 109 | 1.0 | 3.0 | 2.119 | .7035 |
| Q5.8 | 108 | 1.0 | 3.0 | 2.046 | .6322 |
| Q6 | 108 | 1.0 | 45.0 | 8.870 | 8.0226 |
| Q7 | 108 | 21 | 65 | 33.50 | 8.589 |
| Q8 | 108 | 1.0 | 2.0 | 1.204 | .4046 |
| Q9.1 | 108 | 2.0 | 5.0 | 3.769 | .7564 |
| Q9.2 | 108 | 2.0 | 5.0 | 3.630 | .7924 |

| | | | | | |
|---|---|---|---|---|---|
| Q10 | 108 | 1.0 | 2.0 | 1.037 | .1897 |
| Q11 | 109 | 2.0 | 5.0 | 3.927 | .4656 |
| Q12 | 98 | 2.0 | 9.0 | 4.153 | .9454 |
| Q13 | 43 | 350000 | 29500000000 | 717290697.67 | 4495057660.686 |
| Q14 | 75 | 1 | 150 | 17.31 | 24.516 |
| Q15 | 108 | 1.0 | 2.0 | 1.315 | .4666 |
| Valid N (listwise) | 24 | | | | |

# Frequency Tables

**Technological developments are only for architects and designers**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 58 | 53.2 | 53.2 | 53.2 |
| | Disagree | 31 | 28.4 | 28.4 | 81.7 |
| | Neutral | 11 | 10.1 | 10.1 | 91.7 |
| | Agree | 6 | 5.5 | 5.5 | 97.2 |
| | Strongly Agree | 3 | 2.8 | 2.8 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |

**Information and Communication Technologies (ICT) are too expensive**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 10 | 9.2 | 9.3 | 9.3 |
| | Disagree | 16 | 14.7 | 14.8 | 24.1 |
| | Neutral | 42 | 38.5 | 38.9 | 63.0 |
| | Agree | 25 | 22.9 | 23.1 | 86.1 |
| | Strongly Agree | 15 | 13.8 | 13.9 | 100.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Technology potentially removes many mundane elements of traditional quantity surveying**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 11 | 10.1 | 10.1 | 10.1 |
| | Disagree | 17 | 15.6 | 15.6 | 25.7 |
| | Neutral | 36 | 33.0 | 33.0 | 58.7 |
| | Agree | 27 | 24.8 | 24.8 | 83.5 |
| | Strongly Agree | 18 | 16.5 | 16.5 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Technology automates taking off and BoQ production**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 8 | 7.3 | 7.4 | 7.4 |
| | Disagree | 16 | 14.7 | 14.8 | 22.2 |
| | Neutral | 27 | 24.8 | 25.0 | 47.2 |
| | Agree | 36 | 33.0 | 33.3 | 80.6 |
| | Strongly Agree | 21 | 19.3 | 19.4 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Software reduces the time to produce BoQs**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 4 | 3.7 | 3.7 | 3.7 |
| | Disagree | 4 | 3.7 | 3.7 | 7.3 |
| | Neutral | 18 | 16.5 | 16.5 | 23.9 |
| | Agree | 32 | 29.4 | 29.4 | 53.2 |
| | Strongly Agree | 51 | 46.8 | 46.8 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Technology removes human errors from quantity surveying X**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 20 | 18.3 | 18.5 | 18.5 |
| | Disagree | 25 | 22.9 | 23.1 | 41.7 |
| | Neutral | 31 | 28.4 | 28.7 | 70.4 |
| | Agree | 26 | 23.9 | 24.1 | 94.4 |
| | Strongly Agree | 6 | 5.5 | 5.6 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Technology increases efficiency of quantity surveying**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 2 | 1.8 | 1.9 | 1.9 |
| | Disagree | 4 | 3.7 | 3.8 | 5.7 |
| | Neutral | 31 | 28.4 | 29.5 | 35.2 |
| | Agree | 39 | 35.8 | 37.1 | 72.4 |
| | Strongly Agree | 29 | 26.6 | 27.6 | 100.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Total | 105 | 96.3 | 100.0 | |
| Missing | 99.0 | 4 | 3.7 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Technological innovations promote collaboration between stakeholders**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 3 | 2.8 | 2.8 | 2.8 |
| | Disagree | 11 | 10.1 | 10.2 | 13.0 |
| | Neutral | 37 | 33.9 | 34.3 | 47.2 |
| | Agree | 41 | 37.6 | 38.0 | 85.2 |
| | Strongly Agree | 16 | 14.7 | 14.8 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Cost estimation can be improved**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 1 | .9 | .9 | .9 |
| | Disagree | 6 | 5.5 | 5.7 | 6.6 |
| | Neutral | 23 | 21.1 | 21.7 | 28.3 |
| | Agree | 54 | 49.5 | 50.9 | 79.2 |
| | Strongly Agree | 22 | 20.2 | 20.8 | 100.0 |
| | Total | 106 | 97.2 | 100.0 | |
| Missing | 99.0 | 3 | 2.8 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

| Technology increases program certainty at the tender stage | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 4 | 3.7 | 3.7 | 3.7 |
| | Disagree | 23 | 21.1 | 21.5 | 25.2 |
| | Neutral | 40 | 36.7 | 37.4 | 62.6 |
| | Agree | 33 | 30.3 | 30.8 | 93.5 |
| | Strongly Agree | 7 | 6.4 | 6.5 | 100.0 |
| | Total | 107 | 98.2 | 100.0 | |
| Missing | 99.0 | 2 | 1.8 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Technology reduces the amount of variations during the construction phase** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 17 | 15.6 | 15.6 | 15.6 |
| | Disagree | 26 | 23.9 | 23.9 | 39.4 |
| | Neutral | 49 | 45.0 | 45.0 | 84.4 |
| | Agree | 17 | 15.6 | 15.6 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Technological developments can streamline the procurement process** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 7 | 6.4 | 6.4 | 6.4 |
| | Disagree | 14 | 12.8 | 12.8 | 19.3 |
| | Neutral | 31 | 28.4 | 28.4 | 47.7 |
| | Agree | 45 | 41.3 | 41.3 | 89.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Strongly Agree | 12 | 11.0 | 11.0 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Technology enhances life cycle costing data provision to clients**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 3 | 2.8 | 2.8 | 2.8 |
| | Disagree | 13 | 11.9 | 12.0 | 14.8 |
| | Neutral | 44 | 40.4 | 40.7 | 55.6 |
| | Agree | 39 | 35.8 | 36.1 | 91.7 |
| | Strongly Agree | 9 | 8.3 | 8.3 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Technological advances require new skills and knowledge**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 2 | 1.8 | 1.9 | 1.9 |
| | Disagree | 11 | 10.1 | 10.2 | 12.0 |
| | Neutral | 21 | 19.3 | 19.4 | 31.5 |
| | Agree | 51 | 46.8 | 47.2 | 78.7 |
| | Strongly Agree | 23 | 21.1 | 21.3 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**QS practices are too small to embrace technology**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 36 | 33.0 | 33.0 | 33.0 |
| | Disagree | 35 | 32.1 | 32.1 | 65.1 |
| | Neutral | 19 | 17.4 | 17.4 | 82.6 |
| | Agree | 17 | 15.6 | 15.6 | 98.2 |
| | Strongly Agree | 2 | 1.8 | 1.8 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Financial and time commitment from small practices is too large**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 13 | 11.9 | 11.9 | 11.9 |
| | Disagree | 24 | 22.0 | 22.0 | 33.9 |
| | Neutral | 31 | 28.4 | 28.4 | 62.4 |
| | Agree | 32 | 29.4 | 29.4 | 91.7 |
| | Strongly Agree | 9 | 8.3 | 8.3 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Upfront costs are too high**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 8 | 7.3 | 7.3 | 7.3 |
| | Disagree | 12 | 11.0 | 11.0 | 18.3 |
| | Neutral | 33 | 30.3 | 30.3 | 48.6 |
| | Agree | 35 | 32.1 | 32.1 | 80.7 |
| | Strongly Agree | 21 | 19.3 | 19.3 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

| Additional costs of training make technology prohibitive | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 6 | 5.5 | 5.5 | 5.5 |
| | Disagree | 23 | 21.1 | 21.1 | 26.6 |
| | Neutral | 31 | 28.4 | 28.4 | 55.0 |
| | Agree | 32 | 29.4 | 29.4 | 84.4 |
| | Strongly Agree | 17 | 15.6 | 15.6 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **There is no client demand** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 16 | 14.7 | 14.8 | 14.8 |
| | Disagree | 32 | 29.4 | 29.6 | 44.4 |
| | Neutral | 46 | 42.2 | 42.6 | 87.0 |
| | Agree | 11 | 10.1 | 10.2 | 97.2 |
| | Strongly Agree | 3 | 2.8 | 2.8 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **There are problems with legal ownership of information** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 10 | 9.2 | 9.3 | 9.3 |
| | Disagree | 31 | 28.4 | 28.7 | 38.0 |
| | Neutral | 41 | 37.6 | 38.0 | 75.9 |

| | | | | | |
|---|---|---|---|---|---|
| | Agree | 17 | 15.6 | 15.7 | 91.7 |
| | Strongly Agree | 9 | 8.3 | 8.3 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Roles and responsibilities of quantity surveyors will change**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 17 | 15.6 | 15.6 | 15.6 |
| | Disagree | 31 | 28.4 | 28.4 | 44.0 |
| | Neutral | 42 | 38.5 | 38.5 | 82.6 |
| | Agree | 11 | 10.1 | 10.1 | 92.7 |
| | Strongly Agree | 8 | 7.3 | 7.3 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**There is a scarcity of available training**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 12 | 11.0 | 11.1 | 11.1 |
| | Disagree | 23 | 21.1 | 21.3 | 32.4 |
| | Neutral | 39 | 35.8 | 36.1 | 68.5 |
| | Agree | 26 | 23.9 | 24.1 | 92.6 |
| | Strongly Agree | 8 | 7.3 | 7.4 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

| Technology allows the quantity surveyor to focus on strategic activities | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 1 | .9 | .9 | .9 |
| | Disagree | 10 | 9.2 | 9.2 | 10.1 |
| | Neutral | 31 | 28.4 | 28.4 | 38.5 |
| | Agree | 52 | 47.7 | 47.7 | 86.2 |
| | Strongly Agree | 15 | 13.8 | 13.8 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Quantity surveyors resist the introduction and adoption of new technology** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 20 | 18.3 | 18.3 | 18.3 |
| | Disagree | 29 | 26.6 | 26.6 | 45.0 |
| | Neutral | 36 | 33.0 | 33.0 | 78.0 |
| | Agree | 18 | 16.5 | 16.5 | 94.5 |
| | Strongly Agree | 6 | 5.5 | 5.5 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Organizational inertia prevents the adoption of new technology** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 11 | 10.1 | 10.1 | 10.1 |
| | Disagree | 16 | 14.7 | 14.7 | 24.8 |
| | Neutral | 38 | 34.9 | 34.9 | 59.6 |
| | Agree | 29 | 26.6 | 26.6 | 86.2 |
| | Strongly Agree | 15 | 13.8 | 13.8 | 100.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Single rate approximate estimation can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 11 | 10.1 | 10.1 | 10.1 |
| | Disagree | 30 | 27.5 | 27.5 | 37.6 |
| | Neutral | 40 | 36.7 | 36.7 | 74.3 |
| | Agree | 25 | 22.9 | 22.9 | 97.2 |
| | Strongly Agree | 3 | 2.8 | 2.8 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Cost planning can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 16 | 14.7 | 15.0 | 15.0 |
| | Disagree | 35 | 32.1 | 32.7 | 47.7 |
| | Neutral | 32 | 29.4 | 29.9 | 77.6 |
| | Agree | 20 | 18.3 | 18.7 | 96.3 |
| | Strongly Agree | 4 | 3.7 | 3.7 | 100.0 |
| | Total | 107 | 98.2 | 100.0 | |
| Missing | 99.0 | 2 | 1.8 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Procurement advice can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 28 | 25.7 | 25.9 | 25.9 |

| | | | | | |
|---|---|---|---|---|---|
| | Disagree | 30 | 27.5 | 27.8 | 53.7 |
| | Neutral | 33 | 30.3 | 30.6 | 84.3 |
| | Agree | 16 | 14.7 | 14.8 | 99.1 |
| | Strongly Agree | 1 | .9 | .9 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Measurement and quantification can be executed using technology alone**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 25 | 22.9 | 23.6 | 23.6 |
| | Disagree | 28 | 25.7 | 26.4 | 50.0 |
| | Neutral | 19 | 17.4 | 17.9 | 67.9 |
| | Agree | 27 | 24.8 | 25.5 | 93.4 |
| | Strongly Agree | 7 | 6.4 | 6.6 | 100.0 |
| | Total | 106 | 97.2 | 100.0 | |
| Missing | 99.0 | 3 | 2.8 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Document preparation can be executed using technology alone**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 24 | 22.0 | 22.0 | 22.0 |
| | Disagree | 34 | 31.2 | 31.2 | 53.2 |
| | Neutral | 27 | 24.8 | 24.8 | 78.0 |
| | Agree | 18 | 16.5 | 16.5 | 94.5 |
| | Strongly Agree | 6 | 5.5 | 5.5 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |

| | | | | | |
|---|---|---|---|---|---|
| **Cost control during construction can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 28 | 25.7 | 25.9 | 25.9 |
| | Disagree | 36 | 33.0 | 33.3 | 59.3 |
| | Neutral | 27 | 24.8 | 25.0 | 84.3 |
| | Agree | 11 | 10.1 | 10.2 | 94.4 |
| | Strongly Agree | 6 | 5.5 | 5.6 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Interim valuations and payments can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 28 | 25.7 | 26.2 | 26.2 |
| | Disagree | 35 | 32.1 | 32.7 | 58.9 |
| | Neutral | 30 | 27.5 | 28.0 | 86.9 |
| | Agree | 10 | 9.2 | 9.3 | 96.3 |
| | Strongly Agree | 4 | 3.7 | 3.7 | 100.0 |
| | Total | 107 | 98.2 | 100.0 | |
| Missing | 99.0 | 2 | 1.8 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Financial statements can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |

| | | | | | |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 21 | 19.3 | 19.3 | 19.3 |
| | Disagree | 29 | 26.6 | 26.6 | 45.9 |
| | Neutral | 32 | 29.4 | 29.4 | 75.2 |
| | Agree | 18 | 16.5 | 16.5 | 91.7 |
| | Strongly Agree | 9 | 8.3 | 8.3 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Final account preparation can be executed using technology alone**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 30 | 27.5 | 27.5 | 27.5 |
| | Disagree | 33 | 30.3 | 30.3 | 57.8 |
| | Neutral | 25 | 22.9 | 22.9 | 80.7 |
| | Agree | 15 | 13.8 | 13.8 | 94.5 |
| | Strongly Agree | 6 | 5.5 | 5.5 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Settlement of contractual claims can be executed using technology alone**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 32 | 29.4 | 29.6 | 29.6 |
| | Disagree | 43 | 39.4 | 39.8 | 69.4 |
| | Neutral | 22 | 20.2 | 20.4 | 89.8 |
| | Agree | 8 | 7.3 | 7.4 | 97.2 |
| | Strongly Agree | 3 | 2.8 | 2.8 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

| Unit method can be executed using technology alone | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 28 | 25.7 | 25.7 | 25.7 |
| | Disagree | 38 | 34.9 | 34.9 | 60.6 |
| | Neutral | 27 | 24.8 | 24.8 | 85.3 |
| | Agree | 11 | 10.1 | 10.1 | 95.4 |
| | Strongly Agree | 5 | 4.6 | 4.6 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Cube method can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 25 | 22.9 | 22.9 | 22.9 |
| | Disagree | 41 | 37.6 | 37.6 | 60.6 |
| | Neutral | 28 | 25.7 | 25.7 | 86.2 |
| | Agree | 11 | 10.1 | 10.1 | 96.3 |
| | Strongly Agree | 4 | 3.7 | 3.7 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Superficial method can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 26 | 23.9 | 23.9 | 23.9 |
| | Disagree | 36 | 33.0 | 33.0 | 56.9 |
| | Neutral | 33 | 30.3 | 30.3 | 87.2 |
| | Agree | 10 | 9.2 | 9.2 | 96.3 |
| | Strongly Agree | 4 | 3.7 | 3.7 | 100.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Storey enclosure method can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 21 | 19.3 | 19.3 | 19.3 |
| | Disagree | 39 | 35.8 | 35.8 | 55.0 |
| | Neutral | 34 | 31.2 | 31.2 | 86.2 |
| | Agree | 10 | 9.2 | 9.2 | 95.4 |
| | Strongly Agree | 5 | 4.6 | 4.6 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Approximate quantities can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 22 | 20.2 | 21.0 | 21.0 |
| | Disagree | 37 | 33.9 | 35.2 | 56.2 |
| | Neutral | 24 | 22.0 | 22.9 | 79.0 |
| | Agree | 16 | 14.7 | 15.2 | 94.3 |
| | Strongly Agree | 6 | 5.5 | 5.7 | 100.0 |
| | Total | 105 | 96.3 | 100.0 | |
| Missing | 99.0 | 4 | 3.7 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Elemental cost analysis can be executed using technology alone** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 22 | 20.2 | 20.2 | 20.2 |

| | | | | | |
|---|---|---|---|---|---|
| | Disagree | 33 | 30.3 | 30.3 | 50.5 |
| | Neutral | 29 | 26.6 | 26.6 | 77.1 |
| | Agree | 19 | 17.4 | 17.4 | 94.5 |
| | Strongly Agree | 6 | 5.5 | 5.5 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Comparative estimates method can be executed using technology alone**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 25 | 22.9 | 22.9 | 22.9 |
| | Disagree | 33 | 30.3 | 30.3 | 53.2 |
| | Neutral | 27 | 24.8 | 24.8 | 78.0 |
| | Agree | 20 | 18.3 | 18.3 | 96.3 |
| | Strongly Agree | 4 | 3.7 | 3.7 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Interpolation method can be executed using technology alone**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 20 | 18.3 | 18.3 | 18.3 |
| | Disagree | 34 | 31.2 | 31.2 | 49.5 |
| | Neutral | 44 | 40.4 | 40.4 | 89.9 |
| | Agree | 8 | 7.3 | 7.3 | 97.2 |
| | Strongly Agree | 3 | 2.8 | 2.8 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |

## Frequency Table

| Improved efficiency | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Disagree | 4 | 3.7 | 3.7 | 3.7 |
| | Neutral | 26 | 23.9 | 24.1 | 27.8 |
| | Agree | 45 | 41.3 | 41.7 | 69.4 |
| | Strongly Agree | 32 | 29.4 | 29.6 | 99.1 |
| | 58.0 | 1 | .9 | .9 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Accurate measurement** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Disagree | 10 | 9.2 | 9.3 | 9.3 |
| | Neutral | 38 | 34.9 | 35.5 | 44.9 |
| | Agree | 39 | 35.8 | 36.4 | 81.3 |
| | Strongly Agree | 20 | 18.3 | 18.7 | 100.0 |
| | Total | 107 | 98.2 | 100.0 | |
| Missing | 99.0 | 2 | 1.8 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Co-ordination of all design information** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Disagree | 5 | 4.6 | 4.6 | 4.6 |
| | Neutral | 38 | 34.9 | 34.9 | 39.4 |

| | | | | | |
|---|---|---|---|---|---|
| | Agree | 44 | 40.4 | 40.4 | 79.8 |
| | Strongly Agree | 22 | 20.2 | 20.2 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Visual aid** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 1 | .9 | .9 | .9 |
| | Disagree | 5 | 4.6 | 4.6 | 5.5 |
| | Neutral | 30 | 27.5 | 27.5 | 33.0 |
| | Agree | 39 | 35.8 | 35.8 | 68.8 |
| | Strongly Agree | 34 | 31.2 | 31.2 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Cost plan production** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Disagree | 10 | 9.2 | 9.2 | 9.2 |
| | Neutral | 50 | 45.9 | 45.9 | 55.0 |
| | Agree | 32 | 29.4 | 29.4 | 84.4 |
| | Strongly Agree | 17 | 15.6 | 15.6 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Automatic schedule/program production** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Disagree | 12 | 11.0 | 11.0 | 11.0 |
| | Neutral | 38 | 34.9 | 34.9 | 45.9 |

| | | | | | |
|---|---|---|---|---|---|
| | Agree | 38 | 34.9 | 34.9 | 80.7 |
| | Strongly Agree | 21 | 19.3 | 19.3 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Cost effective** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 1 | .9 | .9 | .9 |
| | Disagree | 18 | 16.5 | 16.7 | 17.6 |
| | Neutral | 42 | 38.5 | 38.9 | 56.5 |
| | Agree | 34 | 31.2 | 31.5 | 88.0 |
| | Strongly Agree | 13 | 11.9 | 12.0 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Standardization of routine tasks** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Disagree | 10 | 9.2 | 9.2 | 9.2 |
| | Neutral | 43 | 39.4 | 39.4 | 48.6 |
| | Agree | 38 | 34.9 | 34.9 | 83.5 |
| | Strongly Agree | 18 | 16.5 | 16.5 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |

| **Frequency Table** | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Removed need for a quantity surveyor** | | | | | |

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 53 | 48.6 | 48.6 | 48.6 |
| | Disagree | 24 | 22.0 | 22.0 | 70.6 |
| | Neutral | 20 | 18.3 | 18.3 | 89.0 |
| | Agree | 5 | 4.6 | 4.6 | 93.6 |
| | Strongly Agree | 7 | 6.4 | 6.4 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**Liability concerns**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 24 | 22.0 | 22.0 | 22.0 |
| | Disagree | 20 | 18.3 | 18.3 | 40.4 |
| | Neutral | 31 | 28.4 | 28.4 | 68.8 |
| | Agree | 20 | 18.3 | 18.3 | 87.2 |
| | Strongly Agree | 14 | 12.8 | 12.8 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

**High cost/extra capital investment**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagree | 6 | 5.5 | 5.5 | 5.5 |
| | Disagree | 21 | 19.3 | 19.3 | 24.8 |
| | Neutral | 30 | 27.5 | 27.5 | 52.3 |
| | Agree | 27 | 24.8 | 24.8 | 77.1 |
| | Strongly Agree | 25 | 22.9 | 22.9 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

| Less familiarity with project | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 11 | 10.1 | 10.1 | 10.1 |
| | Disagree | 29 | 26.6 | 26.6 | 36.7 |
| | Neutral | 35 | 32.1 | 32.1 | 68.8 |
| | Agree | 23 | 21.1 | 21.1 | 89.9 |
| | Strongly Agree | 11 | 10.1 | 10.1 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Lack of software application interfaces** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 12 | 11.0 | 11.0 | 11.0 |
| | Disagree | 22 | 20.2 | 20.2 | 31.2 |
| | Neutral | 41 | 37.6 | 37.6 | 68.8 |
| | Agree | 17 | 15.6 | 15.6 | 84.4 |
| | Strongly Agree | 17 | 15.6 | 15.6 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Software complexity** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 10 | 9.2 | 9.2 | 9.2 |
| | Disagree | 29 | 26.6 | 26.6 | 35.8 |
| | Neutral | 30 | 27.5 | 27.5 | 63.3 |
| | Agree | 24 | 22.0 | 22.0 | 85.3 |
| | Strongly Agree | 16 | 14.7 | 14.7 | 100.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Lack of standards** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 13 | 11.9 | 11.9 | 11.9 |
| | Disagree | 30 | 27.5 | 27.5 | 39.4 |
| | Neutral | 39 | 35.8 | 35.8 | 75.2 |
| | Agree | 14 | 12.8 | 12.8 | 88.1 |
| | Strongly Agree | 13 | 11.9 | 11.9 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Threat to services conventionally provided by quantity surveyors** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly Disagree | 21 | 19.3 | 19.6 | 19.6 |
| | Disagree | 28 | 25.7 | 26.2 | 45.8 |
| | Neutral | 36 | 33.0 | 33.6 | 79.4 |
| | Agree | 15 | 13.8 | 14.0 | 93.5 |
| | Strongly Agree | 7 | 6.4 | 6.5 | 100.0 |
| | Total | 107 | 98.2 | 100.0 | |
| Missing | 99.0 | 2 | 1.8 | | |
| Total | | 109 | 100.0 | | |

| | | | | | |
|---|---|---|---|---|---|
| **Frequency Table** | | | | | |
| | | | | | |
| **Performance expectancy** | | | | | |

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Most Significant | 40 | 36.7 | 37.0 | 37.0 |
| | Significant | 30 | 27.5 | 27.8 | 64.8 |
| | Neutral | 24 | 22.0 | 22.2 | 87.0 |
| | Less Significant | 10 | 9.2 | 9.3 | 96.3 |
| | Least Significant | 4 | 3.7 | 3.7 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Effort expectancy**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Most Significant | 25 | 22.9 | 23.1 | 23.1 |
| | Significant | 38 | 34.9 | 35.2 | 58.3 |
| | Neutral | 34 | 31.2 | 31.5 | 89.8 |
| | Less Significant | 10 | 9.2 | 9.3 | 99.1 |
| | Least Significant | 1 | .9 | .9 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Social influence**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Most Significant | 8 | 7.3 | 7.4 | 7.4 |
| | Significant | 23 | 21.1 | 21.3 | 28.7 |
| | Neutral | 46 | 42.2 | 42.6 | 71.3 |

| | | | | | |
|---|---|---|---|---|---|
| | Less Significant | 17 | 15.6 | 15.7 | 87.0 |
| | Least Significant | 14 | 12.8 | 13.0 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Facilitating conditions**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Most Significant | 15 | 13.8 | 14.0 | 14.0 |
| | Significant | 28 | 25.7 | 26.2 | 40.2 |
| | Neutral | 40 | 36.7 | 37.4 | 77.6 |
| | Less Significant | 23 | 21.1 | 21.5 | 99.1 |
| | Least Significant | 1 | .9 | .9 | 100.0 |
| | Total | 107 | 98.2 | 100.0 | |
| Missing | 99.0 | 2 | 1.8 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Top management support**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Most Significant | 21 | 19.3 | 19.3 | 19.3 |
| | Significant | 21 | 19.3 | 19.3 | 38.5 |
| | Neutral | 24 | 22.0 | 22.0 | 60.6 |
| | Less Significant | 25 | 22.9 | 22.9 | 83.5 |
| | Least Significant | 18 | 16.5 | 16.5 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

| Individual resistance to change | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Most Significant | 10 | 9.2 | 9.3 | 9.3 |
| | Significant | 20 | 18.3 | 18.5 | 27.8 |
| | Neutral | 31 | 28.4 | 28.7 | 56.5 |
| | Less Significant | 18 | 16.5 | 16.7 | 73.1 |
| | Least Significant | 29 | 26.6 | 26.9 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |

# Frequency Table

| Age | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No impact | 16 | 14.7 | 14.7 | 14.7 |
| | Some impact | 31 | 28.4 | 28.4 | 43.1 |
| | Major impact | 62 | 56.9 | 56.9 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |

| Gender | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No impact | 81 | 74.3 | 74.3 | 74.3 |
| | Some impact | 24 | 22.0 | 22.0 | 96.3 |
| | Major impact | 4 | 3.7 | 3.7 | 100.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Qualifications** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No impact | 24 | 22.0 | 22.2 | 22.2 |
| | Some impact | 60 | 55.0 | 55.6 | 77.8 |
| | Major impact | 24 | 22.0 | 22.2 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |
| **Experience** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No impact | 18 | 16.5 | 16.5 | 16.5 |
| | Some impact | 46 | 42.2 | 42.2 | 58.7 |
| | Major impact | 45 | 41.3 | 41.3 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Area of operation** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No impact | 17 | 15.6 | 15.6 | 15.6 |
| | Some impact | 66 | 60.6 | 60.6 | 76.1 |
| | Major impact | 26 | 23.9 | 23.9 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |

| Size in terms of annual turnover | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No impact | 15 | 13.8 | 13.8 | 13.8 |
| | Some impact | 49 | 45.0 | 45.0 | 58.7 |
| | Major impact | 45 | 41.3 | 41.3 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Size in terms of number of permanent employees** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No impact | 21 | 19.3 | 19.3 | 19.3 |
| | Some impact | 54 | 49.5 | 49.5 | 68.8 |
| | Major impact | 34 | 31.2 | 31.2 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |
| | | | | | |
| **Voluntariness of use** | | | | | |
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No impact | 19 | 17.4 | 17.6 | 17.6 |
| | Some impact | 65 | 59.6 | 60.2 | 77.8 |
| | Major impact | 24 | 22.0 | 22.2 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |

| **Frequency Table** | | | | | |
|---|---|---|---|---|---|
| | | | | | |

| How many years have you been practicing / practiced as a quantity surveyor? | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1.0 | 2 | 1.8 | 1.9 | 1.9 |
| | 1.5 | 1 | .9 | .9 | 2.8 |
| | 2.0 | 1 | .9 | .9 | 3.7 |
| | 2.5 | 1 | .9 | .9 | 4.6 |
| | 3.0 | 9 | 8.3 | 8.3 | 13.0 |
| | 4.0 | 17 | 15.6 | 15.7 | 28.7 |
| | 5.0 | 17 | 15.6 | 15.7 | 44.4 |
| | 6.0 | 8 | 7.3 | 7.4 | 51.9 |
| | 7.0 | 7 | 6.4 | 6.5 | 58.3 |
| | 8.0 | 8 | 7.3 | 7.4 | 65.7 |
| | 9.0 | 4 | 3.7 | 3.7 | 69.4 |
| | 10.0 | 8 | 7.3 | 7.4 | 76.9 |
| | 11.0 | 4 | 3.7 | 3.7 | 80.6 |
| | 12.0 | 3 | 2.8 | 2.8 | 83.3 |
| | 13.0 | 3 | 2.8 | 2.8 | 86.1 |
| | 14.0 | 1 | .9 | .9 | 87.0 |
| | 15.0 | 2 | 1.8 | 1.9 | 88.9 |
| | 17.0 | 1 | .9 | .9 | 89.8 |
| | 18.0 | 1 | .9 | .9 | 90.7 |
| | 19.0 | 2 | 1.8 | 1.9 | 92.6 |
| | 20.0 | 2 | 1.8 | 1.9 | 94.4 |
| | 25.0 | 1 | .9 | .9 | 95.4 |
| | 30.0 | 1 | .9 | .9 | 96.3 |
| | 37.0 | 1 | .9 | .9 | 97.2 |
| | 39.0 | 1 | .9 | .9 | 98.1 |

| | | | | | |
|---|---|---|---|---|---|
| | 41.0 | 1 | .9 | .9 | 99.1 |
| | 45.0 | 1 | .9 | .9 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**What is your age?**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 21 | 1 | .9 | .9 | .9 |
| | 24 | 2 | 1.8 | 1.9 | 2.8 |
| | 25 | 4 | 3.7 | 3.7 | 6.5 |
| | 26 | 7 | 6.4 | 6.5 | 13.0 |
| | 27 | 12 | 11.0 | 11.1 | 24.1 |
| | 28 | 8 | 7.3 | 7.4 | 31.5 |
| | 29 | 6 | 5.5 | 5.6 | 37.0 |
| | 30 | 8 | 7.3 | 7.4 | 44.4 |
| | 31 | 6 | 5.5 | 5.6 | 50.0 |
| | 32 | 2 | 1.8 | 1.9 | 51.9 |
| | 33 | 8 | 7.3 | 7.4 | 59.3 |
| | 34 | 9 | 8.3 | 8.3 | 67.6 |
| | 35 | 8 | 7.3 | 7.4 | 75.0 |
| | 36 | 6 | 5.5 | 5.6 | 80.6 |
| | 37 | 3 | 2.8 | 2.8 | 83.3 |
| | 38 | 1 | .9 | .9 | 84.3 |
| | 39 | 4 | 3.7 | 3.7 | 88.0 |
| | 42 | 1 | .9 | .9 | 88.9 |
| | 43 | 1 | .9 | .9 | 89.8 |
| | 44 | 1 | .9 | .9 | 90.7 |

| | | | | | |
|---|---|---|---|---|---|
| | 46 | 1 | .9 | .9 | 91.7 |
| | 47 | 2 | 1.8 | 1.9 | 93.5 |
| | 48 | 1 | .9 | .9 | 94.4 |
| | 58 | 1 | .9 | .9 | 95.4 |
| | 60 | 2 | 1.8 | 1.9 | 97.2 |
| | 62 | 2 | 1.8 | 1.9 | 99.1 |
| | 65 | 1 | .9 | .9 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Do you consider your practice/firm to be technology ready?**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Yes | 86 | 78.9 | 79.6 | 79.6 |
| | No | 22 | 20.2 | 20.4 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |

# Frequency Table

**Knowledge**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Low | 4 | 3.7 | 3.7 | 3.7 |
| | Average | 34 | 31.2 | 31.5 | 35.2 |
| | High | 53 | 48.6 | 49.1 | 84.3 |

| | | | | | |
|---|---|---|---|---|---|
| | Very High | 17 | 15.6 | 15.7 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Experience**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Low | 8 | 7.3 | 7.4 | 7.4 |
| | Average | 37 | 33.9 | 34.3 | 41.7 |
| | High | 50 | 45.9 | 46.3 | 88.0 |
| | Very High | 13 | 11.9 | 12.0 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |

# Frequency Table

**Do you consider yourself open to the introduction and adoption of new technology to quantity surveying despite the threats that it might present?**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Yes | 104 | 95.4 | 96.3 | 96.3 |
| | No | 4 | 3.7 | 3.7 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |

**What best describes your highest qualification achieved?**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Certificate | 1 | .9 | .9 | .9 |
| | Diploma / Degree | 13 | 11.9 | 11.9 | 12.8 |
| | Higher Diploma / BTech / Honours | 88 | 80.7 | 80.7 | 93.6 |
| | Masters | 7 | 6.4 | 6.4 | 100.0 |
| | Total | 109 | 100.0 | 100.0 | |

**Indicate your area of operation (where you do or get most of your work).**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Western Cape | 1 | .9 | 1.0 | 1.0 |
| | Eastern Cape | 2 | 1.8 | 2.0 | 3.1 |
| | Kwazulu-Natal | 90 | 82.6 | 91.8 | 94.9 |
| | Mpumalanga | 2 | 1.8 | 2.0 | 96.9 |
| | Gauteng | 3 | 2.8 | 3.1 | 100.0 |
| | Total | 98 | 89.9 | 100.0 | |
| Missing | 99.0 | 11 | 10.1 | | |
| Total | | 109 | 100.0 | | |

**What is the average annual turnover of your firm/practice in Rand value over the last 3 years?**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 350000 | 1 | .9 | 2.3 | 2.3 |
| | 650000 | 1 | .9 | 2.3 | 4.7 |
| | 2000000 | 2 | 1.8 | 4.7 | 9.3 |

| | | | | | |
|---|---|---|---|---|---|
| | 3000000 | 5 | 4.6 | 11.6 | 20.9 |
| | 3500000 | 1 | .9 | 2.3 | 23.3 |
| | 4000000 | 6 | 5.5 | 14.0 | 37.2 |
| | 4500000 | 2 | 1.8 | 4.7 | 41.9 |
| | 5000000 | 5 | 4.6 | 11.6 | 53.5 |
| | 6000000 | 5 | 4.6 | 11.6 | 65.1 |
| | 8000000 | 1 | .9 | 2.3 | 67.4 |
| | 9000000 | 1 | .9 | 2.3 | 69.8 |
| | 10000000 | 3 | 2.8 | 7.0 | 76.7 |
| | 20000000 | 4 | 3.7 | 9.3 | 86.0 |
| | 25000000 | 1 | .9 | 2.3 | 88.4 |
| | 30000000 | 1 | .9 | 2.3 | 90.7 |
| | 50000000 | 1 | .9 | 2.3 | 93.0 |
| | 500000000 | 2 | 1.8 | 4.7 | 97.7 |
| | 29500000000 | 1 | .9 | 2.3 | 100.0 |
| | Total | 43 | 39.4 | 100.0 | |
| Missing | 99 | 66 | 60.6 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**State the average number of permanent staff employed in your company over the last 3 years.**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | .9 | 1.3 | 1.3 |
| | 3 | 5 | 4.6 | 6.7 | 8.0 |
| | 4 | 7 | 6.4 | 9.3 | 17.3 |
| | 5 | 17 | 15.6 | 22.7 | 40.0 |
| | 6 | 1 | .9 | 1.3 | 41.3 |
| | 7 | 3 | 2.8 | 4.0 | 45.3 |

| | | | | | |
|---|---|---|---|---|---|
| | 8 | 7 | 6.4 | 9.3 | 54.7 |
| | 9 | 3 | 2.8 | 4.0 | 58.7 |
| | 10 | 3 | 2.8 | 4.0 | 62.7 |
| | 11 | 1 | .9 | 1.3 | 64.0 |
| | 12 | 5 | 4.6 | 6.7 | 70.7 |
| | 14 | 2 | 1.8 | 2.7 | 73.3 |
| | 15 | 3 | 2.8 | 4.0 | 77.3 |
| | 20 | 2 | 1.8 | 2.7 | 80.0 |
| | 30 | 2 | 1.8 | 2.7 | 82.7 |
| | 35 | 3 | 2.8 | 4.0 | 86.7 |
| | 40 | 2 | 1.8 | 2.7 | 89.3 |
| | 50 | 4 | 3.7 | 5.3 | 94.7 |
| | 70 | 1 | .9 | 1.3 | 96.0 |
| | 80 | 1 | .9 | 1.3 | 97.3 |
| | 100 | 1 | .9 | 1.3 | 98.7 |
| | 150 | 1 | .9 | 1.3 | 100.0 |
| | Total | 75 | 68.8 | 100.0 | |
| Missing | 99 | 34 | 31.2 | | |
| Total | | 109 | 100.0 | | |
| | | | | | |

**Please select your gender:**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Male | 74 | 67.9 | 68.5 | 68.5 |
| | Female | 34 | 31.2 | 31.5 | 100.0 |
| | Total | 108 | 99.1 | 100.0 | |
| Missing | 99.0 | 1 | .9 | | |
| Total | | 109 | 100.0 | | |

## Total Variance Explained

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 10.725 | 24.943 | 24.943 | 10.725 | 24.943 | 24.943 | 6.855 | 15.942 | 15.942 |
| 2 | 4.861 | 11.305 | 36.248 | 4.861 | 11.305 | 36.248 | 5.249 | 12.206 | 28.148 |
| 3 | 3.417 | 7.947 | 44.196 | 3.417 | 7.947 | 44.196 | 3.275 | 7.616 | 35.764 |
| 4 | 2.888 | 6.717 | 50.913 | 2.888 | 6.717 | 50.913 | 2.576 | 5.991 | 41.755 |
| 5 | 2.248 | 5.229 | 56.141 | 2.248 | 5.229 | 56.141 | 2.391 | 5.560 | 47.315 |
| 6 | 1.809 | 4.206 | 60.347 | 1.809 | 4.206 | 60.347 | 2.314 | 5.380 | 52.696 |
| 7 | 1.610 | 3.743 | 64.091 | 1.610 | 3.743 | 64.091 | 2.085 | 4.849 | 57.545 |
| 8 | 1.422 | 3.306 | 67.397 | 1.422 | 3.306 | 67.397 | 2.030 | 4.722 | 62.267 |
| 9 | 1.288 | 2.994 | 70.391 | 1.288 | 2.994 | 70.391 | 1.877 | 4.366 | 66.632 |
| 10 | 1.246 | 2.897 | 73.288 | 1.246 | 2.897 | 73.288 | 1.852 | 4.308 | 70.940 |
| 11 | 1.095 | 2.546 | 75.834 | 1.095 | 2.546 | 75.834 | 1.719 | 3.997 | 74.937 |
| 12 | 1.046 | 2.433 | 78.266 | 1.046 | 2.433 | 78.266 | 1.432 | 3.329 | 78.266 |
| 13 | .930 | 2.164 | 80.430 | | | | | | |
| 14 | .880 | 2.047 | 82.477 | | | | | | |
| 15 | .782 | 1.818 | 84.294 | | | | | | |
| 16 | .711 | 1.652 | 85.947 | | | | | | |
| 17 | .592 | 1.377 | 87.324 | | | | | | |
| 18 | .567 | 1.318 | 88.642 | | | | | | |
| 19 | .507 | 1.178 | 89.820 | | | | | | |
| 20 | .466 | 1.083 | 90.903 | | | | | | |
| 21 | .397 | .924 | 91.828 | | | | | | |
| 22 | .381 | .886 | 92.714 | | | | | | |
| 23 | .348 | .809 | 93.523 | | | | | | |
| 24 | .333 | .774 | 94.297 | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 25 | .320 | .744 | 95.041 | | | | | | | |
| 26 | .288 | .670 | 95.710 | | | | | | | |
| 27 | .273 | .634 | 96.344 | | | | | | | |
| 28 | .228 | .530 | 96.874 | | | | | | | |
| 29 | .202 | .470 | 97.344 | | | | | | | |
| 30 | .189 | .440 | 97.785 | | | | | | | |
| 31 | .153 | .355 | 98.140 | | | | | | | |
| 32 | .148 | .343 | 98.483 | | | | | | | |
| 33 | .127 | .295 | 98.778 | | | | | | | |
| 34 | .105 | .245 | 99.023 | | | | | | | |
| 35 | .097 | .226 | 99.249 | | | | | | | |
| 36 | .083 | .192 | 99.442 | | | | | | | |
| 37 | .058 | .136 | 99.578 | | | | | | | |
| 38 | .047 | .110 | 99.687 | | | | | | | |
| 39 | .046 | .108 | 99.795 | | | | | | | |
| 40 | .033 | .076 | 99.871 | | | | | | | |
| 41 | .028 | .066 | 99.938 | | | | | | | |
| 42 | .016 | .036 | 99.974 | | | | | | | |
| 43 | .011 | .026 | 100.000 | | | | | | | |
| Extraction Method: Principal Component Analysis. | | | | | | | | | | |

**Rotated Component Matrix[a]**

| | Component | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Q1.1 | | | | | | | | | | | | .791 |
| Q1.2 | | | | | | | | | | .427 | .538 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q1.3 | | | | | | | | | | | .688 | |
| Q1.4 | | | | | | .849 | | | | | | |
| Q1.5 | | | | | | .539 | .381 | | | | | |
| Q1.6 | | | | | | .634 | | | | | | |
| Q1.7 | | | | | | | | .807 | | | | |
| Q1.8 | | | | | | | | .819 | | | | |
| Q1.9 | -.334 | | | .386 | .457 | | | .422 | | | | |
| Q1.10 | | | | | .741 | | | | | | | |
| Q1.11 | | | | | .865 | | | | | | | |
| Q1.12 | | | | | .678 | | | | | .356 | | |
| Q1.13 | | | | | | | | | | .736 | | |
| Q1.14 | | | | | | | .593 | | | .302 | | |
| Q1.15 | | | .710 | | | | | | | | | .315 |
| Q1.16 | | | .813 | | | | | | | | | |
| Q1.17 | -.471 | | .708 | | | | | | | | | |
| Q1.18 | -.309 | | .683 | .312 | | | | | | | | |
| Q1.19 | | | .612 | | | | | | | | | |
| Q1.20 | | | .339 | | | | | | | | .670 | |
| Q1.21 | | | .367 | | | | | | .580 | | | |
| Q1.22 | | | .315 | | | | | | | .523 | | .310 |
| Q1.23 | | | | | | | .818 | | | | | |
| Q1.24 | | | | | | | | | .731 | | | |
| Q1.25 | | | | | | | | | .689 | | | |
| Q1.26 | | | | .812 | | | | | | | | |
| Q1.27 | .346 | | | .738 | | | | | | | | |
| Q1.28 | .648 | | | .390 | | .304 | | | | | | |
| Q1.29 | .493 | | | | | .443 | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q1.30 | .688 | .394 | | | | | | | | | | |
| Q1.31 | .878 | | | | | | | | | | | |
| Q1.32 | .862 | | | | | | | | | | | |
| Q1.33 | .556 | .482 | | .462 | | | | | | | | |
| Q1.34 | .791 | | | | | | | | | | | |
| Q1.35 | .582 | .519 | | | | | | | | | | |
| Q1.36 | .380 | .755 | | | | | | | | | | |
| Q1.37 | .420 | .836 | | | | | | | | | | |
| Q1.38 | .398 | .816 | | | | | | | | | | |
| Q1.39 | | .828 | | | | | | | | | | |
| Q1.40 | | .806 | | | | | | | | | | |
| Q1.41 | .406 | .546 | | | | | .300 | | | | | -.347 |
| Q1.42 | .734 | .446 | | | | | | | | | | |
| Q1.43 | .759 | .406 | | | | | | | | | | |

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 14 iterations.

| KMO and Bartlett's Test | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .444 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 66.107 |
| | df | 6 |
| | Sig. | .000 |

| Communalities | | |
|---|---|---|
| | Initial | Extraction |
| TP | 1.000 | .475 |
| LIMIT | 1.000 | .643 |
| TDS | 1.000 | .860 |
| MM | 1.000 | .800 |
| Extraction Method: Principal Component Analysis. | | |

## Scale: ALL VARIABLES

| Case Processing Summary | | | |
|---|---|---|---|
| | | N | % |
| Cases | Valid | 104 | 95.4 |
| | Excluded[a] | 5 | 4.6 |
| | Total | 109 | 100.0 |
| a. Listwise deletion based on all variables in the procedure. | | | |

| Reliability Statistics | | |
|---|---|---|
| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| .706 | .705 | 4 |

## Reliability

## Scale: ALL VARIABLES

| Case Processing Summary | | | |
|---|---|---|---|
| | | N | % |
| Cases | Valid | 106 | 97.2 |
| | Excluded[a] | 3 | 2.8 |
| | Total | 109 | 100.0 |
| a. Listwise deletion based on all variables in the procedure. | | | |

| Reliability Statistics | | |
|---|---|---|
| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| .801 | .799 | 8 |

| Item Statistics | | | |
|---|---|---|---|
| | Mean | Std. Deviation | N |
| Q1.15 | 2.208 | 1.1188 | 106 |
| Q1.16 | 2.981 | 1.1628 | 106 |
| Q1.17 | 3.453 | 1.1223 | 106 |
| Q1.18 | 3.255 | 1.1302 | 106 |
| Q1.19 | 2.557 | .9570 | 106 |
| Q1.20 | 2.849 | 1.0672 | 106 |
| Q1.21 | 2.632 | 1.0896 | 106 |
| Q1.22 | 2.953 | 1.0988 | 106 |

| Inter-Item Correlation Matrix | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Q1.15 | Q1.16 | Q1.17 | Q1.18 | Q1.19 | Q1.20 | Q1.21 | Q1.22 |
| Q1.15 | 1.000 | .545 | .433 | .380 | .425 | .361 | .282 | .256 |
| Q1.16 | .545 | 1.000 | .510 | .460 | .437 | .374 | .325 | .245 |
| Q1.17 | .433 | .510 | 1.000 | .674 | .410 | .280 | .356 | .141 |
| Q1.18 | .380 | .460 | .674 | 1.000 | .273 | .182 | .363 | .232 |
| Q1.19 | .425 | .437 | .410 | .273 | 1.000 | .158 | .244 | .098 |
| Q1.20 | .361 | .374 | .280 | .182 | .158 | 1.000 | .353 | .319 |
| Q1.21 | .282 | .325 | .356 | .363 | .244 | .353 | 1.000 | .168 |
| Q1.22 | .256 | .245 | .141 | .232 | .098 | .319 | .168 | 1.000 |

| Summary Item Statistics | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
| Item Means | 2.861 | 2.208 | 3.453 | 1.245 | 1.564 | .157 | 8 |

| Item-Total Statistics | | | | | |
|---|---|---|---|---|---|
| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
| Q1.15 | 20.679 | 24.220 | .595 | .394 | .765 |
| Q1.16 | 19.906 | 23.362 | .650 | .454 | .755 |
| Q1.17 | 19.434 | 23.867 | .629 | .550 | .759 |

| | | | | | |
|---|---|---|---|---|---|
| Q1.18 | 19.632 | 24.368 | .572 | .512 | .769 |
| Q1.19 | 20.330 | 26.719 | .444 | .286 | .788 |
| Q1.20 | 20.038 | 26.094 | .440 | .285 | .789 |
| Q1.21 | 20.255 | 25.830 | .452 | .236 | .787 |
| Q1.22 | 19.934 | 27.281 | .308 | .156 | .808 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 22.887 | 32.025 | 5.6591 | 8 |

## Scale: ALL VARIABLES

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 104 | 95.4 |
| | Excluded[a] | 5 | 4.6 |
| | Total | 109 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .916 | .917 | 8 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Q1.28 | 2.404 | 1.0568 | 104 |
| Q1.29 | 2.635 | 1.2776 | 104 |
| Q1.30 | 2.462 | 1.1569 | 104 |
| Q1.31 | 2.308 | 1.1241 | 104 |
| Q1.32 | 2.279 | 1.0654 | 104 |
| Q1.33 | 2.663 | 1.2117 | 104 |

| | | | |
|---|---|---|---|
| Q1.34 | 2.356 | 1.1735 | 104 |
| Q1.35 | 2.096 | .9904 | 104 |

**Inter-Item Correlation Matrix**

| | Q1.28 | Q1.29 | Q1.30 | Q1.31 | Q1.32 | Q1.33 | Q1.34 | Q1.35 |
|---|---|---|---|---|---|---|---|---|
| Q1.28 | 1.000 | .571 | .473 | .483 | .528 | .456 | .588 | .528 |
| Q1.29 | .571 | 1.000 | .687 | .532 | .468 | .484 | .502 | .404 |
| Q1.30 | .473 | .687 | 1.000 | .733 | .611 | .583 | .572 | .529 |
| Q1.31 | .483 | .532 | .733 | 1.000 | .892 | .597 | .741 | .566 |
| Q1.32 | .528 | .468 | .611 | .892 | 1.000 | .660 | .720 | .582 |
| Q1.33 | .456 | .484 | .583 | .597 | .660 | 1.000 | .706 | .496 |
| Q1.34 | .588 | .502 | .572 | .741 | .720 | .706 | 1.000 | .580 |
| Q1.35 | .528 | .404 | .529 | .566 | .582 | .496 | .580 | 1.000 |

**Summary Item Statistics**

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 2.400 | 2.096 | 2.663 | .567 | 1.271 | .035 | 8 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Q1.28 | 16.798 | 42.124 | .639 | .509 | .912 |
| Q1.29 | 16.567 | 39.976 | .644 | .558 | .913 |
| Q1.30 | 16.740 | 39.670 | .755 | .705 | .903 |
| Q1.31 | 16.894 | 39.183 | .821 | .878 | .897 |
| Q1.32 | 16.923 | 40.033 | .804 | .846 | .899 |
| Q1.33 | 16.538 | 39.707 | .709 | .610 | .907 |
| Q1.34 | 16.846 | 39.005 | .793 | .707 | .899 |
| Q1.35 | 17.106 | 42.659 | .647 | .453 | .911 |

| Scale Statistics | | | |
|---|---|---|---|
| Mean | Variance | Std. Deviation | N of Items |
| 19.202 | 52.007 | 7.2116 | 8 |

## Scale: ALL VARIABLES

| Case Processing Summary | | | |
|---|---|---|---|
| | | N | % |
| Cases | Valid | 105 | 96.3 |
| | Excluded[a] | 4 | 3.7 |
| | Total | 109 | 100.0 |
| a. Listwise deletion based on all variables in the procedure. | | | |

| Reliability Statistics | | |
|---|---|---|
| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| .925 | .926 | 6 |

| Item Statistics | | | |
|---|---|---|---|
| | Mean | Std. Deviation | N |
| Q1.36 | 2.267 | 1.0676 | 105 |
| Q1.37 | 2.314 | 1.0499 | 105 |
| Q1.38 | 2.314 | 1.0499 | 105 |
| Q1.39 | 2.400 | 1.0433 | 105 |
| Q1.40 | 2.495 | 1.1530 | 105 |
| Q1.41 | 2.514 | 1.1276 | 105 |

| Inter-Item Correlation Matrix | | | | | | |
|---|---|---|---|---|---|---|
| | Q1.36 | Q1.37 | Q1.38 | Q1.39 | Q1.40 | Q1.41 |
| Q1.36 | 1.000 | .920 | .885 | .603 | .587 | .412 |
| Q1.37 | .920 | 1.000 | .930 | .674 | .704 | .528 |
| Q1.38 | .885 | .930 | 1.000 | .674 | .649 | .439 |
| Q1.39 | .603 | .674 | .674 | 1.000 | .769 | .584 |
| Q1.40 | .587 | .704 | .649 | .769 | 1.000 | .801 |
| Q1.41 | .412 | .528 | .439 | .584 | .801 | 1.000 |

| Summary Item Statistics | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Item Means | 2.384 | 2.267 | 2.514 | .248 | 1.109 | .011 | 6 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Q1.36 | 12.038 | 21.768 | .786 | .860 | .912 |
| Q1.37 | 11.990 | 21.086 | .886 | .926 | .898 |
| Q1.38 | 11.990 | 21.510 | .834 | .882 | .905 |
| Q1.39 | 11.905 | 22.125 | .766 | .646 | .914 |
| Q1.40 | 11.810 | 20.752 | .824 | .807 | .906 |
| Q1.41 | 11.790 | 22.725 | .627 | .661 | .933 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 14.305 | 30.733 | 5.5437 | 6 |

## Scale: ALL VARIABLES

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 107 | 98.2 |
| | Excluded[a] | 2 | 1.8 |
| | Total | 109 | 100.0 |

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .530 | .846 | 8 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Q2.1 | 4.477 | 5.2886 | 107 |
| Q2.2 | 3.645 | .8929 | 107 |
| Q2.3 | 3.776 | .8277 | 107 |
| Q2.4 | 3.935 | .9139 | 107 |
| Q2.5 | 3.542 | .8499 | 107 |
| Q2.6 | 3.645 | .9138 | 107 |
| Q2.7 | 3.383 | .9280 | 107 |
| Q2.8 | 3.607 | .8661 | 107 |

| Inter-Item Correlation Matrix | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Q2.1 | Q2.2 | Q2.3 | Q2.4 | Q2.5 | Q2.6 | Q2.7 | Q2.8 |
| Q2.1 | 1.000 | .192 | .210 | .196 | .234 | .199 | .197 | .214 |
| Q2.2 | .192 | 1.000 | .581 | .307 | .443 | .480 | .223 | .294 |
| Q2.3 | .210 | .581 | 1.000 | .679 | .577 | .443 | .322 | .521 |
| Q2.4 | .196 | .307 | .679 | 1.000 | .605 | .469 | .152 | .408 |
| Q2.5 | .234 | .443 | .577 | .605 | 1.000 | .615 | .583 | .638 |
| Q2.6 | .199 | .480 | .443 | .469 | .615 | 1.000 | .373 | .561 |
| Q2.7 | .197 | .223 | .322 | .152 | .583 | .373 | 1.000 | .694 |
| Q2.8 | .214 | .294 | .521 | .408 | .638 | .561 | .694 | 1.000 |

| Summary Item Statistics | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
| Item Means | 3.751 | 3.383 | 4.477 | 1.093 | 1.323 | .112 | 8 |

| Item-Total Statistics | | | | | |
|---|---|---|---|---|---|
| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
| Q2.1 | 25.533 | 20.949 | .278 | .080 | .861 |
| Q2.2 | 26.364 | 56.139 | .407 | .473 | .488 |
| Q2.3 | 26.234 | 55.256 | .524 | .665 | .475 |
| Q2.4 | 26.075 | 55.504 | .444 | .629 | .481 |
| Q2.5 | 26.467 | 54.327 | .586 | .674 | .464 |
| Q2.6 | 26.364 | 54.913 | .490 | .509 | .474 |
| Q2.7 | 26.626 | 55.802 | .413 | .593 | .485 |
| Q2.8 | 26.402 | 54.884 | .526 | .647 | .471 |

| Scale Statistics | | | |
|---|---|---|---|
| Mean | Variance | Std. Deviation | N of Items |
| 30.009 | 62.387 | 7.8985 | 8 |

## Scale: ALL VARIABLES

| Case Processing Summary | | | |
|---|---|---|---|
| | | N | % |
| Cases | Valid | 107 | 98.2 |
| | Excluded[a] | 2 | 1.8 |
| | Total | 109 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .853 | .855 | 8 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Q3.1 | 1.972 | 1.2089 | 107 |
| Q3.2 | 2.822 | 1.3304 | 107 |
| Q3.3 | 3.402 | 1.1885 | 107 |
| Q3.4 | 2.944 | 1.1479 | 107 |
| Q3.5 | 3.047 | 1.2083 | 107 |
| Q3.6 | 3.065 | 1.2152 | 107 |
| Q3.7 | 2.850 | 1.1640 | 107 |
| Q3.8 | 2.617 | 1.1463 | 107 |

**Inter-Item Correlation Matrix**

| | Q3.1 | Q3.2 | Q3.3 | Q3.4 | Q3.5 | Q3.6 | Q3.7 | Q3.8 |
|---|---|---|---|---|---|---|---|---|
| Q3.1 | 1.000 | .466 | .251 | .250 | .343 | .316 | .272 | .367 |
| Q3.2 | .466 | 1.000 | .380 | .327 | .304 | .182 | .153 | .209 |
| Q3.3 | .251 | .380 | 1.000 | .515 | .545 | .543 | .446 | .329 |
| Q3.4 | .250 | .327 | .515 | 1.000 | .716 | .517 | .615 | .493 |
| Q3.5 | .343 | .304 | .545 | .716 | 1.000 | .640 | .682 | .422 |
| Q3.6 | .316 | .182 | .543 | .517 | .640 | 1.000 | .587 | .648 |
| Q3.7 | .272 | .153 | .446 | .615 | .682 | .587 | 1.000 | .381 |
| Q3.8 | .367 | .209 | .329 | .493 | .422 | .648 | .381 | 1.000 |

**Summary Item Statistics**

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 2.840 | 1.972 | 3.402 | 1.430 | 1.725 | .175 | 8 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Q3.1 | 20.748 | 37.473 | .448 | .330 | .852 |

| | | | | | |
|---|---|---|---|---|---|
| Q3.2 | 19.897 | 37.414 | .392 | .339 | .861 |
| Q3.3 | 19.318 | 35.558 | .606 | .438 | .833 |
| Q3.4 | 19.776 | 34.779 | .699 | .616 | .823 |
| Q3.5 | 19.673 | 33.600 | .750 | .674 | .816 |
| Q3.6 | 19.654 | 34.209 | .695 | .650 | .823 |
| Q3.7 | 19.869 | 35.492 | .628 | .544 | .831 |
| Q3.8 | 20.103 | 36.414 | .566 | .510 | .838 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 22.720 | 45.562 | 6.7500 | 8 |

## Scale: ALL VARIABLES

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 104 | 95.4 |
| | Excluded[a] | 5 | 4.6 |
| | Total | 109 | 100.0 |

a

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .478 | .497 | 6 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Q4.1 | 2.154 | 1.1471 | 104 |
| Q4.2 | 2.279 | .9700 | 104 |
| Q4.3 | 3.058 | 1.1045 | 104 |
| Q4.4 | 2.683 | .9681 | 104 |
| Q4.5 | 3.000 | 1.3795 | 104 |
| Q4.6 | 3.337 | 1.3191 | 104 |

**Inter-Item Correlation Matrix**

| | Q4.1 | Q4.2 | Q4.3 | Q4.4 | Q4.5 | Q4.6 |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Q4.1 | 1.000 | .519 | .100 | .141 | .117 | -.240 |
| Q4.2 | .519 | 1.000 | .103 | .116 | .116 | .047 |
| Q4.3 | .100 | .103 | 1.000 | .172 | .268 | .007 |
| Q4.4 | .141 | .116 | .172 | 1.000 | .334 | .138 |
| Q4.5 | .117 | .116 | .268 | .334 | 1.000 | .181 |
| Q4.6 | -.240 | .047 | .007 | .138 | .181 | 1.000 |

**Summary Item Statistics**

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 2.752 | 2.154 | 3.337 | 1.183 | 1.549 | .217 | 6 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Q4.1 | 14.356 | 10.717 | .182 | .359 | .464 |
| Q4.2 | 14.231 | 10.432 | .323 | .303 | .397 |
| Q4.3 | 13.452 | 10.503 | .234 | .086 | .436 |
| Q4.4 | 13.827 | 10.319 | .344 | .141 | .388 |
| Q4.5 | 13.510 | 8.447 | .380 | .186 | .339 |
| Q4.6 | 13.173 | 11.232 | .048 | .150 | .547 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 16.510 | 13.398 | 3.6603 | 6 |

## Scale: ALL VARIABLES

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 107 | 98.2 |
| | Excluded[a] | 2 | 1.8 |
| | Total | 109 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|

| | | |
|---|---|---|
| .527 | .521 | 8 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| Q5.1 | 2.411 | .7391 | 107 |
| Q5.2 | 1.280 | .5102 | 107 |
| Q5.3 | 2.009 | .6658 | 107 |
| Q5.4 | 2.243 | .7248 | 107 |
| Q5.5 | 2.075 | .6250 | 107 |
| Q5.6 | 2.271 | .6946 | 107 |
| Q5.7 | 2.112 | .7048 | 107 |
| Q5.8 | 2.047 | .6352 | 107 |

**Inter-Item Correlation Matrix**

| | Q5.1 | Q5.2 | Q5.3 | Q5.4 | Q5.5 | Q5.6 | Q5.7 | Q5.8 |
|---|---|---|---|---|---|---|---|---|
| Q5.1 | 1.000 | -.033 | .126 | .076 | .178 | .148 | .092 | .180 |
| Q5.2 | -.033 | 1.000 | .159 | .069 | -.066 | .103 | .148 | -.070 |
| Q5.3 | .126 | .159 | 1.000 | .249 | .044 | .198 | .098 | .155 |
| Q5.4 | .076 | .069 | .249 | 1.000 | .334 | -.057 | -.109 | .221 |
| Q5.5 | .178 | -.066 | .044 | .334 | 1.000 | -.025 | .088 | .348 |
| Q5.6 | .148 | .103 | .198 | -.057 | -.025 | 1.000 | .631 | .014 |
| Q5.7 | .092 | .148 | .098 | -.109 | .088 | .631 | 1.000 | .051 |
| Q5.8 | .180 | -.070 | .155 | .221 | .348 | .014 | .051 | 1.000 |

**Summary Item Statistics**

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 2.056 | 1.280 | 2.411 | 1.131 | 1.883 | .116 | 8 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Q5.1 | 14.037 | 5.282 | .224 | .078 | .504 |
| Q5.2 | 15.168 | 6.104 | .089 | .066 | .538 |
| Q5.3 | 14.439 | 5.230 | .301 | .144 | .474 |
| Q5.4 | 14.206 | 5.354 | .212 | .207 | .508 |
| Q5.5 | 14.374 | 5.406 | .273 | .234 | .485 |
| Q5.6 | 14.178 | 5.147 | .304 | .433 | .472 |
| Q5.7 | 14.336 | 5.169 | .288 | .434 | .478 |
| Q5.8 | 14.402 | 5.394 | .269 | .164 | .486 |

| Scale Statistics | | | |
|---|---|---|---|
| Mean | Variance | Std. Deviation | N of Items |
| 16.449 | 6.589 | 2.5670 | 8 |