Validating the Theoretical Underpinnings of the ISO 9001:2015 Quality Management System Standard: a Multi-Country Study

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Abstract

ISO 9000 family of quality management system (QMS) standards — particularly ISO 9001, which stipulates QMS requirements for compliance — have received a great deal of attention by academia and practitioners. Every year, thousands of organisations obtain ISO 9001 certification worldwide, and a plethora of studies have examined the effectiveness of ISO 9001 implementation, empirically or otherwise. One existing knowledge gap is the absence of a comprehensive study that examines the theoretical validity of ISO 9001. Another is ascertaining how ISO 9001 compliance requirements are accepted across countries and regions, given that ISO 9001 is meant for sociotechnical systems. Using responses received from 240 ISO 9001 certified manufacturing companies in five countries, this study empirically examined the theoretical validity of ISO 9001:2015, which is claimed to underpin Plan-Do-Check-Act (PDCA) at the overall QMS level. The theoretical model of the study which posited that "*Leadership Driven QMS Planning (LDQMSP) (reflected via clauses 04 through to 07 of the standard) leads to implementing the planned processes (reflected via clause 08), and checking the effectiveness of these processes (reflected via clause 09) and taking appropriate action (reflected via clause 10) leads to QMS Results*" was found to be a good fit to data, based on goodness of fit criteria used in *partial least squares structural equation modelling*.

As regards national culture effects and regional effects (Australasia, South Asia, and Greece), the empirical test results found that national culture (or region) plays only a very minor role in making ISO 9001 based continual improvement (PDCA) of the QMS being more acceptable to certain cultures than to others; power distance (PDI) and individualism (IDV) showed positive and negative effects (but small) respectively on Plan (LDQMSP), Do, Check, Act, and QMS Results as hypothesised. However, uncertainty avoidance (UAI) failed to show a significant effect ($\alpha = 0.05$). Similarly, the mean scores of Plan (LDQMSP), Do, Check, Act, and QMS Results of South Asia were found to be higher than those of Australasia, although these effects were small. Thus, the findings support the universal relevance and acceptance of the standard, although the study was limited to ISO 9001 certified manufacturing firms of five selected countries. Contributions of the findings were highlighted, and further research directions were suggested.

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List of Acronyms

A&E	Analysing and Evaluating
ANOVA	Analysis of Variance
ANZSIC	Australian and New Zealand Standard Industrial Classification
APQO	Asia Pacific Quality Organisation
AVE	Average Variance Extracted
BE	Business Excellence
BEF	Baldrige Excellence Framework
CAB	Certificate Awarding Body
CBSEM	Covariance Based Structural Equation Modelling
CEO	Chief Executive Officer
CFA	Confirmatory Factor Analysis
CI	Continual Improvement [1]
CMB	Common Method Bias
CQI	Chartered Quality Institute
CSF	Critical Success Factor
CVR	Content Validity Ratio
DMM	Deming Management Method
EFQM	European Foundation for Quality Management
EM	Expected Maximisation
EU	European Union
F&B	Food and Beverage
GDP	Gross Domestic Product
GLOBE	Global Leadership and Organizational Behaviour Effectiveness
HACCP	Hazards Analysis and Critical Control Point
IDV	Individualism-Collectivism

[1] The term continuous improvement and continual improvement (the term used in ISO family of standards) usually refer to the same concept (the subtle difference between the two terms has been highlighted in the thesis). Unless stated otherwise, CI refers to continual improvement in this thesis.

IND	Indulgence
IRCA	International Register of Certificated Auditors
ISO	International Organisation for Standardization
JAS-ANZ	Joint Accreditation System for Australia and New Zealand
JIT	Just-In-Time
LDQMSP	Leadership Driven Quality Management Systems Planning
M&M	Monitoring and Measuring
MANOVA	Multivariate Analysis of Variance
MAS	Masculinity
MI	Multiple Imputation
OLS-MLR	Ordinary Least Squares Multiple Linear Regression
PDCA	Plan-Do-Check-Act
PDI	Power Distance
PDSA	Plan-Do-Study-Act
PLSR	Partial Least Squares Regression
PLS-SEM	Partial Least Squares Structural Equation Modelling
QA	Quality Assurance
QMS	Quality Management System
RES	Results
SD	Standard Deviation
SEM	Structural Equation Modelling
SLSI	Sri Lanka Standards Institute
SRMR	Standardized Root Mean Square Residual
TQM	Total Quality Management
UAI	Uncertainty Avoidance
USA	United States of America
UK	United Kingdom
VIF	Variance Inflation Factor
WCM	World Class Manufacturing

List of Occasionally Used Abbreviations in Tables

AT	ACT
CK	CHECK
HO	Humane Orientation
IC	Institutional Collectivism
MF	Measurement Focus
PF	Process Focus
PLN	Strategic Planning (in a TQM context)
PRM	Process Management

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Not many would disagree that there should be an agreed and documented way of doing things to protect or safeguard the interests of people and organisations. Consequently, people rarely challenge why standards exist. Academia and practitioners rarely question the validity of a standard, because they take into granted the fact that a standard is always grounded in a sound theory or an accepted body of knowledge required to practice a certain profession. The latter can also be deemed as theory, because an accepted body of knowledge, in a broader sense, is theory. A structural engineer can always relate a national or international standard on structural components to a fundamental theory in physics or structural engineering (e.g. Young's modulus). An accountant can always relate a financial reporting standard to accounting fundamentals. However, when one is dealing with a management systems standard such as ISO 9001, the underlying theory of the standard becomes less clear. Another concern about a management system standard is whether the standard fits equally well across different national cultural boundaries. This research attempts to make some inroads on these two concerns.

This chapter provides an overview of the research. Section 1.2 provides the background to the research topic, which is inspired by the researcher's desire to know how the quality management systems (QMS) certification standard ISO 9001 fits to the industry, both at the theoretical level and the practical level. Consequently, section 1.2 introduces key definitions required to introduce ISO 9001, its current structure, the Plan-Do-Check-Act (PDCA) cycle of quality improvement upon which the standard is said to be built, and a brief account of practitioner interest and the academic interest on ISO 9001 certification and implementation. Section 1.3 covers the motivations of undertaking this study. Sections 1.4 and 1.5 set out the research questions and research objectives of the study respectively. Section 1.6 provides an overview of methods being used. Section 1.7 covers the delimitations and limitations of the study. Finally, section 1.8 outlines the structure of this thesis.

1.2 THE BACKGROUND TO THE RESEARCH TOPIC

In an era characterised by complex global supply chains where every actor in the chain depends on every other actor, the quality and reliability of the suppliers become extremely important. Any weak link in the supply chain regarding quality of products and services supplied causes serious damage to the focal company — not to mention the detrimental downstream effects in the supply chain. A good example is Samsung Galaxy Note 7 recall in September 2016, due to quality issues with the battery supplier. Therefore, an internationally accepted standard to regulate supplier quality is of paramount importance. This raises two questions: *what is a standard?* and *what aspect of the supplier is being examined for compliance against the standard, to assure quality?*

Standards Australia (2020), Australia's largest independent body on standards defines standards as "voluntary documents that set out specifications, procedures and guidelines that aim to ensure products, services, and systems are safe, consistent, and reliable." Other national, regional and international bodies and custodians of standards such as the international organisation for standardization (ISO) and the international electrotechnical commission (IEC), maintain similar definitions for "standards". ISO 9001 examines a supplier's QMS for compliance.

1.2.1 Defining a QMS and the Origins of Quality Improvement

Although there is some variation between definitions of a QMS, they all converge to the meaning that a QMS is a system of polices, objectives, procedures and operational activities that determine the quality of a product (or service) being supplied. Therefore, certified against an international standard or not, all originations ought to have a QMS (Dale, Van Der Wiele, & Van Iwaarden, 2007). Some definitions of a QMS follow.

A QMS is "a management system to direct and control an organization with regard to quality" (ISO, 2015a).

A QMS is "a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives" (ASQ, 2017b).

A QMS is "a system of standards and practices established within a company or industry to ensure consistent quality of products or services" (Dictionaries, 2017).

An important aspect of managing quality is *continuous improvement*; continuous improvement implies that improvement never ends; this is because every time an improvement is made to a product (or service), it is assumed that customer expectations rise, requiring further iterations of improvement (Sitkin, Sutcliffe, & Schroeder, 1994; Summers, 2010). More recently, a term that is being promoted among quality fraternity is *continual improvement* (CI) to mean that long-spanning improvement endeavours may have starts and stops, as opposed to being never ending (ASQ, 2017a; Dale et al., 2007). Nevertheless, two terms are frequently being referred to interchangeably, across many disciplines (ASQ, 2017a).

Principles of managing quality came into reckoning as a coherent body of knowledge to the west in 1970s and 80s — mostly due to application of quality principles in Japan to outperform the west — thanks to the teachings of quality advocates such as Shewhart, Deming, Juran, Crosby, Ishikawa, Taguchi, and Garvin (Summers, 2010). In the broadest sense, quality is about satisfying customers by meeting their expectations on products and services being provided (Juran & Godfrey, 1999). The quality advocates prescribed what needs to be in place in an organisation to design, develop, produce, deliver and continuously improve products (and/or services) and outcomes to satisfy the customer (Foster, 2017; Sitkin et al., 1994). Although each quality advocate emphasised mainly on one area — for example Shewhart emphasised on variation typologies and the application of statistics for quality control, Deming further developed Shewhart's ideas to make quality a theory on a sociotechnical system for competitive advantage, Juran emphasised a project-by-project approach to improve quality and so on — all these teachings converge towards strategies for CI (Dale et al., 2007; Summers, 2010). Undeniably, the most elegant, intuitive, and time-honored means of achieving CI is the Plan-Do-Check-Act (PDCA) cycle[2] of iterative improvement (Dale et al., 2007; Moen, 2009; Sokovic, Pavletic, & Pipan, 2010; Summers, 2010). Figure 1.1 depicts the key focus in each stage of the PDCA cycle.

[2] This cycle is also being called the plan-do-study-act cycle (ASQ, 2020).

Figure 1.1: The four stages of the PDCA cycle (Source: ASQ, 2020)

In a PDCA context, “Plan” refers to planning a solution to the problem at hand (e.g. high proportion of nonconforming products in a production run). As in other spheres of management, planning requires the most attention on the part of the quality improvement team (ASQ, 2020; Moen, 2009; Summers, 2010). “Do” refers to performing the planned course of action. “Check” refers to monitoring (also studying) the results of the outcomes of the planned intervention. Finally, “Act” refers to improving the process. If the check phase shows that the root cause(s) of the problem has been eliminated, the changes that were implemented in the Do phase would be made permanent in the Act phase of the PDCA cycle. On the other hand, if the Check phase shows that the problem still persists, the improvement cycle would revert back to the Plan stage for another cycle of improvement (ASQ, 2020; Moen, 2009; Summers, 2010). The truth is that the cycle needs to be iterated — if not for anything else — because customer expectations rise all the time (Foster, 2017; Sitkin et al., 1994). Changes are also needed to a process (cycling through the PDCA wheel so to speak) from time to time to maintain the variation of the process within acceptable limits. It is important to note that PDCA, in the context of the standard, refers to the entire QMS and not a specific quality improvement project or initiative. This study uses the phrases “small PDCA” (PDCA in relation to a specific quality improvement project or initiative) and “big PDCA” (PDCA in relation to the QMS) to distinguish this difference. The ISO, the custodian of ISO 9001:2015 claims that PDCA is the fundamental basis upon which the standard is built. This study examines whether this is an accurate claim.

1.2.2 A Brief Introduction to ISO 9000 Series of QMS Standards

Even though ISO officially began its operations in 1947, it did not become a household name among international trading circles up until ISO published its first QMS standard in 1987, under the ISO 9000 series. Like all ISO standards, the 9000 series is reviewed five yearly to ascertain whether or not a revision to the standard is needed. The ISO 9000 series of standards has been revised on several occasions (details in section 2.2 of Chapter 02) to bring the standards in line with the requirements currently in demand on business processes, and also to close the gap between ISO 9000 and total quality management (TQM) (Fonseca, 2015a). TQM is a broader concept on CI than the PDCA cycle, at least on two counts. Firstly, TQM emphasises involvement of the total organisation (e.g. cross-functional teams). Secondly, TQM includes a commonly accepted comprehensive set of principles, practices, and tools/techniques to achieve CI (Sousa & Voss, 2002; Summers, 2010).

The ISO 9000 series of QMS standards consists of three standards: ISO 9000, ISO 9001, and ISO 9004. ISO 9000 sets out the "fundamental concepts, principles, and the vocabulary" for the other two standards. ISO 9001 stipulates the requirements a QMS should meet to comply with the standard. ISO 9004 is a standard that sets out guidelines for sustained improvement, based on the seven principles stipulated in ISO 9000. The current versions of the three standards are ISO 9000:2015, ISO 9001:2015, and ISO 9004:2018. The focus of this study lies fairly and squarely on ISO 9001:2015.

It is important to note that auditing a supplier's QMS against ISO 9001 need not necessarily be done by an accredited third-party auditor, although that is by far the most common mode of auditing. A purchasing customer too can audit a supplier's QMS for compliance against ISO 9001. In addition, a supplier too could announce that they are ISO 9001 compliant, based on internal audits (Tricker, 2016).

1.2.3 The Structure of ISO 9001:2015

The current format of all management systems certification standards published by the ISO follows a so-called common high-level structure known as the Annex L, formally known as the Annex SL structure (ISO/IEC, 2019). A management system standard that conforms to the Annex L structure would have the exact same captions for the clauses stipulated in the standard. While there are ten clauses in the Annex L format, only Clauses 4 through to 10 contain the actual requirements for certification. Figure 1.2 depicts the structure of ISO 9001:2015 standard. 9001:2015 in the PDCA cycle; the numbers within parenthesis refer to the seven key clauses of the standard. From an academic standpoint, Figure 1.2, often referred to as the *ISO 9001:2015 process model*, is an attempt on the part of ISO to suggest how results of a QMS are caused through CI (via PDCA) by conforming to the requirements stipulated under the seven key clauses of ISO 9001:2015.

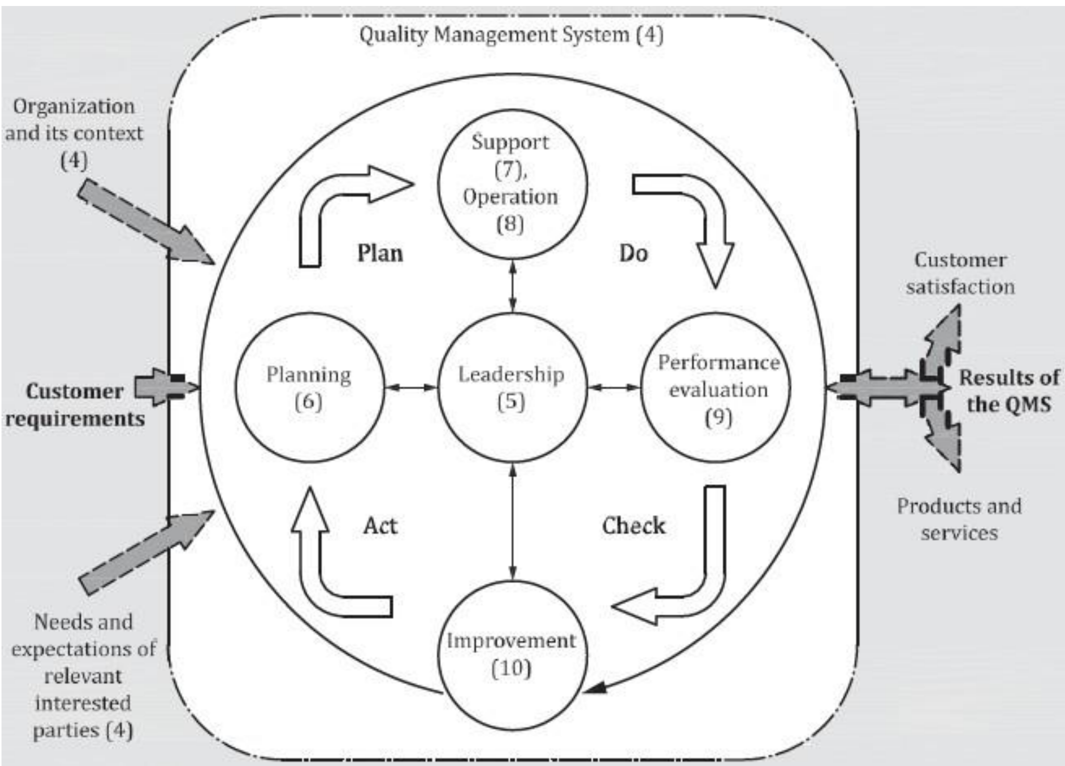
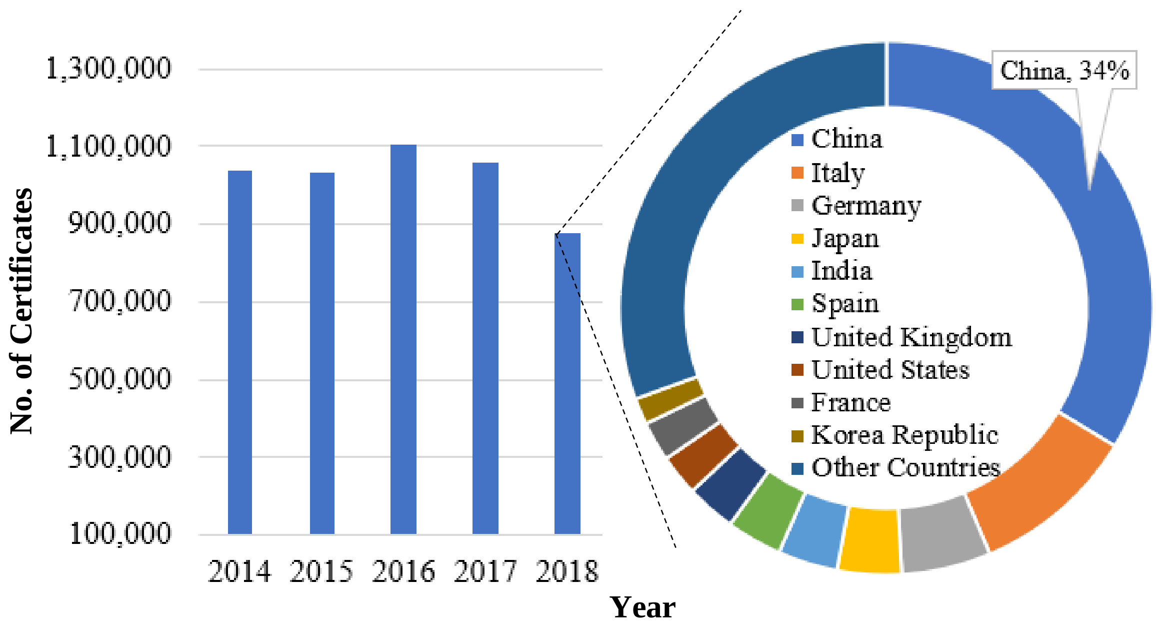


Figure 1.2: Representation of the structure of ISO 9001:2015 in the PDCA cycle (Source: ISO, 2015b)

1.2.4 Practitioner and Academic Attention on ISO 9001

The ISO 9000 series of standards, particularly the certification standard ISO 9001 has received a great deal of practitioner and academic attention (Heras-Saizarbitoria, 2011; Shafiq, Abid, & Jalil, 2014). The practitioner attention on ISO 9001 becomes apparent from the number of ISO 9001 certificates being issued by certification bodies accredited by the members of the international accreditation forum (Figure 1.3). Although 2018 figures suggest that the enthusiasm for ISO 9001 seems to have dropped (after a couple of years of steady results) since the standard received a face lift through the 2015 revision, still the standard receives considerable attention in some jurisdictions, most notably China, the emerging global superpower. Figure 1.3 shows that a third of certificates being issued across the globe in 2018 came from China.



The number of ISO 9001 certificates issued globally since 2014

The proportion of ISO 9001 certificates being issued in 2018 by country: the top ten

Figure 1.3: Some statistics on the global uptake of ISO 9001, based on ISO 9001 certificates issued

There are a large portion of academic research papers that examine or discuss *ISO 9001 implementation* from different perspectives. Some covered the approach organisations use in implementing the standard (Huo, Han, & Prajogo, 2014; Kim, Kumar, & Kumar, 2011; Psomas & Fotopoulos, 2009). Some covered motives for ISO 9001 implementation (Djofack & Camacho, 2017; Kim et al., 2011; Sampaio, Saraiva, & Rodrigues, 2009). Yet others studied ISO 9001 implementation barriers and/or critical success factors of ISO 9001 implantation (Ahmed, Coffey, & Xia, 2017; Aquilani, Silvestri, Ruggieri, & Gatti, 2017; Boiral, 2012). There are also a large portion of academic research papers that focus on the effectiveness of ISO 9001 implementation from various angles (Murmura, Casolani, Liberatore, & Vicentini, 2018). However, only a handful of studies have attempted to examine the theory underlying ISO 9001.

1.3 MOTIVATION FOR THE STUDY

1.3.1 Motivation #1: The Need to Test the Validity of ISO 9001:2015 Directly

Some major changes to the standard was introduced with the release of ISO 9001:2015 standard in September 2015, apart from the Annex L (formerly Annex SL) high-level structure. These include revision of contents in the standard to explicate risk-based thinking, and more importantly substantial revision of the process model to better align the contents of the standard to explicate PDCA based CI, leading to QMS Results (Figure 1.2). Indeed, ISO 9001:2015 process model provides a reasonable basis to empirically test the theoretical validity of the key clauses of ISO 9001:2015, and the interplay between these clauses as a theory explaining QMS Results. To the best of researcher's knowledge, no one has attempted to directly test the theoretical validity of ISO 9001:2015 by translating the ISO 9001:2015 process model into an empirically testable theoretical model. *This is the primary motivation of the study*. However, it must be said that Lin and Jang (2008) did test the theoretical validity of the predecessor of ISO 9001:2015 (ISO 9001:2008) by hypothesising theoretical relationships between ISO 9001 principles and QMS Results and operationalising ISO 9001 principles using the contents of the key clauses of ISO 9001:2008. However, there are shortcomings in this study. Although ISO 9001 is a result of the collective wisdom of the experts all over the world (ISO, 2016; Tricker, 2014), this should not prevent academia from directly testing the validity of the standard, using scientific parameters.

1.3.2 Motivation #2: Acceptance of the Requirements Stipulated in ISO 9001:2015 Across Different Countries and Regions

The requirements stipulated in ISO 9001:2015 (or in previous versions) cover practices such as planning, implementing, monitoring and controlling of activities required to achieve the objectives of a QMS of an organisation (i.e. QMS Results). It is reasonable to assume that members of one society are different from those in another society in the way they look at the above-mentioned practices. In fact, this is the rationale of existence of such a thing as *dimensions of national culture* (Hofstede, 1980). Although there have been quite a few studies that empirically examine the relationship between national culture and TQM practices, there has been no such study on the practices related to ISO 9001 (to be specific, PDCA) barring the meta-analysis conducted by Manders (2015) on ISO 9001 implementation effect sizes on operational performance and market performance (i.e. examining the operational and market-related gains of implementing ISO 9001 across nations). What is not known is whether or not the requirements stipulated in the standard — which are said to capture the activities required for achieving QMS Results (i.e. PDCA) — receive the same level of acceptance across different cultures, or countries or regions, in an aggregate sense. This is the second motivation of the study.

1.3.3 Motivation #3: The Fit Between Theory Testing and the Researcher

The first two motivations lead the researcher in a theory testing pathway, involving application of advanced statistical techniques. The researcher hails from a background of statistics and computer science. Although the researcher had to adjust from being a theoretical statistician to an applied statistician in social research, this transition was a smooth one.

1.4 RESEARCH QUESTIONS

Research questions of a study arise from review of literature around a certain research problem (chapters 02 is dedicated exactly for this purpose). As mentioned at the very outset (paragraph one of this chapter), this research is inspired by wanting to know the *underlying theory of the ISO 9001:2015 QMS standard, and* wanting to know *whether the standard receives the same degree of acceptance across different national cultural boundaries* (the hypotheses derived from the literature argues otherwise). The specific research questions are as follows.

RQ1: How does meeting the requirements stipulated in the key clauses of ISO 9001:2015 (Clauses 04 through to 10) predict and explain the expected outcomes of ISO 9001 implementation (QMS Results) via the PDCA approach?

RQ2: Does ISO 9001:2015 have the same acceptance across cultures and regions?

RQ1 corresponds to motivation #1 and #3 while RQ2 corresponds to motivation #2 and #3.

1.5 AIM AND OBJECTIVES OF THE STUDY

The aim of the research is to test the validity of theoretical underpinnings of the current version of ISO 9001 QMS certification standard. The specific objectives of the study are:

OBJ1: To develop and test a theoretical model that underpins the ISO 9001:2015 process model.

OBJ2: To develop a scientifically validated measurement instrument to operationalise the constructs underpinning the theoretical model(s).

OBJ3: To examine cultural and regional differences in the degree of acceptance levels of the requirements stipulated in ISO 9001:2015, when these clauses are aligned to constructs that explain QMS Results.

OBJ1 and OBJ2 will be achieved by comprehensively answering RQ1. OBJ3 will be achieved by comprehensively answering RQ2.

1.6 METHODS OVERVIEW

First, the study develops an empirically testable theoretical model that represents the ISO 9001:2015 process model (this is to answer RQ1). Next, the study develops empirically testable theoretical models that link national culture (more precisely, national culture dimensions) with the five theoretical response variables: Plan (LDQMSP), Do, Check, Act, and QMS Results. These variables are the constructs of the researcher's empirically testable theoretical model that represents the ISO 9001:2015 process model. In addition, the study compares the mean scores of the five response variables across different geographic regions in the world (these are to answer RQ2).

For empirical testing of models mentioned above, the study develops a survey questionnaire to collect data — these to be collected from ISO 9001 certified manufacturing organisations in different countries — on the variables included in the theoretical models. A Delphi-like method is adopted to develop the questionnaire, based on the inputs received from a panel of international experts on ISO 9001:2015 (details in Chapter 04). This questionnaire, administered among a sample of ISO 9001 certified manufacturing companies3 in five countries — New Zealand, Australia, India, Sri Lanka, and Greece — results in 240 responses (Figure 1.4).4 The two Trans-Tasman neighbours are characterised by a low power distance (less hierarchical) and high individualism culture; the two South Asian neighbours are characterised by a high power distance (very hierarchical) and low individualism culture; Greece, unlike the other four countries, is characterised by a highly uncertainty avoidant culture. As such, the study considers Australasia, South Asia, and Greece as three different levels of the factor "region" in relation to the five theoretical response variables mentioned in the previous paragraph.

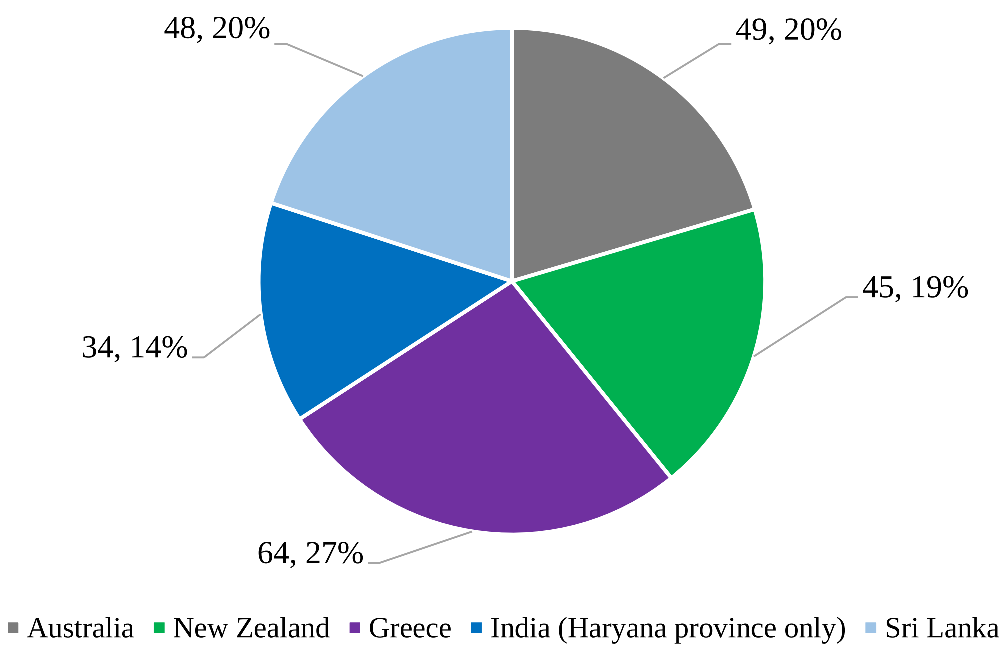


Figure 1.4: The number of manufacturing companies participated by country

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[3] Only one questionnaire per company.

[4] Out of the 240 responses, 11 responses had to be excluded due to no variation across response items.

The study uses the *partial least squares structural equation modelling* technique to empirically test the theoretical model that is derived from the ISO 9001:2015 process model. The study uses the *partial least squares regression* method to test the hypotheses that involve national culture.

1.7 DELIMITATIONS AND LIMITATIONS OF THE RESEARCH

1.7.1 Delimitations

Delimitations of a research design refers to deliberate narrowing of the scope (boundary) of the research to make a research design relatively robust against the effects of confounding variables (Bryman, 2012; Creswell, 2009; Simon, 2011).

The first delimitation (boundary) of this study is that this study is limited to manufacturing. It is well known that there is less *between-country variation* in manufacturing than in services. For example, a ceramic manufacturing plant in India would be comparable with a ceramic manufacturing in Australia or New Zealand. However, there is less parity between a public hospital in India and a public hospital in Australia or New Zealand. It is important for a scientist to take all possible measures to ensure that the observed change came as a result of manipulating the variable of interest (in this study, say power distance for example) and not due to something else (Bryman, 2012; Cooper & Schindler, 2014).

The second delimitation of the study is that the study will be confined to ISO 9001 certified manufacturing companies. The reason for selecting only ISO 9001 certified manufacturing companies is because the study relates to ISO 9001 process model and ISO 9001 implementation.

1.7.2 Limitations

Limitations of a research design refer to possible weaknesses of a study due to reasons *beyond the control* of the researcher (Bryman, 2012; Cooper & Schindler, 2014; Creswell, 2009; Simon, 2011). The limitations of this study are as follows:

Firstly, researcher has no control over who decides to participate in the survey, once the researcher invites participants to participate in the study. Researcher's samples are not probability samples. Reader should exercise some caution in interpreting statistical outputs, such as the confidence intervals and *p* values. In this study, India is represented by the Haryana province only, in spite the researcher's efforts to cast a wider net across India.

Secondly, the study does not include all perceivable control variables due to technical and practical reasons. Omitted control variables included *organisational culture* (Saad & Asaad, 2015; Terziovski et al., 2003),[5] *technology intensity of a firm* (Lo, Wiengarten, Humphreys, Yeung, & Cheng, 2013), and *industry characteristics within country* (Lo et al., 2013). In this study, it was assumed that these omitted variables would act as random noise (the full set of assumptions of the study are given in section 4.5.8 of Chapter 04).

Thirdly, the study does not cover all the culture dimensions that may interest a researcher. For example, the culture dimension masculinity (as opposed to femininity) is not considered because the five countries in the study do not show sufficient contrast in masculinity. Similarly, the study covers only five selected countries. A larger study covering more countries provide a better coverage of the study both practically and statistically (more even spread of scores along the culture axes).

1.8 THE STRUCTURE OF THE THESIS

Rest of the thesis is structured as follows:

Chapter 02 reviews the literature pertaining to themes and sub-themes related to ISO 9000 family of standards, particularly ISO 9001. Themes covered in Chapter 2 include: (a) the general landscape of ISO 9001 research, based on what is covered in review articles on the subject' (b) the theoretical underpinnings of the PDCA cycle and how the standard attempts to align its key clauses to PDCA, to be in line with the process approach promulgated by the standard; (c) studies that attempted to validate ISO 9001 empirically; and (d) empirical studies that examine the extent to which TQM frameworks (including ISO 9001) are being accepted across national and regional cultures. The research gaps resulting from the literature review are presented along with rationalisation of the two research questions (RQ1 and RQ2) at the end of Chapter 02.

[5] At least 30-50 additional survey items should be included in the questionnaire to operationalise organisational culture.

Chapter 03 posits empirically testable theoretical models to answer the research questions. Through literature synthesis and logical reasoning, on this chapter, the researcher developed a testable theoretical model that stems from the ISO 9001:2015 process model. The researcher's theoretical model explains how the key clauses of ISO 9001:2015 related to LDQMSP (Plan), Do, Check, and Act in predicting and explaining QMS Results. Through literature synthesis, Chapter 03 also posits hypotheses on the relationships between national culture and the five theoretical constructs mentioned above (i.e. LDQMSP, Do, Check, Act, and QMS Results).

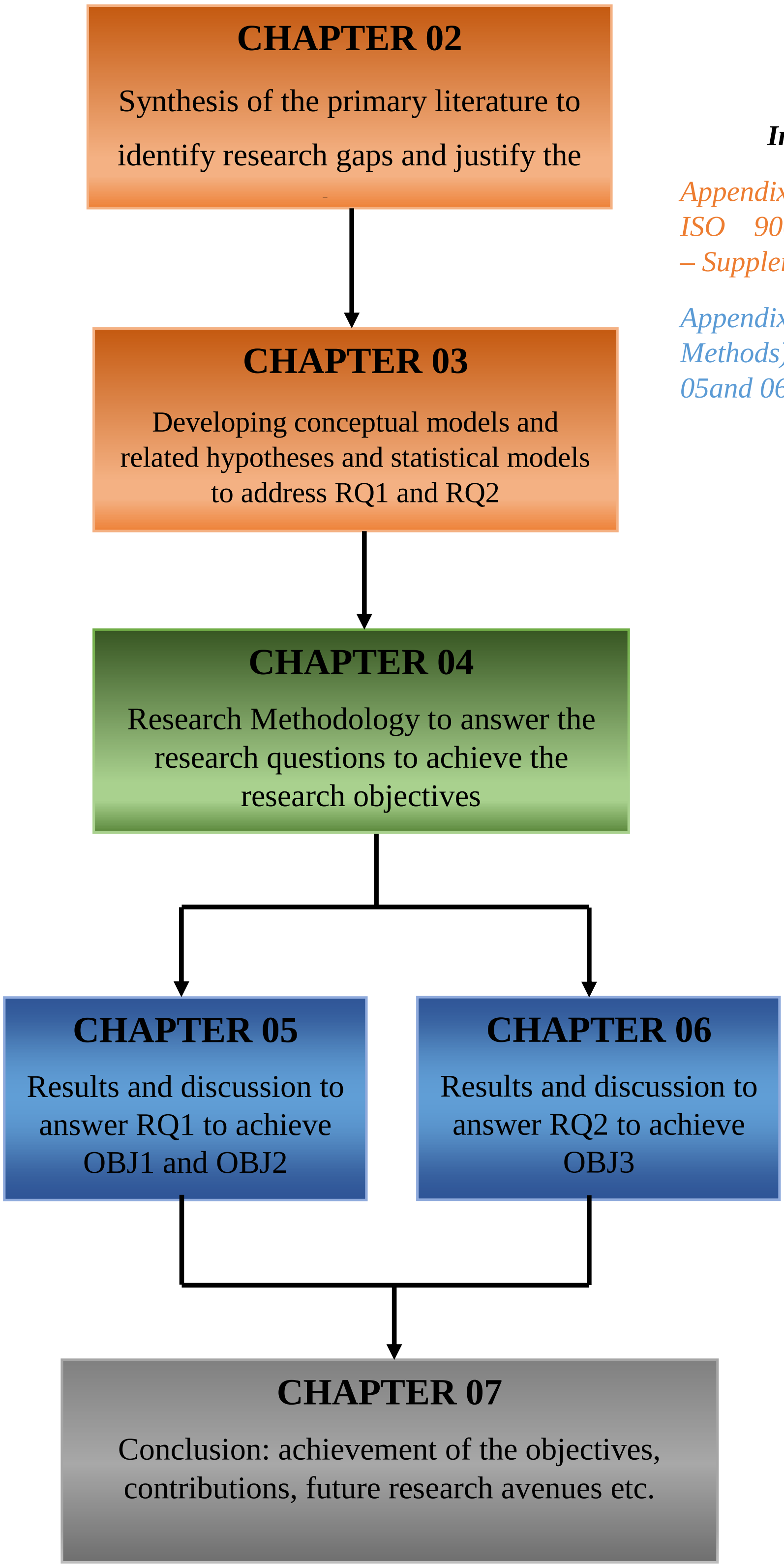
Chapter 04 covers the methodology of the study. Thus, Chapter 04 describes the broad strategy that the researcher used in answering the research questions to achieve the research objectives. Since theoretical models have been posited to answer the two research questions, for the most part, Chapter 04 covers the development of the questionnaire that was used to collect primary data that are required to test the theoretical models/hypotheses. In addition, Chapter 04 describes how the data were processed/handled before they were used for data analysis (statistical hypothesis testing). However, Chapter 04 begins by briefly reviewing key research paradigms available in social research, along with a justification of the chosen research paradigm.

Chapter 05 provides the test results and an accompanying discussion of the theoretical model that pertains to the first research question. This analysis is based on the partial least squares path modelling method. As mentioned earlier. The important outcomes of Chapter 05 are: validation of the survey instrument, empirical test results on the researcher's theoretical model and theoretical implications, the estimated strengths of the relationships (direct effects, indirect effects, and total effects) between the cause and effect constructs of the model and what these mean from a practical perspective.

Chapter 06 provides the test results of hypotheses pertaining to the second research question, along with an accompanying discussion. The analysis is conducted in two ways. In the first analysis, national culture dimensions regressed against the five theoretical constructs LDQMSP, Do, Check, Act, and QMS Results to match the hypotheses (see Chapter 03 overview mentioned above) in a multiple regression setting. Partial least squares regression method has been used to estimate regression model parameters due to collinearity issues associated with predictors. In the second analysis, the three distinct regions Australasia, South Asia, and Greece are treated as three levels of the factor (independent variable) region to examine the differences in the mean scores of the response variables LDQMSP, Do, Check, Act, and QMS Results.

Chapter 07 concludes the study by justifying how the objectives of the study were met. In addition, in this final chapter, the researcher revisits her stated assumptions, delimitations and limitations of the study. Finally, the contribution of the study to the academia and the practitioners, and suggestions on future research directions are also covered in this chapter.

Figure 1.5 provides an overview of the thesis structure from Chapter 02 onwards.



Important Appendices:

Appendix 1 (Further Information on ISO 9000 Family of Standards) – Supplements Chapters 02 and 03

Appendix 6 (Advanced Statistical Methods) – Supplements Chapters 05and 06

Figure 1.5: The structure of the rest of the thesis

CHAPTER 2
REVIEW OF PRIMARY LITERATURE FORMING THE KNOWLEDGE GAPS

2.1 INTRODUCTION

This chapter covers the core literature on the ISO 9001 *quality management systems* (QMS) certification standard leading to the knowledge gaps. Section 2.2 briefly introduces the evolution of the ISO 9000 family of standards to their current form. The primary focus is on ISO 9001:2015. Risk-based thinking, the Plan-Do-Check-Act (PDCA) cycle of continuous improvement, and process thinking — the three pillars upon which the standard is said to be built upon, is reviewed in this section. Section 2.3 covers the general landscape of ISO 9001 research, based on what is covered in review articles. Most ISO 9001 research covered in the review articles — and in fact in most other articles — revolve around implementation aspects of ISO 9001. Some of these studies are empirical in nature (e.g. studies that measure the size of effects of ISO 9001 implementation on expected outcomes). Section 2.4 covers the theoretical underpinnings of the PDCA cycle and how the standard attempts to align its key clauses to PDCA, to be in line with the process approach. The researcher highlights that the PDCA approach advanced by quality gurus Walter Shewhart and W Edwards Deming have been inspired by the "theory of knowledge" paradigm advanced by American pragmatic philosophers. Section 2.5 covers studies that attempted to validate ISO 9001 empirically. The researcher shows that nearly all these studies examine the validity of the standard indirectly (i.e. without incorporating the contents of the standard as building blocks of a theory). Section 2.6 reviews empirical studies that examine the extent to which TQM frameworks (including ISO 9001) are being accepted across national and regional cultures. Section 2.7 highlights two major research gaps that lead to the two research questions of the study. Finally, Section 2.8 concludes the chapter, summarising the key points.

2.2 EVOLUTION OF ISO 9000 FAMILY OF STANDARDS AND THE CORE COMPONENTS OF THE CERTIFICATION STANDARD ISO 9001:2015

2.2.1 A Brief History of the Evolution

Quality management systems (QMS) standards have come a long way since formal quality assurance (QA) came in to reckoning during World War I (1914–1918) and World War II (1939–1945), when the militaries of the United Kingdom (World War I) and the United States (World War II) faced serious quality issues with the ammunition supplied by their suppliers (Corinna, 2010). QA back then was reliant upon supplier-generated documented procedures and the skills of government-appointed inspectors (Corinna, 2010). Although the international organisation for Standardisation (ISO) officially began its operations in 1947, it did not become a household name in international trading up until ISO published its first QMS standard in 1987, under the ISO 9000 series. The purpose of introducing the ISO 9000 series of standards was to harmonise incompatible QMS standards that existed in different jurisdictions, which acted as a barrier for international trading (Dale, 1999).

The nomenclature of the three standards that constitute the ISO 9000 series of standards remains unchanged since the year 2000. *ISO 9000* outlines the QMS fundamentals and the vocabulary used in the ISO 9000 family of standards (e.g. a set of principles on quality, standard-specific terms such as the process approach). *ISO 9001* stipulates the requirements a QMS needs to comply with for certification. *ISO 9004* provides guidelines for organisations to achieve sustained success. All three standards are given a four-digit extension to indicate their version; the 4-digit extension always refer to the year in which a specific version came into force. The versions of the ISO 9000 series of standards currently in force are ISO 9000:2015, ISO 9001:2015, and ISO 9004:2018.

The focus in this chapter and elsewhere is ISO 9001 because this is the only standard in the ISO 9000 series that provides a theoretical and practical basis on QMS certification. ISO 9001:2015, which preceded ISO 9001:2008 — the latter is almost identical to its predecessor ISO 9001:2000 — stipulates QMS requirements under seven assessment areas: Context of the Organization (Clause 4), Leadership (Clause 5), Planning (Clause 6), Support (Clause 7), Operation (Clause 8), Performance Evaluation (Clause 9), and Improvement (Clause 10). Most of the assessment subareas (subclauses) in ISO

9001:2015 were included in ISO 9001:2008 in somewhat equivalent forms under four assessment areas (Secretariat, 2015).

It needs to be mentioned that ISO 9001 is the generic QMS certification standard and few other QMS standards that either feed into ISO 9001 or act as a standalone QMS certification standard exist. For example, ISO/IEC/IEEE 90003:2018 provides guidance for suppliers in software engineering business in the application of ISO 9001:2015, and ISO 13485:2016 applies to organisations that provide medical devices and related services. Like all ISO standards, each standard in the ISO 9000 series is reviewed five-yearly to ascertain whether or not a revision to the standard is needed. A detailed description on the evolution of ISO 9000 family of standards is given in Appendix 1.

2.2.2 The Core Components of the Standard

The literature is not short of examining the core elements of ISO 9001. While most of the literature have been provided by quality practitioners for practitioners (thus commentaries), some academic literature (conceptual articles) was found on this area. Table 2.1 provides a summary.

Table 2.1: A Summary of Findings on the Literature on Core Components of ISO 9001:2015

Author (Year)	Type of Article	Key Arguments
Fonseca (2015a)	Journal Article *(a conceptual synthesis)*	ISO 9001:2015 standard was identified as a “stronger open systems approach”, compared to its predecessor ISO 9001:2008 version (a closed system), thus being in line with several organisational theories such as the general systems theory, resource dependency theory, the institutional theory, and so on.
Illés, Szuda, and Dunay (2017)	Book Chapter *(a conceptual synthesis)*	Core component of the standard are the risk-based thinking, use of opportunities, skills management, and customer satisfaction (the outcome). Suggest ISO 9001:2015 be considered at the strategic planning level.
ISO (2015c)	Whitepaper *(a directive)*	The key concepts that underpin ISO 9001:2015 are the risk-based thinking, PDCA, and the process approach.
Wilson and Campbell (2020)	Journal Article *(a conceptual synthesis)*	The key concepts that underpin ISO 9001:2015 are the risk-based thinking, PDCA, and the process approach.
Murray (2016)	Commentary	The key concepts that underpin ISO 9001:2015 are the risk-based thinking, PDCA, and the process approach.

Although commentaries provided by quality practitioners are often treated as "grey literature", their relevance on the topic being reviewed (e.g. the intent ISO 9001, how the standard achieves outcomes through its implementation, any implementation issues) cannot be downplayed, because the standard is intended for the practitioners, and how practitioners interpret the standard (the gist of it) and what they achieve is important.

As shown in the Table 2.1, the key concepts that underpin the ISO 9001:2015 standard are the *risk-based thinking*, *PDCA*, and the *process approach*. At a theoretical level, ISO 9001:2015 attempts to accommodate these three concepts within its process model, through the 7 key clauses of the standard. As such working definitions for *risk-based thinking*, *PDCA*, and the *process approach*, as defined by the ISO are as follows.

2.2.2.1 Risk-Based Thinking

In the standard risk-based thinking refers to mitigating threats and capitalising on opportunities (Tricker, 2016). This strategic approach to management of the quality system is known as risk-based thinking (ISO, 2015c; Tricker, 2016). ISO (2015c) defines risks as something (especially decisions and environmental influences) that affects the organisation's objectives, and therefore, actions the management need to take. Further, ISO (2015c) assert that risk-based thinking should be used throughout the process approach in order to: (a) determine how risk and opportunities must be addressed in establishing processes to achieve the outcomes., (b) define the amount of planning and controls needed to be imposed upon the processes, (c) general improvement of the QMS effectiveness, and (d) evolve a system that achieves objectives through risk-based action.

2.2.2.2 PDCA

The PDCA (or PDSA, which is discussed later) is a well-known iterative cycle of continual improvement of processes and outcomes. Since PDCA is central to the researcher's study, it is reviewed separately. In this section, only what PDCA means in the context of ISO 9001:2015 is briefly reviewed. ISO (2015c) says that PDCA is an approach that can be used to manage "processes and systems." In this context, the "systems" refer to the entire QMS and its subparts. According to ISO 9001:2015, since the entire QMS can be represented by the aspects covered by seven key clauses of the standard (clauses 4 through to 10), the aspects of each key clause can be interpreted as a system within a system (i.e. the QMS). The processes are the actions that put in place by the organisation to achieve objectives. As such each key cause has a set of objectives, and the entire QMS has a set of objectives more focused towards the product and service results as well as customer satisfaction (ISO 2015c; Tricker 2016). To put this in another way, PDCA applies to each key clause of the standard (more specifically aspects related to each clause) as well as the entire QMS.

ISO (2015c) clearly mentions that “Plan” refers to setting the objectives of the system (the entire QMS or each key clause, depending on the level, the PDCA is being applied) and the processes established to achieve those objectives — stated alternatively what needs to be done and how these need to be done. Similarly, ISO mentions that “Do” refer to execute the actions (processes) that were identified at the Plan stage, with the necessary controls; “Check” refers to monitoring/measuring the process and outcomes against the policies and objectives set at the beginning (i.e. the Plan stage) and report the results (in the context of the entire QMS, this refers to product and service results as well as customer satisfaction); finally, “Act” refers to taking action to ensure that outcomes delivered through the processes continue to improve. The standard mentions that PDCA is iterative and “risk-based thinking” is applied to each of the four phases of the PDCA cycle (ISO 2015a; ISO 2015c; Tricker 2016). The theory underlying PDCA is further reviewed in section 2.4.

2.2.2.3 The Process Approach

The process approach is derived from the general systems theory, which holds that an organisation must not be looked at as an independent collection of different segments (e.g. departments) but as a collective whole (that consists of interconnected parts) that is open to the external environment (Kast & Rosenzweig, 1972; Williams, Kennedy, Philipp, & Whiteman, 2017). The process approach appreciates that converting inputs to outcomes through actions (processes) needs to take into account the interconnectedness of the processes and the relationship these have with the internal and external environment (Gregory, 1995; Kast & Rosenzweig, 1972; Williams, Kennedy, Philipp, & Whiteman, 2017).

The whitepaper by the ISO (2015c) describes the process approach, as applied to ISO 9001:2015. In the standard, the process approach acts as the binding element that binds the requirements stipulated in the key clauses of the standard (clauses 4 through to 10) and PDCA to achieve continual improvement (the very purpose of the Act stage in

PDCA). More specifically, in Section 2.3 below, the researcher examines how academic literature approach ISO 9001 as a research area of interest in past studies.

2.3 REVIEW ARTICLES ON ISO 9001

2.3.1 Leading Authors and Publication Outlets

ISO 9001 is arguably the most widely subscribed standard in the world. Many organisations around the world pursue ISO 9001 certification, regardless of type, size and sector (Heras- Saizarbitoria, 2011; Shafiq et al., 2014). According to the survey conducted by the ISO (2018), by the year 2018, over 800,000 ISO 9001 certificates have been issued to businesses worldwide. Consequently, it is not surprising that academic literature is proliferated with ISO 9000 research (Hussain, Eskildsen, & Edgeman, 2018).

The article database "Scopus" was used to generate bibliometric data on journal articles published in the past ten years (from 2010 through to 31 December 2019) with the words "ISO 9000" OR "ISO 9001" in the *article title*. The search term ISO 9000 is necessary because authors often use this term to mean implementation of the QMS requirements stipulated in ISO 9001. The search lead to 401 publications. Least number of articles were published in 2012 (n = 22) while the greatest number of articles were published in 2019 (n = 49). Figure 2.1 shows the leading authors, based on the qualification "five or more publications". Together, the 14 leading authors account for approximately 22% of the publications (to be exact, 86/401 as a proportion). Heras-Saizarbitoria was found to be the author who published most (13 publications). This author has published nearly double the number of publications published by each of the next set of leading authors (7 publications each).

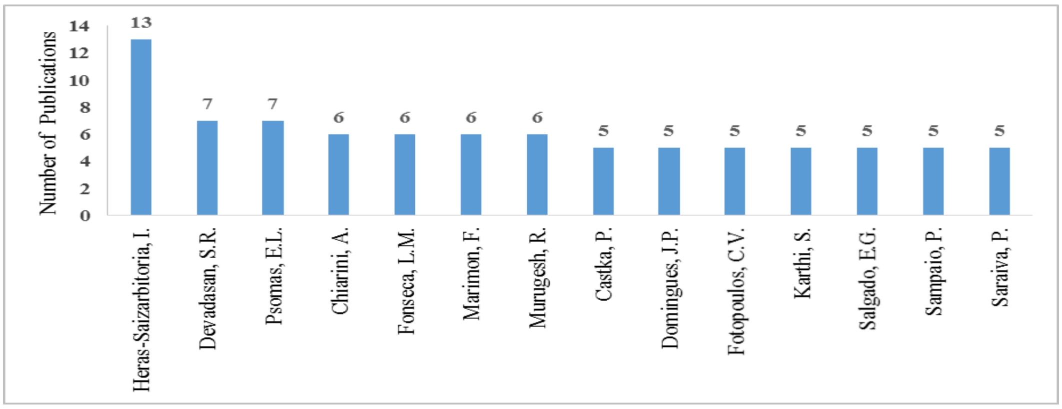


Figure 2.1: Leading authors on ISO 9000/9001 based on number of publications (review period: 01/01/2010 ~ 31/12/2019)

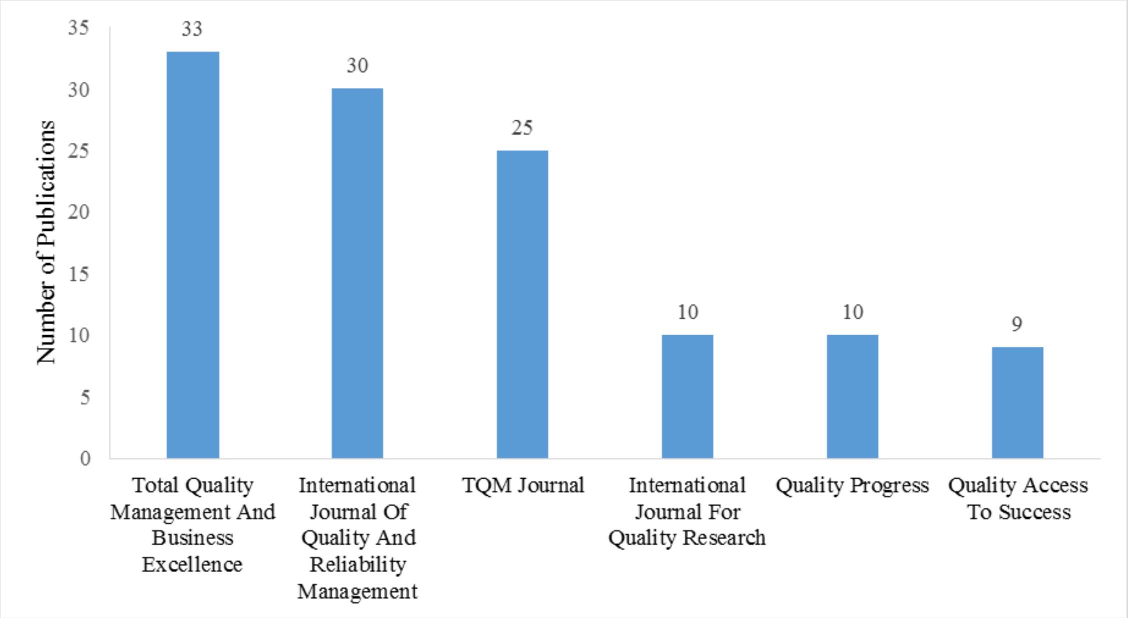


Figure 2.2: Leading publication outlets

Figure 2.2 depicts the leading publication outlets. The reader will note that the top three are reasonable academic journals (more so in the field of quality management). It is important to note that ISO 9000/9001 has attracted the attention of the highest ranked journals in the field such as journal of operations management (two articles having ISO 9000/9001 in the title since 2010) and management science (one article having ISO 9000/9001 in the title since 2010). These articles focus on substantive theory testing.

2.3.3 Major Findings Reported in the Review Articles

Table 2.1 summarises the findings of seven selected review articles. The findings summarised in Table 2.1 indicate that authors who reviewed ISO 9001 research (more generally, ISO 9000 family of standards) have identified the following themes: (1) Issues concerning implementation of ISO 9001; (2) The consequences of implementing ISO 9001; (3) Issues concerning implementing ISO 9001 with other management standards; (4) The theoretical relationship between ISO 9001 implementation and outcomes (both operational and business outcomes). Since suggested further research revolved around above themes, and themes 1 to 3 make little theoretical contribution to academia, the researcher paid more attention to the fourth theme to go beyond the simple X and Y relationship between processes (ISO 9001 implementation) and outcomes. The researcher has reviewed the literature to synthesise knowledge gaps via several sections of this chapter.

Table 2.2: The Literature Review Summary Table on Review Articles on ISO 9000/9001

Author(s) (Year)	Key Objective(s) of the Review	Method/Approach	Findings
Hussain et al. (2018)	To identify major research areas and future research directions	Bibliographic coupling method on publications published between 1987 – 2015, followed by factor analysis.	Eight major research areas were found: • ISO 9001 certification and organisational competitiveness • Organisational motivates behind pursuing ISO 9001 certification • ISO 9001 certification as a roadmap for quality management • Critical success factor and their measurement scales • Lesson learned from ISO 9001 certified organisations • Impact of ISO 9001 certification on organisational performance • Challenges and perspectives of revised ISO 9000 standards • Global diffusion of ISO 9000 family of standards
Heras-Saizarbitoria and Boiral (2013)	To identify main research areas of a selected list of meta standards including ISO 9001	Integrative review on two meta standards – ISO 9001 and ISO 14001.	Seven research areas were identified: • Creation of meta-standards and implications for global governance • International diffusion process of meta-standards • Motivations to adopt meta-standards • Benefits of adoption and impact on performance • Differences in adoption levels (internalisation) • Integration of standards • Consultancy and auditing for meta-standards
Sampaio et al. (2009)	To identify major research issues (i.e. current debates)	A literature review was carried out and sorted according to the methodology used: surveys; analysis of financial indicators; case studies; interviews; literature review; and statistical data analysis.	Nine issues were identified: • ISO 9001 certification market evolution • ISO 9001 certification motivations • ISO 9001 certification barriers • ISO 9001 certification benefits • Impacts on organisational performance • Impacts on companies' financial performance

Author(s) (Year)	Key Objective(s) of the Review	Method/Approach	Findings
			• ISO 9001 certification drawbacks • Relationships between ISO 9001 motivations and benefits • ISO 9001 and TQM – are they complementary or independent from each other?
Psomas and Fotopoulos (2009)	To identify major research themes and possible future directions.	A literature review was conducted on contemporary academic papers which were focused only with the 2000 version of the ISO 9001 standard.	Five major areas were identified: • Approaches of implementing the quality standard • Certification motives • Difficulties faced during the standard's implementation • Benefits from implementing the standard and their impact • ISO 9001:2000 as a first step towards TQM Found that in general, companies seem to have benefited from ISO 9001:2000 certification.
Tuczek, Castka, and Wakolbinger (2018)	Among other things, to identify major themes on ten volunteer standards including ISO 9000 series	A literature review was conducted on empirical papers published between 2001 and 2016 on voluntary standards.	Seven major themes identified Heras-Saizarbitoria and Boiral (2013)) were scrutinized to analyse 62 papers published on 10 volunteer standards: • Creation of voluntary standards and implications for global governance • International diffusion process of standards • Motivations to adopt meta-standards • Benefits of adoption and impact on performance • Differences in adoption levels (internalization) • Integration of Standards • Consultancy and auditing for meta-standards

Author(s) (Year)	Key Objective(s) of the Review	Method/Approach	Findings
Boiral (2012)	To examine the impact of ISO 900X certification on organisational performance.	Systematic review of empirical studies published between 1994 and 2008 (111 papers)	Found 46 variables that measure impact. They were classified under two groups: variables on operational benefits (n = 22) and variables on managerial/strategic benefits (n = 14). Of the 22 variables on operational benefits seven were *operations management variables* (e.g. productivity), five were *quality-related variables* (e.g. product quality), six were *customer-related variables* (customer satisfaction), and four were *supplier-related variables* (e.g. supplier relations). Of the 14 variables on managerial/strategic benefits four were *organisational effectiveness variables* (e.g. financial performance), five were *human resource management related variables* (e.g. training and awareness), three were *marketing-related variables* (e.g. sales growth), and two were competitiveness-related variables (market share and competitive advantage).
Sfreddo, Vieira, Vidor, and Santos (2018)	To understand the relationship between ISO 9001 implementation and organisational performance.	A systematic literature review of studies that examined the relationship between ISO 9001 implementation and organisational performance published between 2000 and 2017.	From 57 studies reviewed, majority of the studies found a positive relationship between ISO 9001 implementation and organisational performances with operational and market performance dimensions having greater relation than other organisational performance dimensions.
Note: Other authors who conducted review studies include Kim et al. (2011) and Tarí, Molina-Azorín, and Heras (2012)			

2.4 THE PDCA CYCLE VIS-À-VIS ISO 9001:2015

Since ISO 9001:2015 process model remains a candidate worthy of being developed into a testable theoretical model, and PCDA remains central to it, in the first subsection of this section (section 2.5.1), the researcher reviews the theoretical basis of PDCA as a system-wide explanation (more specifically, the focus is on the QMS) of continuous improvement. In the next subsection, the researcher reviews the practical and theoretical basis of alignment of key clauses of ISO 9001:2015 to imply PDCA at system level (for the entire QMS). The ISO 9001:2015 process model at best provides just a crude mock of this alignment.

2.4.1 The Historical Background of PDCA

The PDCA (Plan-Do-Check-Act) approach of continual improvement was initially articulated by Walter Shewhart in 1939 through his product quality improvement concept Specification → Production → Inspection, which he later transformed into an iterative and cycle process known as the "Shewhart Cycle". This cycle was inspired by the work of C.I. Lewis (1883-1964), who calls himself a "conceptualistic pragmatist" (Mauléon & Bergman, 2009); Lewi's pragmatism be traced back to the foundations of modern science (Lovitt, 1997; Mauléon & Bergman, 2009; Moen & Norman, 2010). Shewhart cycle concept was subsequently improved by W Edwards Deming in 1950 to the represent the stages of designing the product, making it, putting it on the market, and testing it through market research, and redesigning (improving) the product. This iterative process of improvement came to know as the "Deming Wheel" (Moen, 2009; Moen & Norman, 2010), which therefore consisted of Design, Production, Sales, and Research phases of cyclic improvement. Later, Japanese executives embraced Deming's teachings, including the Deming wheel, to develop the concept that was called the PDCA cycle in 1951, which was further tweaked by the Japanese quality guru Kaoru Ishikawa in 1985 (Moen & Norman, 2010). Deming's final iteration to his Deming wheel came in 1993, which he labelled as the Plan-Do-Study-Act (PDSA) cycle. The parallel major phases of the evolution of PDSA and PDCA cycles, with their origins, is depicted in Figure 2.3.

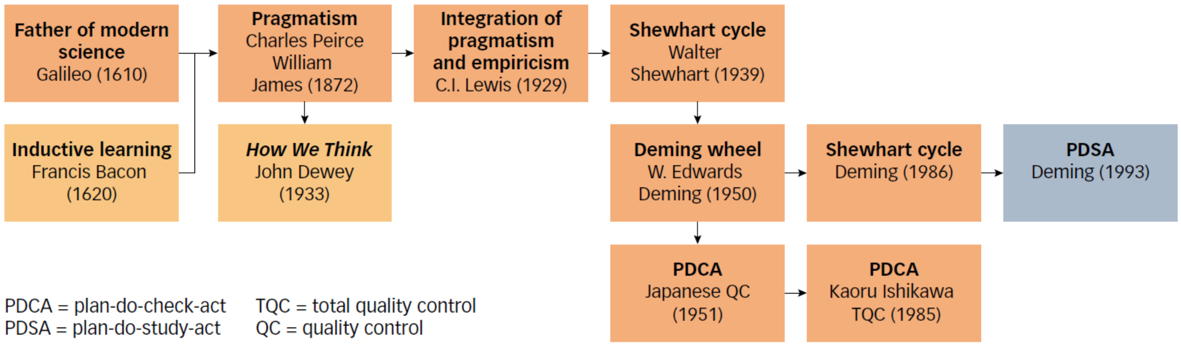


Figure 2.3: The evolution of pragmatism and PDSA/PDCA (Source: Moen & Norman, 2010)

2.4.1.1 The PDCA vs PDSA

It is well-known that Deming hated his quality improvement cycle be called the PDCA cycle, particularly because he believed that the word "Check" merely means to check whether the plan as worked, rather than *studying* what has been learned by doing that was planned (Gorenflo & Moran, 2011; Moen & Norman, 2010). However, the learning notion features very much in Ishikawa's improved PDCA notion (Figure 2.3) and like many practitioners and scholars, the researcher does not see a difference between PDCA and PDSA either practically or theoretically. As such, the researcher uses the two terms interchangeably in this chapter.

2.4.2 The PDCA and the Theory of Knowledge

Both Water Shewhart and W. Edwards Deming mention the "theory of knowledge" advanced by the American empiricist pragmatist C.I. Lewis (Lewis, 1929), as the basis of their quality improvement cycles (Cunningham, 1994; Lovitt, 1997; Mauléon & Bergman, 2009; Moen & Norman, 2010). However, a full account of the philosophy "pragmatism" developed in America, and its fusion with British empiricism, which lead to emergence of empiricist pragmatist C.I. Lewis (Figure 2.3) is beyond the scope of this review. Pragmatism attempts to answer the philosophical question, what is truth? According to Charles Peirce (1839-1914), a belief is true if it would stand up to whatever challenge, event that belief is subjected to (Lewis 1929, 1934; Mauléon & Bergman, 2009). This assertion does not depart from the scientific notion of failing to reject a hypothesis. Although William James (1842-1910) burrowed the pragmatic maxim advanced by Peirce, he argued that a belief is true if it is good to believe, and this is being shaped by the society (culture) in which one is brought up (Lewis

1929, 1934; Mauléon & Bergman, 2009). Empiricism as a philosophy holds that knowledge comes from experience and experimentation (Lewis 1929, 1934). C.I. Lewis married then understood pragmatism and empiricism to advance his version of pragmatism (Lewis 1929, 1934). According to Lewis (1926, 1934), three elements go into creating knowledge: (a) sense data, (b) relations of ideas (pure conceptual elements and their interrelationships), and (c) the human interpreter. Sense data are the images and other cues that hit the human interpreter's perceptual system. According to Lewis, the human interpreter uses "relations of ideas" among all possible ideas they know of, to select the best set of ideas (theoretical constructs and their interrelations) that make the most sense out of the sense data. Using this as a basis, Deming asserted that there is no knowledge with theory and there is no theory without the data (Deming, 1982, 1993b). Implicit in this notion is the assumption that knowledge is the key for success, and this will come by making sense out of the data (Cunningham, 1994; Lovitt, 1997; Mauléon & Bergman, 2009; Moen & Norman, 2010). Although Deming did not emphasise all the assertions of C.I. Lewis's theory of knowledge (e.g. Deming does not emphasise that knowledge is relative as C.I. Lewis and others such as William James) when he explained the "Deming Wheel" as the model for improvement, it is clear that the three elements of theory knowledge articulated by C.I. Lewis features prominently in PDCA/PDSA (the next section).

2.4.3 Steps Used in Each Phase of PDCA in Practice

The PDCA cycle is undeniably the most elegant, intuitive, and time-honoured means of achieving CI (Dale et al., 2007; Moen, 2009; Sokovic, Pavletic, & Pipan, 2010; Summers, 2010). In some fields the PDCA is so pervasive that this cycle is taken as the template for improvement. For example, in the field of healthcare, the PDSA cycle is known as "the model for improvement" (Moen & Norman, 2010; Taylor et al., 2014). Generally, the authors describe the steps involved in the PDCA cycle (or PDSA cycle), in relation to a specific quality improvement problem or an opportunity for improvement. A sample of summary descriptions given by five authors (in their own words) are shown in Table 2.2. While some authors prescribe more steps than the others, and there is some discrepancy regarding the particular activities being done in each stage6, the four phases could be reconciled with the scientific method of: problem identification, hypotheses, and experimental design (Plan)7, executing the experiment (Do), comparison of experimental results with the expectations (Check), and further experiments, if the plan has not worked (Act).

The Plan, Do, Check, Act phases with reference to the ISO 9001:2015 process model are for the entire QMS (although the PDCA cycle also applies to each key clause of ISO 9001:2015) and therefore, as part of converting the ISO 9001:2015 process model into a testable theoretical model, it is important to: (a) reconcile the contents of the key clauses with each of the four phases of PDCA, as understood in the TQM literature (e.g. the five studies shown in Table 2.2), and (b) posit the relationships between phase, given how the literature describes the connections. The development of the researcher's theoretical model is shown in Chapter 03. In the next section (section 2.4.4), the researcher reviews how the key clauses of the standard are aligned to Plan, Do, Check, and Act phases based on the extant literature.

Table 2.3: The Steps in Each Phase of PDCA Identified by Different Authors

Author (Year); *Other Comments*	**Plan**	**Do**	**Check/Study**	**Act**
Taylor et al. (2014) *Focus on PDSA as opposed to PDCA; do not see a big difference between the two, in practice.*	1. Identify objectives 2. Identify questions and predictions 3. Develop action plan to carry out the plan (who, when, where)	4. Execute the plan 5. Documents problems and unexpected observations	6. Begin data analysis 7. Complete data analysis 8. Summarise what was learnt	9.Determine the changes that need to be made 10. What will the next cycle be?
Gorenflo and Moran (2010)	1. Identify and prioritize opportunities 2. Develop aim statement	9. Implement the improvement 10. Collect and document the data	12. Reflect on the analysis 13. Document problems, observation,	Route 1: Adopt (standardise/hold gains) Rote 2: Adapt (revert to Do to

6 For example, Taylor et al., 2010 consider documenting the problems encountered in executing the plan in the Do stage, but Gorenflo and Moran, 2010 consider this activity in the Check stage; Summers (2010) considers identifying the solution as an essential first step of the do stage but many other authors consider this in the Plan stage.

7 For example, a manufacturing process may be producing more nonconformities than what it should be capable of and: (a) the hypothesis could be increase the flow rate, reduce the pressure, and the experiment could be a process optimisation experiment involving the flow rate and pressure as parameters (predictors) and defects count (or process capability) as the response.

Author (Year); *Other Comments*	**Plan**	**Do**	**Check/Study**	**Act**
	3. Describe the current process 4. Collect data on current process 5. Identify all possible causes 6. Identify potential improvements 7. Develop improvement theory 8. Develop action plan	11. Document problems, observations, and lessons learned	and lessons learned	modify and try again) Route 3: Abandon (start all over again from Plan)
Moen and Norman (2010) *Attempt to explain the difference between PDCA and PDSA beyond semantics (discussed in this section); what is mentioned in this table is the PDCA being adapted by Kaoru Ishikawa*	1. Determine goals and targets 2. Determine methods of reaching the goals 3. Engage in education and training	4. Implement the work	5. Check the effects of implementation	6. Take appropriate action
Summers (2010) *Focuses on PDSA (does not make any mention of PDCA); attempts to simultaneously compare with the DMAIC approach used in Six Sigma*	1. Identify the problem (recognise a problem exists) 2. Form an improvement team 3. Develop measures to measure performance 4. Now define the problem (mention which customers, what they want, the processes involved, and write-down an	7. Identify, select, and implement the solution	8. Evaluate the solution	9. Ensure performance (this means depending on what was found, either adopt the change or abandon it, or repeat the problem-solving cycle) 10. CI (this means, if the solution has worked to close the project, divert the team to solving a new problem)

Author (Year); *Other Comments*	Plan	Do	Check/Study	Act
	improvement statement) 5. Document and analyse the problem/process (e.g. process mapping) 6. Determine possible root causes			
Lovitt (1997) *Focuses on PDSA but says that PDCA is similar; also focuses on action and learning through experimentation*	1. Select opportunities for improvement (via experimentation) 2. Ask questions 3. Predict outcomes	4. Carryout the solution (the experiment) as per plan	5. Compare results (experimental outcomes) with predictions	Route 1: Adopt (standardise/hold gains) Rote 2: Adapt (revert to Do to modify and try again) Route 3: Abandon (start all over again from Plan)

2.4.4 Review of the Theoretical or Practical Basis of Alignment of Key Clauses of the Standard to Plan, Do, Check, and Act

There is a plethora of anecdotal accounts that cover allocation of key clauses of ISO 9001:2015 to PDCA, in addition to justifications given by ISO, which cannot be taken lightly. Table 2.4 covers a selection of such accounts.

Table 2.4: Allocation of the key Clauses ISO 9001:2015 to PDCA

Author (Year)	ISO 9001:2015 Clause #				Practical or Theoretical Justification Given
	Plan	Do	Check	Act	
Gonzalez (2016)	5,6,7	8	9	10	ISO 9001:2015 and ISO 9001:2008 learnings and Deming's teachings on PDSA
Hammer (2020)	4,5,6,7	8	9	10	A substantive review of the ISO 9001:2015 standard and ISO 9001:2015 auditing expertise
ISO (2015c)	4,5,6	7,8	9	10	Describing the foundation of the ISO 9001:2015 standard through a white paper

Author (Year)	ISO 9001:2015 Clause #				Practical or Theoretical Justification Given
	Plan	**Do**	**Check**	**Act**	
Al-Mahasneh et al. (2020)	4,5,6,7	8	9	10	A brief review of contents in the ISO 9001:2015 standard
ABCI Consultants (2020)	4,5,6,7	8	9	10	A brief review of contents in the ISO 9001:2015 standard
Biswas (2019)	4,5,6	7,8	9	10	Review of documents published by the ISO and consultancy experience in Kuwait
Note: Clause 4: Context of the Organization; Clause 5: Leadership; Clause 6: Planning; Clause 7: Support (7); Clause 8: Operation; Clause 9: Performance evaluation; Clause 10: Improvement					

The information shown in Table 2.4 suggest the following:

- Other than the book chapter by Al-Mahasneh et al. (2020) and the white paper by ISO (2015c), the other sources are websites published by ISO 9001:2015 consultants. The documents published by the consultants have not been openly reviewed by the academia, but if there is consistency in the consultants' prescriptions, such information can be taken as useful information, for the purpose of aligning ISO 9001:2015 clauses to PDCA. Hence a random mix of four consultant led sources have been included in Table 2.4.

- There is some discrepancy/inconsistency in the allocation of a clauses to Plan. The fact that at least three clauses have been aligned to Plan. This suggests that Plan may not be a unidimensional construct, when operationalized through ISO 9001:2015 clauses. IN a PDCA context also, Plan is the most important step with many diverse tasks.

- There is some discrepancy/inconsistency in the allocation of a clauses to Do. Some have included both clauses 7 and 8, while others have included clause 8 only.

- There is high degree of consistency (100% based on the sample covered) in the allocation of clauses to check (clause 9) and act (clause 10).

The above points indicate that more synthesis is needed to theoretically rationalise how PDCA could be optimally operationalised through ISO 9001:2015 clauses (this is covered in Chapter 3 on model development). The while paper by ISO (2015c) can be taken as the "go-to-source", because ISO 9001:2015 is their standard, and they make a detailed reconciliation between the contents of the key clauses of ISO 9001:2015 and the four steps of PDCA.

The above said, the only main issue to be resolved is whether the rationalisation given by ISO (2015c) to include both clauses 7 and 8 under "DO" is consistent with the "DO" step in the PDCA cycle, based on the core teaching of total quality. According to ISO (2015c), clause 7 (support) reflects "Do", because through this clause, the auditors examine how well the organisation determines the tangible resources (e.g. the workforce, physical infrastructure, financial capital, material and components) and intangible resources (e.g. the environment, information, knowledge) needed to operate its processes effectively. According to ISO (2015c), Clause 8 (operation) reflects "Do", because through this clause, the auditors examine the actions the organisation needs to implement to achieve planned outcomes. This fact of "DO" is quite straightforward and does not need further questioning.

2.5 STUDIES ON THE VALIDITY OF ISO 9001

Theory building and testing lie at the very heart of science. There are two reasons why the validity of ISO 9001 needs to be scrutinised. Firstly, validity of ISO 9001 in applied settings is useful for practitioners, managers as well as employees to understand the worth of their investment on ISO 9001 certification; *researcher refers to this as the practical validity of ISO 9001*. Secondly, scholars and academics gain insights and advance knowledge by testing explanations and predictions — for example, logical interrelationships between the key clauses of ISO 9001 that explain CI of a QMS, leading to product/service outcomes and customer satisfaction; *researcher refers to this as the theoretical validity of ISO 9001*. For the purpose of validity examination of ISO 9001, any study that critically considers the cause variable(s) and/or the effect variable(s) can be considered as a study on the validity of ISO 9001. In this regard, the literature covered in section 2.4 (ISO 9001 implementation, which is the cause), section 2.5 (ISO 9001 implementation effectiveness, which is the effect), and section 2.6 (ISO 9001 implementation → ISO 9001 implementation effectiveness relationship) make some form of a validity claim on ISO 9001.

For practical validity of ISO 9001, the researcher considered evidences that supports the proposition "ISO 9001 implementation results in expected outcomes". *For theoretical validity*, the researcher considered the evidence of validity of the building blocks of theories being posited and tested in prior research, where theoretical constructs supposedly represent some aspect of the standard and the expected outcomes of implementing the standard. Consequently, the validity of the theoretical constructs (i.e. construct validity) and hypothesised relationships between constructs (statistical conclusion validity) have been examined under theoretical validity.

2.5.1 Practical Validity of ISO 9001

Literature that examines the practical validity of ISO 9001 (more technically, ISO 9001 implementation success or effectiveness) are categorised under three headings. First heading covers studies that directly examine ISO 9001 implementation effectiveness. Second heading covers studies that indirectly examine ISO 9001 implementation effectiveness; in the latter set of studies researchers seem to have (covertly) taken the position that ISO 9001 implementation yields results, but certain factors act as drivers and restraints of ISO 9001 implementation success or effectiveness. Third heading reviews studies based on the methodology or approach being used to test practical validity.

2.5.1.1 Studies that Directly Examine ISO 9001 Implementation Effectiveness

One approach of directly examining ISO 9001 implementation effectiveness has been to examine whether ISO 9001 certified organisations have benefited from the certification, and if so, what benefits they gained through certification (e.g. see Cagnazzo et al., 2010; del Castillo-Peces et al., 2018; Fonseca, Domingues, Baylina, & Harder, 2019; Gotzamani, 2010; Gotzamani & Tsiotras, 2002; Hoonakker, Carayon, & Loushine, 2010; Magd, 2008; Murmura et al., 2018; Rusjan & Alič, 2010; Sampaio et al., 2009; Santos et al., 2014). The findings vary from "none/very little benefit" to "substantial". Mostly cited benefits have been customer satisfaction, productivity improvement, product quality improvement and reduction of non-conformities.

Another approach of directly examining ISO 9001 implementation effectiveness has been examining the impact on firm performance (e.g. Aba et al., 2015; Bayati & Taghavi, 2007; Blessner et al., 2013; Cândido et al., 2016; Chatzoglou et al., 2015; Feng et al., 2007; Huo et al., 2014; Ivanova et al., 2014; Iwaro & Mwasha, 2012; Jain & Ahuja, 2012; Jang & Lin, 2008; Kafetzopoulos et al., 2015; Kusumah & Fabianto, 2018; Lin & Jang, 2008; Psomas, Fotopoulos, & Kafetzopoulos, 2011; Psomas & Pantouvakis, 2015; Sampaio et al., 2011; Sharma, 2005; Sun, 2000; Terziovski & Guerrero, 2014; Wu & Chen, 2012). These studies focused on estimating the effect size (e.g. R^2 in regression context) on different facets of firm's performance. Again, findings vary from "none/very little impact" to "substantial". Mostly cited impact categories have been operational performance, financial performance, quality performance and market performance (more details were given in section 2.5 and its subsections).

Yet another approach of directly examining ISO 9001 implementation effectiveness has been examining the drawbacks of ISO 9001 certification (e.g. Boiral, 2012; Gamboa & Melão, 2012; Hoonakker et al., 2010; Moturi & Mbithi, 2015; Murmura et al., 2018; Poksinska et al., 2006; Turk, 2006). Mostly cited drawbacks have been cost of certification, increased business cost; increased company procedure complexity; bureaucracy and decline in profits.

2.5.1.2 Studies that Indirectly Examine ISO 9001 Implementation Effectiveness

Indirect validation studies of ISO 9001 can be classified under three categories. First category is where researchers have examined different approaches for successful ISO 9001 implementation (e.g. Becker, 2019; Feng et al., 2008; Huo et al., 2014; Kim et al., 2011; Poksinska et al., 2006; Samat et al., 2012; Sumaedi & Rakhmawati, 2017). These studies have assumed that ISO 9001 implementation brings benefits to the organisations but there are some approaches that can enhance the effectiveness of it. Mostly cited approaches have been basic, supportive and advanced (see Huo et al., 2014).

Second category is where researchers have examined factors that drive or hinder effective ISO 9001 implementation. Such studies have headed in two directions: (i) examination of factors that enhance effective implementation of the standard, and (ii) examination of factors that impede effective implementation of the standard. The former is frequently cited as CSFs for ISO 9001 implementation success (e.g. Psomas & Antony, 2015; Psomas et al., 2010) while the latter is frequently cited as barriers for successful implementation of ISO 9001 (e.g. Zeng et al., 2007).

Third category is where researchers have examined the motives of ISO 9001 implementation and their consequences (e.g. Gotzamani & Tsiotras, 2002; Poksinska, 2010; Valmohammadi & Kalantari, 2015). These studies have covered one or more of the following: approaches (details in section 2.4.1), CSFs/barriers (details in section 2.4.3), and motives (details in section 2.4.2).

In addition to above, studies that compare the ISO 9001 and TQM relationship (details in section 2.7.1), studies that cover consultancy and external auditing (details in section 2.7.2), and studies that cover risk-based thinking in ISO 9001 (details in section 2.7.3), can also be considered as studies that recognise ISO 9001 implementation as a practically valid quality management initiative.

2.5.2 Statistical Models Used in Establishing Practical Validity of ISO 9001

The previous section covered studies that established practical validity of ISO 9001, directly or indirectly. This section covers the statistical tests used in the said studies (section 2.8.1) to establish practical validity of ISO 9001. The researcher observes that studies that use statistical methods to establish practical validity fall into three categories: (a) studies that test the relationship between ISO 9001 implementation aspects and one or more facets of organisational performance, (b) studies that compare mean (or median) performance of ISO 9001 certified organisations with non-certified organisations, and (c) studies that compare pre-certification performance with post-certification performance.

2.5.2.1 Studies that Test the Relationship between ISO 9001 Implementation Aspects and Different Facets of Organisational Performance or Organizational Benefits Received

The researcher observes that authors have proposed many different conceptualisations to show a relationship between ISO 9001 certification and performance (or ISO 9001 implementation benefits). A widely used approach has been to posit that ISO 9001 implementation improves some facets of organisational performance through certain organisational attributes that ISO 9001 is supposed to improve (e.g. Feng et al., 2007; Huo et al., 2014; Kafetzopoulos et al., 2015; Psomas et al., 2011; Psomas & Pantouvakis, 2015). Although the researcher has listed above studies under practical validity on the grounds that theoretical variables in these models do not map into ISO 9001 content, many of these studies cover theoretical validity concepts such as construct validity, predictive validity and statistical conclusion validity (García-Pérez, 2012; Nunnally & Bernstein, 1994). One problem in comparing studies that fall into above classification is very different conceptualisations being used as organizational attributes (predictors). Some have used HRM embodied in ISO 9001 (e.g. Kafetzopoulos et al., 2014; Psomas et al., 2011), some have used ISO 9001 adoption level (e.g. Chatzoglou et al., 2015; Huo et al., 2014; Jang & Lin, 2008; Terziovski & Guerrero, 2014), and yet others have used ISO 9001 motives (e.g. Gotzamani & Tsiotras, 2002; Valmohammadi & Kalantari, 2015).

As a variant of above approach, del Castillo-Peces et al. (2018) fitted a multiple regression model to predict benefits achieved through ISO 9001 implementation using ISO 9001 maturity and other situational variables (e.g. firm size and motives) as predictors. Jain and Ahuja (2012) analysed bi-variate correlations between ISO 9001 implementation success factors (e.g. management commitment, resource management, customer focus etc.) and manufacturing performance benefits (e.g. operational benefits, production benefits, technological benefits etc.), based on data collected from the Indian manufacturing industry. Djofack and Camacho (2017) fitted a logistic regression model to predict cost of ISO 9001 implementation (high versus not high) using a battery of situational variables (e.g. age, size, involvement of consultants etc.) as predictors, based on data collected from the Spanish tourism industry. Prajogo (2011) fitted regression models to examine the effect of internal motives of ISO 9001 implementation, external motives of ISO 9001 implementation and their two-way interaction on operational performance, based on data collected from ISO 9001 certified Australian organisations. All these studies provide evidence of practical validity of ISO 9001 because they attempt to predict a benefit(s) or outcome(s) as a result of ISO 9001 implementation.

2.5.2.2 Studies that Compare Mean Performance of ISO 9001 Certified Organisations with Non-certified Organisations

Marín and Ruiz-Olalla (2011) compared quality and operational results between ISO 9001:2000 certified (n = 85) and non-certified (n = 45) Spanish companies. They found that ISO 9001 certified companies outperform non-certified firms in both performance dimensions (for quality results, F = 10.602, p < 001; for operational results, F = 6.097, p < 0.015).

Aba et al. (2015) compared financial operating performance of ISO 9001 certified US companies (n = 397) with non-certified companies as well as with a matched control group for a period of five years, commencing from one year prior to certification, to examine if ISO 9001 certification seems to improve financial performance. They found that certified companies outperform noncertified companies as well as the control group, based on both mean and median financial operating income throughout the post certification period ($p <$ 0.01 in most years based on Wilcoxon signed tests).

Blessner et al. (2013) compared goods' acceptance rates of variety of commodities supplied by ISO 9001 certified suppliers to that of non-certified suppliers in relation to a contract manufacturer belonging to US department of defence. Their χ^2 test for difference of acceptance rates for all commodity groups (acceptance rate corresponding to ISO certified suppliers and noncertified suppliers were the same at 95.8%) showed that there is no difference in supplier performance between ISO certified and non-certified groups. More importantly, they found (via a χ^2 test) that non-certified suppliers outperform ISO 9001certified suppliers in the commonality group military hardware (receipt quantity = 46,541; acceptance rate for ISO 9001 certified suppliers = 97.8%; acceptance rate of non-certified suppliers = 98.5; χ^2 = 31.786 and p < 0.001).

Sampaio et al. (2011) compared the financial performance of ISO 9001 certified (n = 143) and non-certified (n = 64) companies in Portugal on four measures. Their results on T tests showed no difference between the two groups on three financial measures (p >> 0.05), and a higher performance in "operational results/asset" ratio for non-certified companies over certified companies (T = 2.708, p = 0.007). However, Sampaio et al. showed that several companies that returned higher financial performance were ISO 9001 certified. Other studies that compared ISO 9001 companies with non-certified companies include Sun, 2000; Valmohammadi and Kalantari, 2015; and Iwaro and Mwasha, 2012. These studies showed mixed results.

Cândido et al. (2016) compared the financial performance of 143 Portuguese companies who failed to retain their ISO 9001 certification against matching counterpart companies over three different financial performance measures. They did not find a performance deference in any of the three financial performance metrics between the two groups. Wu and Chen

(2012) compared the performance of Taiwanese companies that passed ISO 9001 certification audit with those who failed to pass the certification audit, on 38 performance measures belonging to four performance dimensions in the balanced score card (32 performance measures for service companies). There F tests for the two groups (passed vs failed) based on data collected from 212 manufacturing and 130 service firms showed that companies that passed ISO 9001 certification outperformed the ones that failed ISO 9001 certification in all performance measures, and the difference between the two groups were more pronounced for manufacturing than for service companies.

2.5.2.3 Studies that Compare Pre-certification Performance against Post-certification Performance

Sharma (2005) compared the financial performance of 70 companies listed in the Singapore stock exchange before and after ISO 9001 certification, over a period of six years from certification. He found that ISO 9001 certification positively impact the internal business processes which in turn bring superior financial performance. Kusumah and Fabianto (2018) compared pre-post financial performance of 27 manufacturing companies in Indonesia. They found that although results did not change after one year from certification, significant improvements did occur after three years from certification. This finding is consistent with the findings of many others (e.g. .Jang & Lin, 2008; Kim et al., 2011; Lin & Jang, 2008). There are also studies that examine post ISO 9001 implementation impact, based on survey data on perceived impact collected from respondents (e.g. Bayati & Taghavi, 2007; Djofack & Camacho, 2017; Gotzamani, 2010).

In general, studies that examine the practical validity of ISO 9001 implementation fail to explain why and how ISO 9001 certification or implementation lead to improved performance. In cases where theoretical constructs have been used, these did not represent the contents of the standard as the enablers of performance. Other issues include not controlling or matching samples (e.g. certified versus non-certified comparison) and alternative explanations. For this reason, it becomes necessary to review literature that examine the theoretical validity of ISO 9001.

2.5.3 Theoretical Validity of ISO 9001

Some researchers have attempted to posit and test theoretical relationships that underpin ISO 9001 in some shape or form.

Lin and Jang (2008) developed a theoretical model that mimics ISO 9001 practices — key enablers of operational and business outcomes via continuous improvement based on ISO 9001 principles — that impact on operational and business performance of firms (Figure 2.4). The authors used some of the compliance requirements stipulated in ISO 9001:2000 to generate measures for their enabler constructs (i.e. top management support, quality planning, employee involvement, and continuous improvement). Using structural equation modelling, they showed that their model is a good fit to data; the data were collected from 441 ISO 9001 certified Taiwanese companies.

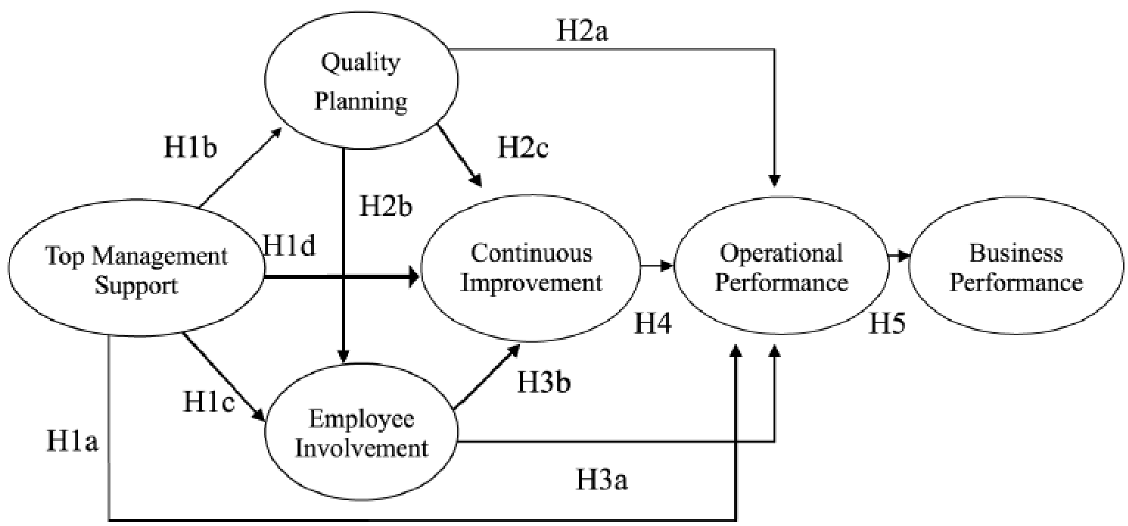


Figure 2.4: The theoretical model posited by Lin and Jang (2008, p. 603)

The study by Lin and Jang (2008) can be critiqued on two counts. First criticism is that it is difficult to reconcile the first three constructs used by them (Figure 2.4) with ISO 9001:2000 (Psomas & Fotopoulos, 2009, p. 139). Researcher observes that Clause 5 of ISO 9001:2000 (Management Responsibility) does not map well into the deeper meaning of Top management support[8]. Similarly, Clause 6 of ISO 9001:2000 (Resource Management) does

8 Lin and Jang (2008) operationalised "Top Management Support" using a single survey item. The likely reason for this could be that that Clause 5 of ISO 9001:2000 (also ISO 9001:2008) represents only a small portion of the concept "Top Management Support".

not map well into the deeper meaning of Employee Involvement[9] (Fonseca, 2015b; Yung, 1997); Clause 7 of ISO 9001:2000 (Product Realisation) does not map well into the full meaning of Quality Planning; and Clause 8 of ISO 9001:2000 (Measurement, Analysis and Improvement) *does* not map well into the deeper meaning of Continuous Improvement. Second criticism is that the hypotheses posited by Lin and Jang (2008) are too generic, in the sense, they cannot be traced back to the standard.

Psomas et al. (2012) theorised and empirically tested a confirmatory factor model representing ISO 9001 implementation effectiveness. The purpose was to establish the validity of three factors Continuous Improvement, Customer Satisfaction and Prevention of Nonconformities as concepts reflecting the higher-order concept ISO 9001 Effectiveness[10] (see the highlighted section in Figure 2.7). Psomas et al. (2012) fitted their confirmatory factor model using survey data collected from 820 ISO 9001 certified Greek food manufacturing companies. They found their model is a good covariance fit to data. This study was replicated by Psomas (2013) in the service industry based on data collected form 100 service companies to demonstrate reproducibility of the results.

As a theory extension to the above two studies, Kafetzopoulos et al. (2015) tested a theoretical model that posits the following: ISO 9001 Effectiveness causes Product Quality, Operational Performance, and Business Performance; Product Quality is also caused by Operational Performance; Product Quality and Operational Performance (in addition to ISO 9001 Effectiveness) cause Business Performance. By testing these hypotheses using data collected from 287 ISO certified Greek manufacturing firms, Kafetzopoulos et al. (2015) found that their model was a good covariance fit to data and that ISO 9001 Effectiveness had no direct positive effect on Business Performance; instead, they found that the effect of ISO 9001 Effectiveness on Business Performance was felt through the indirect effects via the mediating variables Operational Performance and Product Quality.

In a yet another theory extension, Psomas and Antony (2015) theorised that the critical success factors for ISO 9001 effectiveness are: Internal Motivation, Employee Attributes,

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9 "Employee Involvement" has been operationalised by Lin and Jang (2008) using a single survey item. Again, although no reason for this has been given by them, the likely reason for this could be that Clause 6 of ISO 9001:2000 (also its predecessor ISO 9001:2008) only represents a small portion of Employee Involvement (in quality improvement).

10 Relabelled as ISO 9001 QMS Effectiveness in Psomas and Antony (2015).

Company Attributes, External Environment Pressure, and Quality System Attributes (see Figure 2.5). Empirical testing of the model based on data collected from 163 ISO certified Greek manufacturing firms, Psomas and Antony (2015) revealed that External Environment Pressure and Quality Systems Attributes do not have a statistically significant effect on ISO 9001 Effectiveness ($p >> 0.05$).

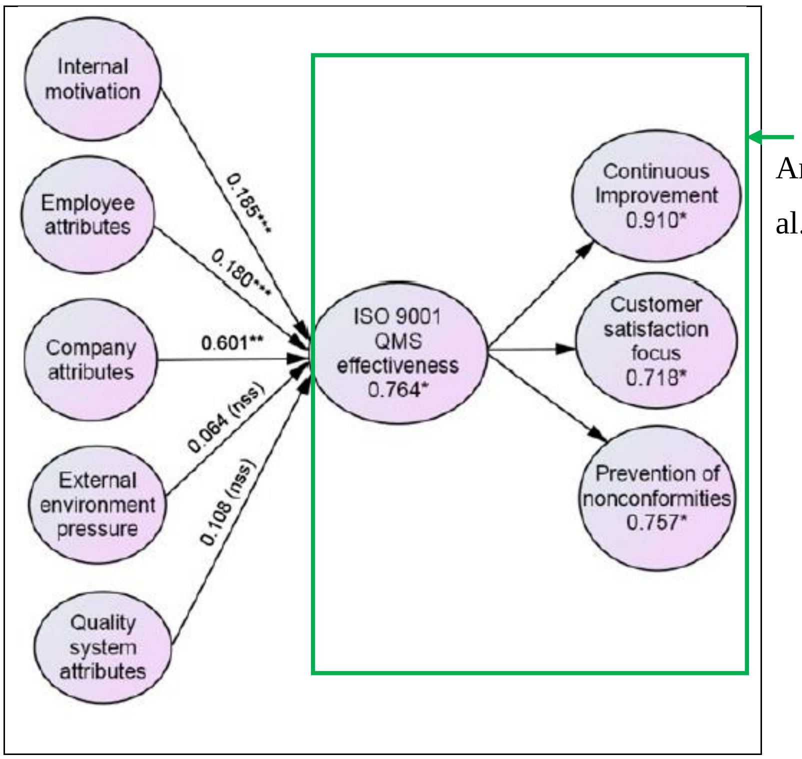

Figure 2.5: The causal predictive model used by Psomas and Antony (2015) to explain ISO 9001 effectiveness, plus structural model parameters

The studies discussed above (i.e. .Kafetzopoulos et al., 2015; Psomas & Antony, 2015; Psomas et al., 2012; Psomas, Pantouvakis, & Kafetzopoulos, 2013) are useful because they repetitively confirm that ISO 9001 Effectiveness is a valid concept. What is not clear in these studies is how ISO 9001 Effectiveness is caused. The real causal antecedent of ISO 9001 Effectiveness is ISO 9001 itself. This is because Continuous Improvement, Customer Satisfaction and Prevention of Nonconformities occur as a result of an intervention, and that intervention can purport to be implementation of ISO 9001. The critical success factors that Psomas and Antony posited can be regarded as factors that drive or impede ISO 9001 effectiveness.

Fotopoulos, Psomas, and Vouzas (2010) empirically tested a theoretical model consisting of TQM concepts embodied in ISO 9001 — Top Management Involvement[11], Customer Focus, Quality Tools and Techniques, Employee Involvement, Process Management, and Data Quality Management[12] — using data collected from 370 ISO 9001 certified Greek companies. This model hypothesises that the three drivers of Employee Involvement and Process/Data Quality Management are Top Management Commitment, Customer Focus, and Quality Tools and Techniques. Although the model and the hypotheses were well-supported by data, it is difficult to argue that this study, like other studies covered in this section, provides direct evidence of the validity of ISO 9001. Other studies that fall into this league include the ones by Ivanova et al., 2014; and, Jaafreh and Al-abedallat, 2013.

2.6 TQM ACROSS CULTURES

The ISO 9001:2015 standard, arguably the most well-known TQM framework[13], is being used by many nations and regions. One way to characterise nations and regions is their economic wealth. However, a more reliable and a useful yardstick to categorise nations and regions is “shared values” or “culture” (Hofstede 2011). If the PDCA approach embedded in ISO 9001:2015 can be interpreted in its abstract essence (one of the main objectives of the researcher’s study), most pragmatists may have different levels of acceptance on the notion that PDCA approach is embedded in ISO 9001:2015. This is because as mentioned earlier (section 2.4.2), from a pragmatists’ standpoint (e.g. William James’s assertion), a belief is true if it is good to believe, based on how one is being programmed by the society.

If there is a difference in the acceptance the PDCA approach embedded in ISO 9001:2015 across nations, what theoretical explanation can be given as the best explanation for such a discrepancy? This question brings one to the search of frameworks being used to operationalise national culture. The researcher found that Hofstede’s framework and GLOBE framework feature prominently in social research as two competing frameworks that define national culture operationally. In OM literature, Trompenaars and Hampden-Turners’

[11] For some reason, Fotopoulos et al. (2010) used the label Quality Management instead.

[12] For some inexplicable reason, Fotopoulos et al. (2010) combined Process Management and Data Management to form a single construct labelled “Process and Data Quality Management”.

[13] Some scholars and practitioners may have strong views about ISO 9001 and may argue that ISO 9001 is no more than a standard to check the fitness of the QMS of a supplier who supplies goods and services to customers.

framework also features sporadically (Trompenaars & Hampden-Turners, 1997). In recent years new scales for measuring national culture have emerged, including hybrid scales that combine Hofstede and GLOBE scales (e.g. see Rarick & Nickerson, 2008; Shackman, 2018), but a detailed review of national culture frameworks is beyond the scope of this study.

2.6.1 Review of the Hofstede's Framework and the GLOBE Framework

2.6.1.1 The Hofstede's Framework

Dutch anthropologist Geert Hofstede is regarded as a pioneer in the field of culture studies, owing to his seminal work. Based on correlational analysis of secondary data on about 117,000 IBM employees in over 60 countries, Hofstede (1980a) identified four distinct cultural dimensions that describe and compare cultures across nations and societies. Hofstede uses the onion analogy (see Figure 2.6, the so-called cultural onion) to explain the constituents of culture. The cultural onion, as the name implies, represents a core surrounded by three outer layers. The model illustrates the cultural phenomena in different levels of depth — values representing the deepest routed manifestation of culture (the core, which is inimitable) and symbols representing the most superficial manifestation of culture (Fang, 2010; Hofstede , Hofstede , & Minkov 2010; Richter, 2016).

According to Hofstede (1991), values reside at the core of one’s behaviour and are enriched or highly affected by life experiences of one’s childhood; further, values are crucial in building a person’s behaviour, attitudes and character. Because values are inherited from the childhood and lay at the core of one’s behaviour, according to Hofstede, values have a higher resistance to change in later life. Moreover, societal and national cultures are built upon core values and for this reason, values of a national culture remain resistant to change (Hofstede, 2011). Accoding to Hofstede (2011), the national culture dimensions identified by him are rooted in the values; these culture dimensions together are sometimes referred to as the “cultural value framework”.

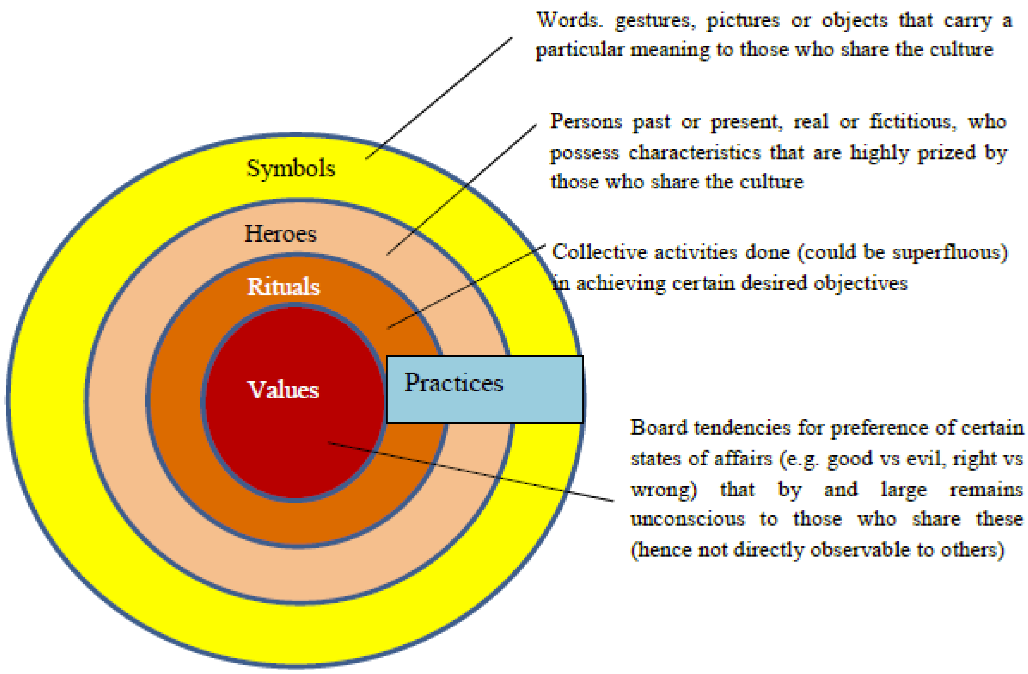

Figure 2.6: Hofstede's cultural onion (Source: Hofstede, 1991)

The proposition that an organisation — within a society — has its own unique culture has credence because although an organisation is a society in miniature to which people bring their own values from the wider society (Luthans & Youssef, 2007; Schermerhorn, 2011). People in an organisation achieve the so-called common purpose, through division of labour, under hierarchical control (Schein 2010; Schermerhorn, 2011). The values of the organisation, which reflect the culture of that organisation, are shaped by the top management at the stage of formation of the organisation, which is then transmitted to new members unconsciously (Schein 2010). While the national culture directly affects organisational culture, the latter remains less resistant to change, because it is being directly affected by the leadership (Hofstede et al., 2010). For example, with the passage of time, the leadership of a particular organisation may comprehend that the prevailing organisational culture is not conducive for continuous improvement and a culture change is necessary and act accordingly; in this case the leadership would act as the culture change agent (Deming, 1993a; Summers, Humphrey, & Ferris, 2012).

In his seminal work, Hofstede (1980a) operationalised culture through four dimensions: Power Distance, Uncertainty Avoidance, Individualism/Collectivism and

Masculinity/Femininity. Two additional dimensions — Long Term Orientation and Indulgence — that Hofstede added later are not covered in this review. Hofstede's original cultural dimension are described hereunder.

Power Distance

Power Distance (PD) is defined as the degree to which the less powerful members of an organisation expect and accept that power is distributed unequally (Hofstede, 2011). This dimension has been defined from the less powerful person's perspective and the power inequality is represented as high (one end of the continuum) versus low (the other end of the continuum) (Hofstede, 2011). A power difference exists in societal roles and it is reflected between "role pairs", such as, parent-child, teacher-student, manager-subordinate and authority-citizen (Hofstede et al., 2010). In Hofstede's PD scale, referred to as the *Power Distance Index (PDI)*, East European, Latin, Asian and African nations score highly (high PD nations) while Germanic and English-speaking Western nations score lowly (low PD nations) (Hofstede et al. 2010).

Uncertainty Avoidance

Uncertainty Avoidance (UA) is defined as the degree to which the members of a society feel uncomfortable and threatened in unknown and unstructured situations (Hofstede, 2011; Hofstede et al., 2010). In other words, UA reflects how the members of a society feel anxious in uncertain (ambiguous) situations. The UA is represented in a high versus low continuum and according to Hofstede, societies with high UA tend to follow strict behavioural codes, laws, rules, procedures and believe in absolute truth to minimize the possibilities of uncertainty (Hofstede, 2011). Furthermore, high UA cultures are more emotional and structured while people in low UA cultures are innovative and adaptable (Hofstede, 2011). In Hofstede's UA scale, referred to as the *Uncertainty Avoidance Index (UAI)*, East and Central European, Latin, Japan and German speaking countries score highly (high UA nations) while native English-speaking nations, Nordic and Chinese countries score lowly (low UA nations) (Hofstede et al., 2010).

Individualism/Collectivism

Individualism/Collectivism (IDV) is defined as the degree to which people in a society are integrated into groups. This dimension is represented as a measure that represents two ends of a continuum: highly individualist on one extreme and highly collectivist on the other extreme. Individualism refers to low within group ties in relation to an individual while collectivism refers to high within group (hence collective) ties in relation to an individual. People in individualist cultures have a strong connection only with their immediate families while people in collectivist cultures keep strong ties with their extended families (Hofstede, 2011). According to Hofstede et al. (2010), developed and Western nations tend to be highly individualist while less developed and Eastern nations tend to be highly collectivist.

Masculinity/Femininity

Masculinity/Femininity (MAS) is defined as the degree to which the distribution of values between genders vary in a society (Hofstede, 2011). In general, in masculine cultures, men are supposed to be assertive, tough, competitive and focused on material success while women are supposed to be softer, modest and caring (Hofstede et al., 2010). In feminine cultures the above emotional gender roles are less pervasive (Hofstede, 2011). In effect, MAS reflects how big a gap exists between the values of men and women in a society or country (Hofstede, 2011). There is lower gap between men and women in feminine cultures relative to masculine cultures (Hofstede, 2011). In Hofstede's MAS scale, Japan, German speaking countries and some Latin countries (Italy, Mexico) emerge as highly masculine nations while Netherland and Nordic countries emerge as highly feminine nations (Hofstede et al., 2010). Further, native English-speaking western countries emerge as moderately masculine nations while Latin and Asian countries (France, Spain, Korea, and Thailand) emerge as moderately feminine nations.

2.6.1.2 The GLOBE Framework

The GLOBE (Global Leadership and Organisational Behaviour Effectiveness) study is a more recent cross-cultural study (originated in 1991) conducted by a large group of social and management scientists (House et al., 2002; Minkov & Blagoev, 2012; Shi & Wang, 2011; Venaik & Brewer, 2008). GLOBE researchers (sometimes referred to as *team GLOBE*) collected data from about 17000 middle managers representing food processing, finance and telecommunication industries spanning across 62 societies. The primary objective of the GLOBE project was to examine cultures across nations as widely as possible to study their influence on organisational leadership behaviour and practices (House et al., 2002).

The GLOBE researchers used Hofstede's framework as a starting point, but they burrowed contributions made by other researchers to expand Hofstede's operationalisations to provide a supposedly richer framework to cluster diverse cultures used in their study. As such, nine culture dimensions (also six leadership styles) were identified through the GLOBE study (Table 2.5). Like many other researchers, the author of this thesis considers the GLOBE framework as an extension of Hofstede's cultural value framework (Kull & Wacker, 2010).

Table 2.5: Cultural Dimensions and Leadership Styles Identified by GLOBE Researchers (Source: House, Hanges, Javidan, Dorfman, and Gupta, 2004)

Cultural Dimension	Leadership Style
1. Power Distance*	1. Performance-oriented
2. Uncertainty Avoidance*	2. Team-oriented
3. Humane Orientation *	3. Participative
4. Collectivism I (Institutional Collectivism) **	4. Humane
5. Collectivism II (In-Group Collectivism) **	5. Autonomous
6. Assertiveness ♣	6. Self-protective
7. Gender Egalitarianism ♣	
8. Future Orientation	
9. Performance Orientation ♣♣	

* Directly copied from Hofstede's framework; Human Orientation is exactly the same as Individuation in Hofstede's framework (House et. al., 2002)

** Adapted/Modified from Hofstede's framework (House et. al., 2002)

♣ Replaced the Masculinity in Hofstede's framework (House et. al., 2002)

♣♣ Replaced Long-term orientation (known as Confucian Dynamism at the time) in Hofstede's framework but has the same meaning (House et. al., 2002)

The researcher selected the Hofstede's framework because it is parsimonious (relative to the Globe framework), still highly recognised, and is fit for purpose.

2.6.2 Empirical Studies on the Relationship between National Culture and ISO 9001:2015 Implementation

Based on the meta analysis of 147 empirical studies that examined the size of effects of ISO 9001 implementation (after performance minus before implementation performance) in different countries, Manders (2015) found support to some of her hypotheses that hypothesised directional relationships between national culture dimensions (she used the GLOBE framework) and: (i) operational performance, and (ii) market performance. She also tested the overall hypothesis which posited that ISO 9001 implementation improves operational results as well as business results. Manders found that ISO 9001 implementation has a positive effect on operational performance ($p < 0.01$) as well as market performance ($p < 0.01$). Of eight hypotheses that posited directional relationships between the nine GLOGE dimensions and operational performance, only GLOBE dimensions — power distance, institutional collectivism, and permanence orientation — were found to influence operational performance improvement. As regards market performance, only performance orientation dimension was found to influence market performance (all other GLOBE dimensions didn’t support the hypotheses on the relationships between GLOBE dimensions and market performance).

2.6.3 Parallel Empirical Studies on TQM Frameworks

Mathews et al. (2001) examined the influence of culture on patterns of QM practices and adoption of quality tools in European countries, based on a survey conducted in the UK, Portugal and Finland, involving 450 manufacturing and service organisations. Cultural differences were examined based on Hofstede’s framework and two other frameworks. Mathews et al. found that implementation of quality practices differ across the countries that they considered, and that national culture traits can explain these differences considerably. Mathews et al. went on to calm that UAI and PDI dimensions of Hofstede’s model explain much of the variations of QM practices and application of tools (e.g. UAI cultures tend to practice “management-by-fact” approaches where they report adoption of more “quality tools” and statistical techniques related to monitoring and measurement related activities while high PDI cultures facilitate the uptake of QM practices). The weakness of this study is that no attempt has been made to make statistical inferences (e.g. confidence intervals of mean scores for each country, one-way ANOVA and Tukey's post hoc tests) or to quantify the amount of variability attributable to the factor culture via measures such as the R^2.

Lagrosen (2002) conducted a qualitative study involving the European operations of multinational company drawing cases from the UK, Germany, Italy and France to explore culture specificity of QM practices (TQM elements). Data were collected via interviews and differentiation of countries based on cultural perspective was made based on Hofstede's framework. Since only PDI and UAI differed across four countries involved in the study, the exploration was confined to these two dimensions only. Lagrosen claims that high PDI countries were found to depend on leaders while low PDI countries were found to depend more on workers, regarding matters related to quality performance; similarly, he claims that UAI was found to influence decision making practices — for example low UAI countries putting trust on individuals while high UAI seeking support from leaders and/or documented procedures. Lagrosen went on to conclude that the influence of culture on QM practices is small but should not be overlooked, for example by multinational corporations in managing their global operations.

Subsequently, Lagrosen (2003) used survey data (n = 47) collected from 30 countries to test hypotheses involving Hofstede's dimensions and core TQM elements that he operationalised: customer orientation, leadership commitment, full participation, business process focus, continuous improvement, and measurement focus. Lagrosen found that only the hypotheses involving UAI (correlation with business focus = -0.323, $p < 0.05$ and correlation with important customer = -0.320, $p < 0.05$) and IDV (correlations with close customer = -0.328, $p < 0.05$) were supported by data, suggesting that these two dimensions influence TQM values. He also discussed how his findings translate to managerial practice (e.g. in customer relationship management) in different cultures. It can be argued that the primary reason for non-support of most of the hypotheses could be attributable to the small sample size, which results in low statistical power.

Flynn and Saladin (2006) showed that the relevance and acceptance of TQM constructs (as operationalised via Baldrige Criteria for Performance Excellence) differ across national cultures in otherwise similar organisations, namely organisations that are deemed world class.

Using secondary data collected from 167 plants in five developed counties (33 plants were from Germany, 34 were from Italy, 46 were from Japan, 21 from England, and 30 from the USA) listed in the WCM database (e.g. see Flynn & Saladin, 2001 for details of the WCM database) Flynn and Saladin examined strength and nature of the bivariate association between Hofstede's national culture dimensions (predictor) and each of TQM/Baldrige constructs (response); they also considered two-way interactions between Hofstede dimensions as predictors (independent variable) in their modelling. Flynn and Saladin found that most of the four original Hofstede's culture dimensions are associated with Baldrige constructs (the exception being Customer and Market Focus) and Japanese and US cultures return higher mean scores for Baldrige constructs than the other three countries. Flynn and Saladin concluded that there is greater relevance and acceptance of Baldrige Criteria for Performance Excellence (i.e. TQM) in these two cultures than in other cultures.

Vecchi, Demeter, and Brennan (2011) examined to what extent that QM practices are culture bound to fall in line with the proposition that organisations are culture bound (divergent viewpoint). Based on data collected from 641 manufacturing firms in 21 countries, nine hypotheses — each involving a GLOBE dimension as the predictors and quality management as response — were tested by the authors using nonparametric techniques, on account of highly non-normal data. Results showed significant variations of quality priorities and quality practices across GLOBE culture dimensions. Specifically, UAI, performance orientation, institutional collectivism dimensions were found to be significantly impact quality priorities as well as quality practices, while PDI was found to impact in quality practices only. Authors concluded that some QM practices are more "culture-specific" than others. Subsequently, Vecchi and Brennan (2009) conducted a similar study adopting Hofstede's four original culture dimensions; they found that all four Hofstede culture dimensions significantly affect quality practices ($p < 0.05$) while MAS and UAI affect quality priorities, albeit weakly.

2.7 RESEARCH GAPS

Gap 1: Need of Further Research to Understand the Theory Underlying ISO 9001

While researchers have attempted to establish the validity of ISO 9001 (section 2.5), apart from the study by Lin and Jang (2008), as highlighted in section 2.5.3, all other studies (e.g.

Fotopoulos et al., 2010; Ivanova et al., 2014; Jaafreh & Al-abedallat, 2013; Kafetzopoulos et al., 2015; Psomas & Antony, 2015; Psomas et al., 2012; Psomas et al., 2013) have, at best, established theoretical validity of ISO 9001 in round about ways. Coming back to the study by Lin and Jang (2008), where they attempted to map the contents of the four key clauses of ISO 9001:2000 into their theoretical model, their model was critiqued by the researcher on two counts. Firstly, the researcher argued that there is some mismatch between the contents of the key clauses of ISO 9001:2000 and the theoretical constructs used by Lin and Jang (2008). Secondly, the researcher argued that the hypotheses posited by Lin and Jang are somewhat arbitrary (e.g. do not represent any proposition stated or implied in ISO 9001:2000 or ISO 9001:2008).

Compared to ISO 9001:2000 and ISO 9001:2008, ISO 9001:2015 is a substantially reviewed standard and its process model attempts to align the seven key clauses of ISO 9001:2015 to PDCA to suggest that there is a basis for QMS results (Rybski et al., 2017; Tricker, 2016). The theoretical underpinnings of PDCA were revived by the researcher, and it was found that PDCA is solidly grounded in the theory of knowledge espoused in pragmatic empiricism. However, there are several areas that needs to be cleared. Firstly, although PDCA is undeniably a sound proposition for identifying an opportunity to improve and implementing a plan to improve product and customer results, how that translates to the entire QMS via the standard remains unclear. Secondly, alignment of the seven key clauses of ISO 9001:2015 to PDCA by the ISO has not been empirically validated and, there is some lack of clarity on the alignment itself. Thirdly, there is no explicit theory that uses the contents of ISO 9001:2015 as a building block to explain QMS results. The ISO 9001:2015 process model is a crude mock-up that attempts to address all of the above, but so far, no one has published an empirical study involving the ISO 9001:2015 process model. These knowledge gaps justify the first research question (RQ1):

RQ1: How does meeting the requirements stipulated in the key clauses of ISO 9001:2015 (Clauses 4 through to 10) predict and explain the expected outcomes of ISO 9001 implementation (QMS Results) via the PDCA approach?

Gap 2: Acceptance of ISO 9001:2015 Across Countries and Regions: the Cultural Perspective

The saying that what is "good" to someone may be "poor" to someone else, has a philosophical basis. This is because as mentioned earlier (section 2.4.2), from a pragmatists' standpoint (e.g. William James's assertion), a belief is true if it is good to believe, based on how one is being programmed by the society. In section 2.6 studies that attempt examine the acceptance of TQM constructs across several countries and regions (cultures) were examined. Since ISO 9001 is claimed to be a collective output of quality experts around the world (ISO, 2015b), and the standard is claimed to be *equally good* for all firms, industries and cultures, the truthfulness of this across countries and regions is something worthy of being studied. Unfortunately, with the notable exception of the work of Manders (2015), who meta-analysed published literature to study the effects of national culture on ISO 9001 implementation effectiveness (the change in operational performance and market performance after ISO 9001 implementation in different cultures), there is a paucity of empirical research that examine the relationship between national culture and ISO 9001. This justifies the seconds research question (RQ2):

RQ2: Does ISO 9001:2015 have the same acceptance across cultures and regions?

2.8 CONCLUSION

Literature review was organised under several themes keeping in mind the over-arching research question: *what is the underlying theory of ISO 9001?* In the famous words of Deming (1993a, p. 106), *"without theory, one has no questions to ask. Hence, without theory, there is no learning"*. Large volume of literature on ISO 9001 implementation and its effectiveness are available but these studies do not directly examine the theoretical validity of the contents of the standard. The ISO, the custodian of ISO 9001:2015 claims that the contents of the key clauses of the standard are aligned to the PDCA cycle to predict and explain QMS results via continual improvement (section 2.2). Notwithstanding some limitations on content validity, hypothesis justification, and coverage of an out-of-date standard, the study by Lin and Jang (2008) was found to be the one that became closest to theoretical validation of the contents of ISO 9001. The research question (RQ1) stemming from this particular knowledge gap is *"how does meeting the requirements stipulated in the* *key clauses of ISO 9001:2015 (Clauses 4 through to 10) predict and explain the expected outcomes of ISO 9001 implementation (QMS Results) via the PDCA approach"?*

The following sub-questions can be knitted into RQ1:

RQ1a: What does "PDCA for the entire QMS" really mean?

RQ1b: How can the key clauses of ISO 9001:2015 be best aligned to PDCA theoretically?

RQ1c: What is the relationship between the key clauses of ISO 9001:2015, PDCA, and QMS Results?

The second research question (RQ2) of the study — "*does ISO 9001:2015 have the same acceptance across cultures and regions?"* — came from the paucity of studies on the acceptance of ISO 9001:2015 in an international context. The meta analytic study by Manders (2015) is important because her study is based on the premise that national culture has an effect on the way the standard is interpreted and implemented across cultures and this affections QMS outcomes (operations results and market results). The studies that examine the acceptance of TQM constructs across cultures covered in this study can be used as a platform to answer RQ2.

The next chapter (Chapter 03) covers derivation of the theoretical models including several testable hypotheses to answer the first two research questions.

CHAPTER 3

DEVELOPMENT OF THEORETICAL FRAMEWORKS AND RESEARCH HYPOTHESES

3.1 INTRODUCTION

This chapter covers the development of theoretical models to answer the two research questions:

RQ1: How does meeting the requirements stipulated in the key clauses of ISO 9001:2015 (Clauses 4 through to 10) predict and explain the expected outcomes of ISO 9001 implementation (QMS Results) via the PDCA approach?

The above research question was portioned into three sub-questions:

RQ1a: What does "PDCA for the entire QMS" really mean?

RQ1b: How can the key clauses of ISO 9001:2015 be best aligned to PDCA theoretically?

RQ1c: What is the relationship between the key clauses of ISO 9001:2015, PDCA, and QMS Results?

RQ2: Does ISO 9001:2015 have the same acceptance across cultures and regions?

The first research question (RQ1) can be answered once the ISO 9001:2015 process model has been advanced into a testable theoretical model that explains how QMS Results are caused. The three sub-questions of RQ1 are meant to facilitate this process. As mentioned in the previous chapter, the researcher views the ISO 9001:2015 process model as a crude mock-up that explains the application of Plan-Do-Check-Act principle for the entire QMS to cause QMS Results.

The second research question (RQ2) can be answered once cultures and regions can be theoretically related to QMS Results and their antecedents — the antecedents being Plan, Do, Check, Act in relation to the entire QMS, based on the theoretical model that would be developed to answer RQ1.

The rest of this chapter is organised as follows. Section 3.2 summarises the assessment areas of the QMS, based on ISO 9001:2015. These assessment areas appear as key clauses of the standard. The summary provided in section 3.2 is based on the researcher's theoretical understanding of the standard and researcher's practical training on ISO 9001:2015 (Chapter 04). Section 4.3 covers development of the hypotheses that constitute the theoretical model that attempts to answer RQ1. The selection of indicators that represent the latent variables in the theoretical model is also covered in section 4.3. Section 4.4 covers development of hypotheses that attempt to answer RQ2. While countries and regions can be compared and contrasted through several variables — national culture, economic development, climate, political ideology —only national culture is considered for the formulation of hypotheses because that is arguably the only key variable that closely relates to acceptance of certain practices (in this study the practice of CI by adherence to the PDCA approach to the entire QMS) in an aggregate sense — that is at national level, rather than firm level. This study uses Hofstede's national culture dimensions (Hofstede, 1980a) to operationalise national culture as an explanatory variable of CI and QMS Results. The study also compares regional mean scores of the theoretical constructs (QMS-wide Plan, Do, Check, Act, and QMS Results) to answer RQ2 more fully. Finally, section 4.5 provides a summary of this chapter.

3.2 SUMMARISING THE KEY ASSESSMENT AREAS OF IS0 9001:2015

The ISO 9001:2015 standard consists of ten clauses. Barring the first three clauses, which are generic in nature, the remaining clauses of the standard stipulate certain requirements that organisations need to fulfil to accredit their QMS against the standard. The following brief description indicates what each key clause stipulates as a compliance requirement on the QMS (more details in section 1.4.1 of Appendix 1).

Context of the Organization (Clause 4): This clause requires an organisation to: (a) understand internal and external issues that needs to be considered as part of strategic planning; (b) understand the expectations of the interested parties; (c) determine the boundaries of the QMS; and, (d) determine the processes required to maintain and improve the QMS, and delegate authority for staff to execute the processes.

Leadership (Clause 5): This clause requires the leadership to: (a) demonstrate their commitment to achieve the goals of the QMS; (b) demonstrate customer focus; (c) establish and implement quality policy; and, (d) assign authority and responsibility for people to ensure that the requirements of the standard and the intended outputs are met.

Planning (Clause 6): This clause requires the organisation to: (a) plan actions to reduce risk and exploit opportunities; (b) establish quality objectives commensurate with the quality policy; and (c) establish plans to accommodate actions into QMS process and changes to the QMS.

Support (Clause 7): This clause requires the organisation to provide the necessary human and physical resources, infrastructure, and a climate to execute the processes covered under operations.

Operation (Clause 8): This clause requires the organisation to: (a) implement the processes required to meet the product/service specifications and other requirements; (b) maintain the required customer communication for production and delivery; (c) maintain requisite design and development inputs, controls, outputs, and changes; (d) control products, processes and services provided externally; and (e) conduct quality control of product and services provided (within and outside the boundary of the QMS such as delivery).

Performance Evaluation (Clause 9): This clause requires the organisation to: (a) determine what needs to be measured, when and how; (b) evaluate customer satisfaction; (c) conduct internal audits; and, (d) conduct management reviews of QMS performance, inputs, and outputs.

Improvement (Clause 10): This clause requires the organisation to respond to nonconformities through corrective and preventive actions and continually improve the effectiveness of the QMS.

3.3 CONVERTING THE ISO 9001:2015 PROCESS MODEL INTO A TESTABLE THEORETICAL MODEL

3.3.1 Key Considerations Relevant to the Process Model

3.3.1.1 The Process Approach, Risk-based Thinking, and PDCA

As mentioned in the previous chapter, according to the ISO, the ISO 9001:2015 standard rests on three key pillars: *the process approach, risk-based thinking, and PDCA* (ISO, 2015b). The process approach in the standard highlight the need to identify, define and plan the core processes needed for the effectiveness of the QMS, the interactions between the processes and their inter-relationships. Risk-based thinking is built into the process approach to address risk (positive and negative), particularly when establishing the processes needed to achieve QMS goals and objectives. The PDCA approach of a CI cycle is built into the process approach to manage and improve performance, both at individual process level as well as system level (ISO, 2015b; Tricker, 2016). The process approach covers several key steps, and most of these key steps cover the Plan phase of the PDCA cycle, spanning across certification requirements stipulated in several ISO 9001:2015 clauses.

3.3.1.2 Small PDCA and Big PDCA

The PDCA cycle was reviewed in detail in the previous chapter, especially in relation to a specific quality improvement initiative. For example, the quality improvement team may find the existing defective rates of a particular product unacceptable and the improvement team may adopt the PDCA approach to rectify the problem. This this study, the use of the PDCA approach for such an improvement indicative is referred to as the small PDCA approach. Likewise, in this study the big PDCA approach is the application of the PDCA for the entire QMS. It must be said that the phrases “big PDCA” and “small PDCA” are not phrases coined by the researcher. These phrases have been browed from the literature. The phrase big PDCA is often used when PDCA remains the model that underpins the overall performance management system of an organisation (Du, Cao, Ba, & Cheng, 2008; Pu, 2014), or when PDCA remains the means by which a high-level management systyem is developed. For example, Liker and Morgan (2011) use the phrase to describe Ford’s overall product development system based on Lean management. Similarly, Ye-jiao, Qing-gui, Wen-cai, Zhi-chao, and Dong-mei (2011) use the phrase to describe the development of the overall safety management system in the mining industry. Within a big PDCA cycle, several small PDCA cycles operates to achieve a high level objective (Du et al., 2008; Liker & Margan, 2011; Pu, 2014).

In Chapter 2, the activities involved in the Plan, Do, Check, Act stages of a quality improvement project (small PDCA) were reviewed based on the extant literature (e.g. Gorenflo & Moran, 2010; Lovitt, 1997; Moen & Norman, 2010; Summers, 2010; Taylor et al., 2014). Likewise, the activities involved in in the Plan, Do, Check, Act stages of big PDCA were covered based on the literature published by the ISO (ISO, 2015c). Table 3.1 puts small PDCA activities side-by-side with big PDCA activities.

Table 3.1: Plan, Do, Check, and Act Activities in Small PDCA vis-à-vis Big PDCA

QI Phase	Small PDCA	Big PDCA
Plan	• Identify and prioritize opportunities • Develop aim statement • Describe the current process • Collect data on current process • Identify all possible causes • Identify potential improvements • Develop improvement theory • Develop action plan	• Setting strategic quality objectives from the quality policy • Establishing processes required to meet the objectives (this includes identifying interactions between the processes) • Determining activities required for each process (risk assessment is part of establishing these planned activities) • Establishing measurement criteria to examine the effectiveness of the processes • Acquiring and developing resources for the processes (activities)
Do	• Implement the improvement • Collect and document the data • Document problems, observations, and lessons learned	• Implementing the planned activities
Check	• Reflect on the analysis • Document problems, observation, and lessons learned	• Checking the effectiveness of the processes
Act	• Depending on what transpired in the check stage, either adopt the solution, or adapt (modify) the solution (revert to do), or abandon the solution to start a new improvement cycle from "Plan"	• Making necessary adjustments to the processes to keep improving QMS Results

Whether one is referring to the small PDCA or the big PDCA (Table 3.1), the following questions needs to be answered, given that improvement takes place because of implementing planned activities.

(a) Apart from the obvious relationship Plan → Do, what other direct and indirect relationships exist within the PDCA cycle?

(b) Out of the four stages Plan, Do, Check, Act, what directly relates to results?

With regard to big PDCA, by “results”, the researcher means QMS Results.

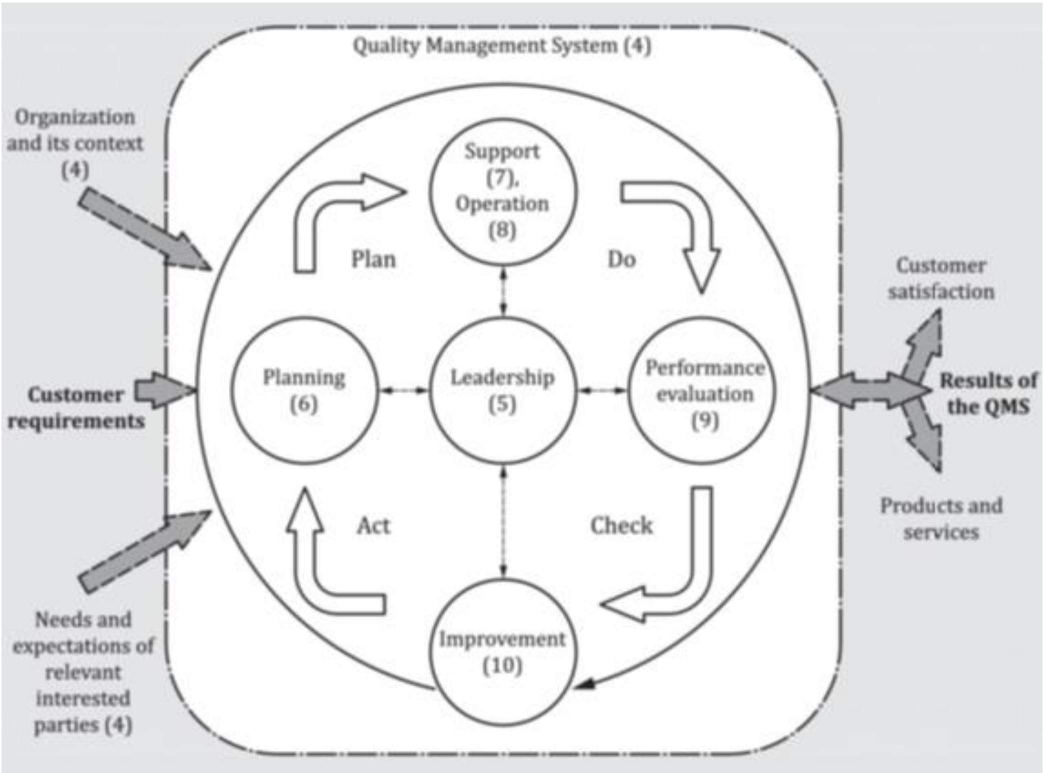

Figure 3.1: ISO 9001:2015 process model (Source: ISO, 2015b)

The ISO 9001:2015 process model, depicted in Figure 3.1 above suggests in a somewhat convoluted fashion how the key clauses of the standard are related to Plan, Do, Check, Act phases (from a big PDCA sense) and how these phases result in QMS Results. None of the direct and indirect causal paths are apparent in the ISO 9001:2015 process model, which is meant for practitioners as a way of demonstrating the integrated nature of the key clauses of ISO 9001:2015.

3.3.1.3 Plan in Big PDCA is Leadership Driven

Whether one is referring to small PDCA or big PDCA (Table 3.1), one thing is clear. That is, relative to Do, Check, and Act, Plan is front loaded with several activities. Plan is big PDCA means: (i) setting strategic quality objectives from the quality policy; (ii) establishing processes required to meet these objectives, which includes identifying interactions between the processes; (iii) determining activities required for each process where risk assessment is part of establishing these planned activities; (iv) establishing measurement criteria to examine the effectiveness of the processes; and (v) acquiring and developing resources for the processes activities (ISO, 2015c). Of these activities, setting strategic quality objectives from the quality policy and establishing processes required to meet these objectives remains reasonably invariant (no frequent adjustments are needed), but the remaining activities associated with Plan need timely adjustments. In any case all the activities are pitched at strategic level and as such being driven by the leadership (Al-Mahasneh et al., 2020; Biswas, 2019; Gonzalez, 2016; Hammer, 2020; ISO, 2015). For this reason, the researcher uses the phrase *"leadership driven QMS planning"* (LDQMSP) to mean Plan in big PDCA. The central nature of the leadership is also implied in the ISO 9001:2015 process model.

3.3.1.4 Results of the QMS

Justifiably, the ISO 9001:2015 process model depicts results of the QMS (in this study referred to as QMS Results) as the final effect variable, but as mentioned earlier, what is not clear which of the four stages — Plan (LDQMSP), Do, Check, and Act — of PDCA are directly related to QMS Results. This ambiguity can be cleared by taking the four stages one at a time and examining/questioning whether each stage alone can bring about QMS Results. For example, clearly LDQMSP cannot have a direct relationship with QMS Results because any plan is no good unless it is being implemented. The causal antecedents of QMS Results as well as causal antecedents of Do, Check, and Act (in relation to big PDCA) are posited in section 3.3.2, as part of building the researcher's theoretical model to answer RQ1.

3.3.1.5 Bi-directional Relationships in the ISO 9001:2015 Process Model

In total quality management and business excellence (BE) models (e.g. Deming Management Model, Baldrige Criteria for Performance Excellence Framework, EFQM Excellence Model) represent CI as an outcome, but researchers have not statistically tested CI as a complete cycle. On the same token, there are many implied bidirectional relationships in these models. For example, in the empirical validation of the implied causal relationships of the original Baldrige Criteria for Performance Excellence as well as its revised versions, Flynn and Saladin (2001) treated all implied bidirectional relations and feedback loops as unidirectional, in keeping with the logic of quality management. Subsequent studies on the same or similar models by other researchers (e.g. Bou-Llusar, Escrig-Tena, Roca-Puig, &

Beltrán-Martín, 2009; Parast & Golmohammadi, 2019; Peng & Prybutok, 2015) followed the same logic.

3.3.2 Positing the Theoretical Model that Predicts and Explains QMS Results

The theoretical model is derived by examining the antecedents of Do, Check, Act, and QMS Results, within the big PDCA approach. Since QMS Results via continuous improvement is driven by LDQMSP, the researcher treats the latter variable as an exogenous variable to fall in line with management systems models (Anderson, Rungtusanatham, & Schroeder, 1994; Bou-Llusar et al., 2009; Evans & Jack, 2003; Flynn and Saladin, 2001; Wilson & Collier, 2000). Of course, one can argue that in a strict sense, LDQMSP is not an exogenous variable, because the process act can loop-back to Plan (LDQMSP), when the decision is to "adapt" (Dale et al., 2007; Deming, 1986; Moen & Norman, 2010), meaning modifying the plan to run another iteration of the PDCA. Also, one cannot rule out the possibility of looping back to Do, if the modification is minor (Gorenflo & Moran, 2010). Although having the above such feedback loops is real in management practice, testing such relationships using causal models (technically known as non-recursive models) brings about serious technical problems (Folmer et al., 2012; Hair Jr, Hult, Ringle, & Sarstedt, 2016; Kline, 2011). In management systems models, feedback loops operate between "business results" and the processes that yield those results, as well as more upstream causal variables such as leadership and strategy. However, in causal modelling, such feedback looks are not modelled due to technical reasons.[14] Thus, the researcher argues that treating LDQMSP as an exogenous construct is not an ad hoc decision.

Causal Antecedents of DO (big PDCA)

Do, in "big PDCA" (Du et al., 2008; Pu, 2014) means implementing the planned activities included under LDQMSP (see Table 3.1) (Al-Mahasneh et al., 2020; ISO, 2015; Tricker, 2016). This gives rise to the first hypothesis:

H_1: LDQMSP has a direct effect on Do

[14] Of course, one can argue that this reductionist approach (oversimplification of reality to facilitate hypothesis testing) is an inherent weakness in positivism.

Causal Antecedents of CHECK (big PDCA)

Check, in big PDCA means checking the effectiveness of the processes set out in LDQMSP (see Table 3.1) (ISO, 2015c; Tricker, 2016). Thus, Check is dependent not only on what was implemented (Do), but also on LDQMSP, in the sense, once one implements the planned activities (Do), the only way to compare the effectiveness is these planned activities is to compare the outcome with the planned activities themselves (ISO, 2015; Summers, 2010).

These reasoning give rise to the second and third hypotheses:

H_2: Do has a direct effect on Check

H_3: LDQMSP has a direct effect on Check

Causal Antecedents of ACT (big PDCA)

Act in big PDCA means making necessary adjustments to the plans and processes to keep improving QMS Results (see Table 3.1) (ISO, 2015c; Moen & Norman, 2010; Tricker, 2016). Of course, in some instances no adjustment is needed (i.e. "adopt"), but in many instances some adjustment is needed (i.e. "adapt" by reverting to Do stage or to plan stage) or a complete redesign of processes is needed (i.e. abandon the Plan) to improve the QMS Results (ISO, 2015c; Lovitt, 1997; Moen & Norman, 2010; Tricker, 2016). The appropriate action thus depends on the processes set out in LDQMSP, how the processes were implemented (Do), and what transpired at the at the Check stage. These reasoning give rise to three more hypotheses:

H_4: Check has a direct effect on Act

H_5: Do has a direct effect on Act

H_6: LDQMSP has a direct effect on Act

Causal Antecedents of QMS Results (big PDCA)

As mentioned earlier, LDQMSP itself does not directly affect results, because to achieve results, at a minimum, the planned processes need to be implemented, which is only covered in the Do stage. On the same token, checking itself makes no direct impact on QMS Results, unless appropriate action, is taken which is only covered in the Act stage. This said, according to Deming (1986) and his followers, Check is a phase where considerable amount of organisational learning takes place (Dale et al., 2007; Gorenflo & Moran, 2010; Moen & Norman, 2010). A direct effect on organisational learning on QMS Results is conceivable (Garvin, Edmondson, & Gino, 2008; Senge, 1990). However, several enabler criteria are needed for organisational learning to take place (Armstrong & Foley, 2003; Garvin et al., 2008; Senge, 1990; Watkins & Marsick, 1993), which are beyond the considertaion of big PDCA conceptualisaion captured in the ISO 9001:2015 process model. As such theorisaion of a direct effect of Check on QMS Results is exclused in the resercher's theoritical model (Figure 3.2).

These reasoning give rise to the seventh and eighth hypotheses respectively:

H_7: Do has a direct effect on QMS Results

H_8: Act has a direct effect on QMS Results

The above eight hypotheses constitute the researcher's theory on achieving QMS Results. This theory is represented as a model in Figure 3.2. The model consists of five theoretical constructs: LDQMSP, Do, Check, Act, and QMS Results. In the next sub-section the researcher aligns the key clauses of ISO 9001:2015 with the theoretical constructs LDQMSP, Do, Check, and Act. This alignment is necessary to operationalise the constructs.

3.3.3 Alignment of Key ISO 9001:2015 Clauses with the Theoretical Constructs

In the previous chapter (specifically in sub-section 2.4.4) researcher summarised literature that allocate the seven key clauses of ISO 9001:2015 (Clauses 04 through to 10) to Plan (in this study LDQMSP), Do, Check and Act phases of improvement (see Table 2.4). The literature reviewed (ABCI Consultants, 2020; Al-Mahasneh et al., 2020; Biswas, 2019; Gonzalez, 2016; Hammer, 2020; ISO, 2015) were unanimous in arguing which ISO 9001:2015 clause Check represents (Clause 09), and which clause Act represents (Clause 10). Having reviewed the contents of the key clauses (section 3.2) and having understood the interplay between the five theoretical constructs, it is clear that there is no ambiguity with the indicators of Check and Act. Since Do means implementing the planned processes, the literature is unanimous in assigning Clause 08 (Operation) as an indicator of Do. However, unlike many other authors, the ISO also assigns Clause 07 (Support) also to Do (ISO, 2015c). However, review of the contents in Clause 07 (section 3.2) clearly suggests that Clause 07 covers the provision of necessary human and physical resources, infrastructure, and a climate to execute the processes in the operations. As such clause 07 should be assigned to LDQMSP.

The next question is, other than clause 07, what other clauses are needed to represent LDQMSP, which is a heavily front-loaded construct. It is clear from the literature reviewed (ABCI Consultants, 2020; Al-Mahasneh et al., 2020; Biswas, 2019; Gonzalez, 2016; Hammer, 2020; ISO, 2015) that the other clauses that represent LDQMSP are Clauses 04, 05, and 06.

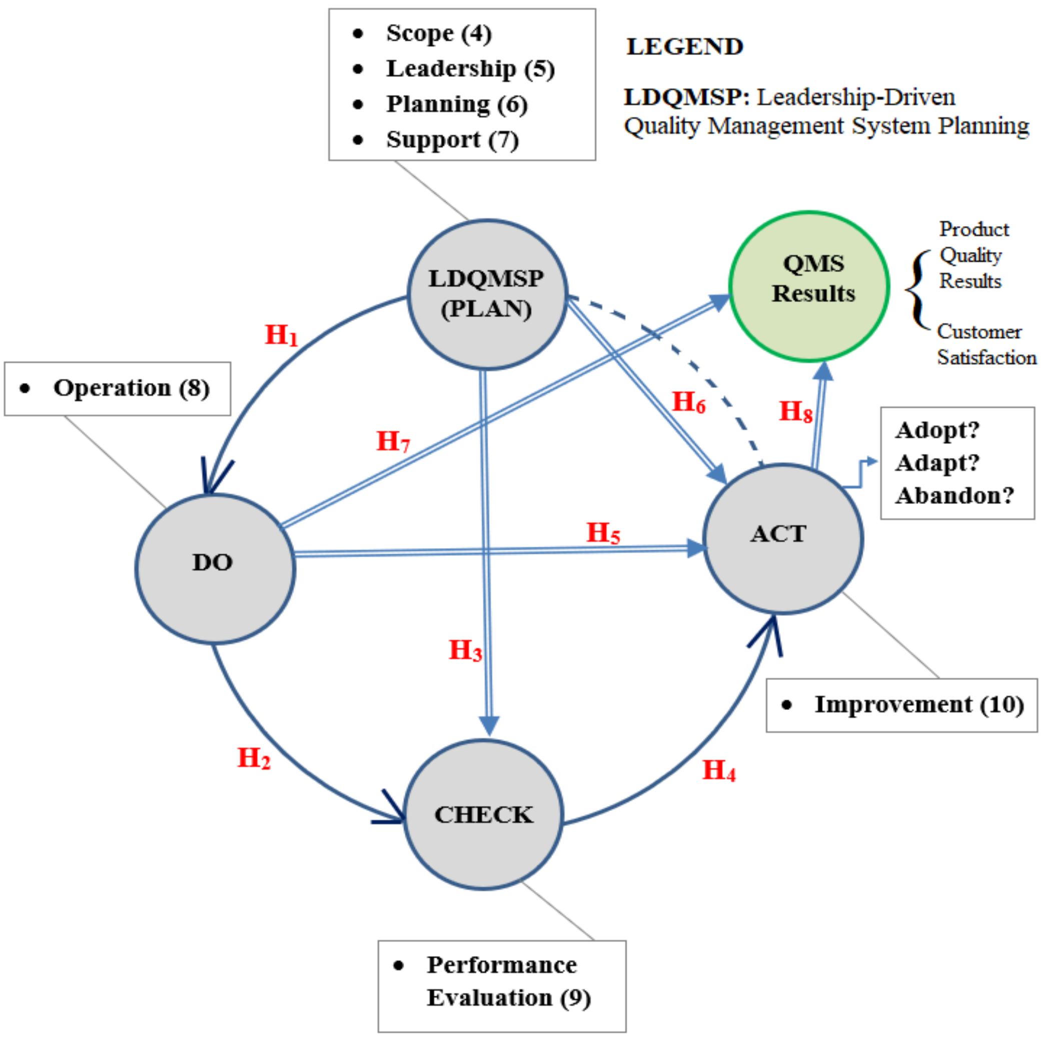

Figure 3.2: The theoretical model underpinning the ISO 9001:2015 process model

Now, having assigned the key clauses of ISO 9001:2015 to LDQMSP, Do, Check, and Act, the only other requirement that needs to be fulfilled in correcting data to test the eight hypotheses is to develop operational definitions for the constructs. The researcher used international experts who are deeply knowledgeable about the contents of the key clauses of ISO 9001:2015 to develop these operational definitions. This is covered in the next chapter (details in section 4.4).

3.4 ISO 9001 BASED CI VERSUS NATIONAL CULTURE

This section derives the theoretical models required to answer the second research question (RQ2). Hofstede's framework is used in this study and justifications for selecting Hofstede's framework over its rival framework (the GLOBE framework) have been provided in Chapter 03 (section 3.3.4).

Scholars have given a great deal of attention to CI as a tried and tested strategy in achieving overall organisational performance (Nilsson-Witell, Antoni, & Dahlgaard, 2005). Nevertheless, some nations seem to have mastered CI methodologies better than the others, which have in turn lead to quality improvements of products and processes of some nations compared to other nations (e.g. Japan compared to the western nations) (Flynn & Saladin, 2006; Hofstede, 1991). There is a well-known saying in TQM that "quality is the state of mind" (Grayson & O'Dell, 1988); that is to say that the "attitudes" of the people involved in quality improvement in an organisation brings significant improvements to the outcomes. This necessitates CI of organisational processes and outcomes (e.g. reduced defects rates, reduced variation), which in turn lead to customer satisfaction and customer loyalty (Koval, Nabareseh, Chromjaková, & Marciniak, 2018; Matzler, Hinterhuber, Bailom, & Sauerwein, 1996).

According to Hofstede, peoples' values are crucial in shaping their behaviour, attitudes and character; moreover, societal and national cultures are built upon shared core values of the people in it (Hofstede, 1991, 2011). Taking this as the starting point, many studies have attempted to study how different cultures differ in incorporating quality principles and concepts, based on CI and related concepts such as Business Excellence (Flynn & Saladin, 2006; Jayamaha, Grigg, & Mann, 2009), Lean/Toyota Way (Jayamaha et al., 2017), TQM (Jung et al., 2008; Kumar & Sankaran, 2007), ISO 9001 (Manders, 2015; Mathews et al., 2001; Pallawala, Jayamaha, & Grigg, 2016,2019) and Lean Six Sigma (Jacobs, 2014).

As mentioned in section 3.3.1, Hofstede's national culture dimensions are rooted in the values; these culture dimensions together are also referred to as the "cultural value framework" (Hofstede, 2011). For the researcher's study purposes, among six dimensions identified by Hofstede, only three — Power Distance, Individualism and Uncertainty Avoidance — have been considered in the empirical analysis. One reason for confining to only three culture dimensions is that based on Hofstede's culture scores reported for various countries (Hofstede, 2011) the five countries considered in the researcher's study show variability only among the aforesaid three dimensions. Another reason for excluding some Hofstede's culture dimensions (e.g. Indulgence, which was a new cultural dimension discovered by Hofstede) is that it is difficult to formulate hypotheses on the relationships between these dimensions and CI based on the extant literature. The next three subsections outline how each of the three Hofstede's culture dimensions were theoretically related to CI.

3.4.1 The Effect of Power Distance on CI

Hofstede defines power distance (PDI) as the acceptance of the unequal distribution of power by the members in the lower power levels in the hierarchies of societies, organisations or institutions (Hofstede, 1980a). What this implies is that while PDI can vary within organisations of the same society (within group variation), a representative sample of organisations in one society could show a significant difference in PDI to another society (between group variations). Accordingly, Hofstede categorises countries (more precisely cultures/societies) as high PDI, moderate PDI and low PDI, for the purpose of studying cultural phenomena (Flynn & Saladin, 2006; Hofstede, 2011; Lagrosen, 2003; Recht & Wilderom, 1998). However, Hofstede treats PDI as a continuous variable (i.e. a covariate rather than a factor having fixed levels). The score that Hofstede reports on a particular country on PDI (or any other dimension for that matter) can therefore be regarded as the mean score of PDI for all societal contexts or organisations within that country.

Interestingly, most studies on TQM and similar concepts/philosophies such as Business Excellence, Lean and Six Sigma treat PDI as an important cultural trait to study the cultural effects on quality and related concepts (Jung et al., 2008; Mathews et al., 2001). Since CI remains an underlying theme in TQM and similar concepts (Fonseca, 2015a), it is not surprising that PDI remains relevant to a study on CI. Many empirical studies that focused on the effect of PDI on quality management practices highlight the following behavioural characteristics: the nature of the leaders, the nature of their followers (in a management context the subordinates), and the nature of the relationship between the leadership and the followers (Flynn & Saladin, 2006; Jung et al., 2008; Manders, 2015; Mathews et al., 2001).

High PDI cultures are characterised by tall hierarchies, with each member observing their authority boundaries and knowing to who they must obey and seek guidance when needed (Hofstede, 1980a, 2011; Kumar & Sankaran, 2007). In such cultures, an autocratic leadership style becomes more prevalent and the leaders tend to exercise control over their followers more than their counterparts in low PDI cultures (Hofstede, 1980a, 2011). Correspondingly, the members in high PDI cultures have high tolerance for being controlled by their superiors; reciprocally, subordinates tend to be more obedient to their superiors (Hofstede, 1980a, 2011; Jung et al., 2008). In fact, subordinates in high PDI cultures perceive autocratic leadership as a blessing as they could be more dependent over their superiors in providing direction and guidance on workplace activities (Hofstede, 1980a, 2011; Jung et al., 2008). The opposite becomes true for low PDI cultures, which have short and flat structures (less hierarchical levels). The members in low PDI cultures are reluctant to seek superior opinions, and perceive close supervision being annoying and disrespectful for their self-esteem and independence (Hofstede, 1980a, 2011; Jung et al., 2008; Mathews et al., 2001).

In terms of the nature of the superior-subordinate relationships, in high PDI cultures, power is centralised around managers and the role of the manager becomes apparent and strong (Hofstede, 1980a; Lagrosen, 2003). Hence, management involvement is high on all major tasks such as planning, decision-making, and acting on immediate circumstances. Reciprocally, the employees are bound to do what they have been asked to do (Kanagaretnam, Lim, & Lobo, 2011; Kumar & Sankaran, 2007). Therefore, superior-subordinate relationships in high PDI cultures are more likely to be formal, but strongly bonded. In low PDI cultures on the other hand, power is more distributed among employees and hence employee engagement and level of responsibility assumed by the employees becomes high (Naor et al., 2010; Robert, Probst, Martocchio, Drasgow, & Lawler, 2000). Therefore, in low PDI cultures, the roles of organisational members are being less defined and consequently, the manager’s role is less powerful and hidden (Hofstede, 2011). The superior-subordinate relationship in such cultures is friendly and less formal (Tyler, Lind, & Huo, 2000), and hence less tightly bound. The superiors’ characteristics, the subordinates’ characteristics as well as superior-subordinate relationships discussed above on different PDI cultures are linked to CI and related proxies as follows.

CI is defined as an ongoing effort of aggregating small improvements into any quality related aspect (Recht & Wilderom, 1998). Since CI is an ongoing approach, CI process need a strong enforcement and support from the superiors (Imai, 2007). In addition, because CI is a collective process of small-step improvements, supervision of each step becomes crucial for the success of the next step. This is mainly because the benefits of CI programmes take a long time to eventuate (Imai, 2007; Jayamaha et al., 2014; Sanchez & Blanco, 2014). The implication of this is that strong involvement of the leadership at every stage of CI activity facilitates the implementation of CI programmes. On the other hand, strong leadership involvement would not be sufficient if the subordinates are reluctant to follow (or comply with) the orders and commands being given to them by their superiors (Jung et al., 2008). This indicates that both a dominant leadership and wilful acceptance of the leaders' authority on the part of the subordinates enable better adoption of CI strategies and methodologies (Jung et al., 2008; Recht & Wilderom, 1998). Both conditions become prevalent in high PDI cultures than in low PDI cultures (Hofstede, 1980a; Jung et al., 2008).

For the above reasons, it is argued that high PDI cultures have greater acceptance for CI compared to low PDI cultures. This (coupled with the fact that CI is manifested as PDCA in the ISO 9001:2015 process model) leads to the following hypothesis:

H_9: There is a greater acceptance for continual improvement (in a PDCA context) in high PDI cultures than in low PDI cultures

Since CI is manifested via the four steps of PDCA (Plan → Do→ Check → Act), it is important to show that H_{22} can be partitioned into sub hypotheses involving PDI as the explanatory variable and each step of PDCA as the dependant variable.

PLAN vs PDI

In TQM and related concepts that are built upon the premise of CI, the PDCA approach becomes a primary tool in implementing CI (Deming, 1986; Sokovic et al., 2010). Since PDCA is cyclical, it is implied that the PDCA approach continuously seeks better ways to improve quality (Sokovic et al., 2010). *Planning* is mostly a top-level activity, and this becomes more so when high-level planning is involved (Flynn & Saladin, 2006). A stronger, well-defined managerial role is more conducive for defining and setting objectives and putting forward good action plans for them (Flynn & Saladin, 2006). In contrast, organisations that rely on self-coordination hinder the clarity of the superiors' role, which may lead to more conflicts (Jung et al., 2008). For above reasons, leadership role in high PDI cultures is in the favour of "Plan" (in this study, more specifically, LDQMSP) within a PDCA context. Thus:

H_{9a}: There is a greater acceptance for Plan (in a PDCA context) in high PDI cultures than in low PDI cultures.

DO vs PDI

"Do" in a PDCA context is simply putting the planning activities into action — that is, implementing the plans (Sokovic et al., 2010). In such approach leadership and employee relationships tends to be crucial. Employees in high PDI cultures are more obliged and inclined to accept the plans put in place by their superiors and they would be corporative with the superiors in implementing these plans (Jung et al., 2008). In high PDI cultures, more supervision and guidance would boost implementation activities while in low PDI cultures more supervision and guidance tend to be destructive.[15] This is because employees in low PDI cultures are more independent and self-coordinated; they would be reluctant to implement orders given by their superiors without reasoning (Jung et al., 2008). Further, as reported by Jung et al. (2008), implementation of strategic planning needs more enforcement in low PDI cultures, although it could be argued that planning activities within a PDCA cycle and planning corporate strategies are not the same. It is concluded that employees in high PDI cultures are better oriented towards DO than their counterparts in low power PDI cultures. Thus:

H_{9b}: There is a greater acceptance for Do (in a PDCA context) in high PDI cultures than in low PDI cultures.

[15] The exception being certain ambiguous task situations. This has been covered under Hofstede's Uncertainty Avoidance dimension.

CHECK vs PDI

In a PDCA context, what being done need to be *check*ed for the conformance (Sokovic et al., 2010). Use of suitable techniques for inspection and measurement and use of statistical analysis methods for the measurement analyses are fundamental in floor-level activity of quality improvement (Deming, 1993b). When these "Check" activities are being carried out in strong supervisory climates, such activities receive greater acceptance by the subordinates (Wacker & Sprague, 1998; Anh, Yen, & Matsui, 2015). According to Wacker and Sprague (1998), high PDI cultures have a higher likelihood of applying statistical methods and computer technology to facilitate checking aspects in quality. Thus:

H_{9c}: There is a greater acceptance for Check (in a PDCA context) in high PDI cultures than in low PDI cultures.

ACT vs PDI

Act in a PDCA context means taking corrective action on nonconformances and making preventive action to prevent the occurrence of nonconformances. The latter is being accomplished by identifying potential future risks and their impact and taking action to mitigate these risks through risk analysis (ISO, 2015b). Such an approach needs making difficult and crucial decisions, where managerial involvement becomes important. Furthermore, managerial decisions would become more effective and practical if these are taken based on the facts and information — that is, a climate in which fact-based-decision making is being greatly appreciated (Tort-Martorell, Grima, & Marco, 2011). Since the power is centralised around top-level managers in high PDI cultures, managers have more freedom and opportunities to Act (Hofstede, 1984). Hence, managers in high PDI cultures have a greater tendency of gathering information to Act compared to their counterparts in low PDI cultures. In addition, communication becomes essential in gathering information and implementing decisions (i.e. Act) promptly (Flynn & Saladin, 2006). High PDI cultures facilitate the information flow through clearly laid down employee roles; clarity in employee roles enable efficient communication, as employees know what they are supposed to do and who they need to contact to seek help and support when needed. It is therefore argued that there is a greater likelihood of making sound decisions (i.e. taking corrective and preventive actions) through well-established communication channels in a superior–subordinate relationship typically prevalent in a high PDI culture. In contrast, employees in low PDI cultures need more self-coordination as roles become less clear in such cultures.

In addition to above, employees in low PDI cultures are more empowered and involved in the decision-making process. Hence the employees in low PDI cultures often make decisions based on their own judgement, which could lead to conflicts (Robert et al., 2000). Also, since employees in low PDI cultures tend to be self-oriented and comfortable with lack of interference from their superiors, there is a tendency for employees to get themselves alienated from the workplace, which could constrain access to information needed for quality improvement. In other words, leader–subordinate relationships in a low PDI culture could hinder the communication flow to undermine the Act process. Thus:

H_{9d}: There is a greater acceptance for Act (in a PDCA context) in high PDI cultures than in low PDI cultures.

3.4.2 The Effect of Individualism-Collectivism on CI

Hofstede (2011) introduces the individualism-collectivism dimension (IDV) as a behavioural measure that represents two ends of a continuum: highly individualistic behaviour on one extreme and highly collectivistic behaviour on the other extreme. IDV is defined as the degree to which people in a society are integrated into groups. Individualism refers to lose within-group ties in relation to an individual while collectivism refers to high within group (hence collective) ties in relation to an individual.

Similar to PDI discussed in the previous section, IDV has gained much attention as an important culture dimension to study effect of national culture on quality management approaches such as TQM (e.g. Jung et al., 2008; Mathews et al., 2001), Business Excellence (Flynn & Saladin, 2006), Lean (e.g. Jayamaha, Wagner, & Grigg, 2014), Six Sigma (Jacobs, 2014) and other similar philosophies (Manders, 2015; Mueller, Rosenbusch, & Bausch, 2013). The literature suggests that IDV affects deployment of quality management practices in a workplace in three ways: behaviour and attitudes of leaders towards their employees; behaviours and attitudes of employees towards group success vs individual success; and nature of the leaders-employees and employee-employee relationships (Jung et al., 2008; Kanagaretnam et al., 2011; Manders, 2015; Wendt, Euwema, & Van Emmerik, 2009).

Behaviour and Attitudes of Leaders Towards Employees

Drawing inferences from path goal theory House (1996), and Wendt et al. (2009) discussed the effectiveness of two key leadership behaviours — *Directive Leadership* and *Supportive Leadership* — in individualistic cultures vis a vis collectivistic cultures to argue that both leadership styles better fit a collectivistic culture. Wendt et al. also assert that other leadership styles such as Participative Leadership or Transformational Leadership better fit the individualistic cultures. Characteristics of directive leadership behaviour are being autocratic and dominant (exercising more control over the employees) over all important task-related decisions pertaining to the organisation and its performance (Cruz, Henningsen, & Smith, 1999; Wendt et al., 2009). Thus, directive leadership is more "task-oriented" (See Wendt et al., 2009, p. 359), where directing and tight monitoring of the performance of the subordinates on target accomplishment is rife (Wendt et al., 2009). Directive leadership better fits collectivistic cultures compared to individualistic cultures in general; stated alternatively, directive leadership is less appreciated in individualistic cultures as that leadership style tends to result in conflicts (Dickson, Hartog, & Mitchelson, 2003; Hofstede, 2001). Supportive leadership behaviour is more sensitive towards followers' emotions and this leadership style provides more space to listen to subordinates (House, 1996). As such, employee welfare is given priority over the material success. Therefore, friendly work environment is inevitable under such leadership behaviour. It is argued that supportive leadership behaviour is more prevalent in collectivistic cultures than individualistic cultures (Wendt et al., 2009).

It is important to note that according to path goal theory, directive leadership style or supportive leadership style is effective in motivating employees and workplace productivity only when the employees' tasks are highly structured, for example, having clearly written down procedures, work instructions and even job descriptions (House, 1996). In articulating the path goal theory, House (1996) asserts that these leadership styles would work against employee motivation and workplace productivity, if employees have to engage in very unstructured tasks (e.g. research and development dominant or innovation-oriented organisational environments). It is argued that ISO 9001:2015 favours structured task environments as opposed to unstructured task environments, and hence the standard better fits to collectivistic cultures than to individualistic cultures.

Behaviours and Attitudes of Employees Towards Group Success vs Individual Success

The behaviours and attitudes of employees towards group success as opposed to an individual's success is also an important consideration in organisational behaviour. In individualistic cultures, individuals value self-interest and they are motivated by their personal success; hence reward and recognition commensurate with an individual's effort is expected in individualistic cultures (Earley, 1993; Hofstede, 2011). Consequently, an individual's contribution towards group targets and success is considered less important in individualistic cultures (Earley, 1993; Winkler et al., 2008). In contrast, individuals in collectivistic cultures place more attention to group goals over personal-targets and are motivated by group achievements. Individual contribution toward group success is considered important in collectivistic cultures but rewarding and recognising the entire group is appreciated in collectivistic cultures (Early, 1993; Winkler et al., 2008; Hofstede, 2011).

Leader-Employee Relationships and Employee-Employee Relationships

The nature of the relationships between leaders and employees as well as employees and employees are arguably the most important characteristic relevant to explaining the success of quality deployment. Leaders in collectivistic cultures, as discussed above, tend to show either a directive behaviour or a supportive behaviour or a mixture of both toward their subordinates, and hence display more paternal behaviour towards employees, rather than a formal relationship (Wendt et al., 2009). Collectivistic cultures are more people-oriented and hence relationships come ahead of tasks where employee well-being is prioritised, building more trust between leaders and followers (See Hofstede, 2011, p. 11; Sousa-Poza et al., 2001). In contrast, relationship between leaders-employees in individualistic cultures is more likely to be formal and leaders are more results-oriented and hence "task prevails over relationships" (See Hofstede, 2011, p. 11; Sousa-Poza et al., 2001). On the other hand, employees in collectivistic cultures are more obedient and loyal to their superiors and also, they are more attached to the organisation; therefore, the employees work towards achieving organisational goals rather than their personal goals (Hofstede, 2011; Kumar & Sankaran, 2007). Employees in collectivistic cultures are committed towards maintaining long-term relationships with their organisation (Kumar & Sankaran, 2007). In contrast, employees in individualistic cultures are more independent and work toward own-goals and own-success;

consequently, long-term commitment and loyalty towards the organisation is less in such cultures (Hofstede, 2011; Pagell et al., 2005). Further, employees in individualistic cultures are more empowered and value self-autonomy; hence they tend to challenge superiors' decisions, although this is not necessarily dysfunctional (Kumar & Sankaran, 2007).

In terms of employee-employee relationships, individuals in collectivistic cultures show more caring and sharing among fellow members and emphasis on personal goals is constrained by the commitment towards the group success (Hofstede, 2011; Oyserman, Coon, & Kemmelmeier, 2002). In collectivistic cultures, responsibility is shared among fellow members in the group and any failure of group gives guilty feeling to them. The opposite is true for individualistic cultures where individuals are more self-oriented and independent and self-responsibility is highlighted over the group commitment (Pagell et al., 2005).

Having discussed the characteristics of IDV, following sections argue how IDV relates to CI.

As discussed already in section 4.4.1, being an ongoing approach, CI needs strong involvement and commitment of both superiors and subordinates. Directive Leadership prevalent in collectivistic cultures emphasises on being task-oriented and strict on timely completion of given tasks; leaders become more involved and committed towards setting goals and targets as well as ensuring that these are being achieved. Moreover, directive leaders, as name implies, direct their employees towards achieving the goals and they closely monitor the progress of their followers (Wendt et al., 2009). Consequently, nonconformities are identified very quickly in collectivistic cultures, thus intensifying CI activities. As opposed to their counterparts in collectivistic cultures, leaders in individualistic cultures tend to be less dominant, allowing individuals' responsibility towards assigned work and their consequences (Pagell et al., 2005). Hence, leadership involvement and close supervision is not advocated in these cultures as much as in collectivistic cultures. Further, employees in collectivistic cultures are more obedient and loyal to their superiors (and the organisation); employees therefore tolerate strict rules and regulations imposed upon by the superiors and they have no resentment of being controlled and supervised by the superiors (Hofstede, 2011). As mentioned earlier, employees in collectivistic cultures tend to be more committed towards organisational success over self-satisfaction. The opposite is true for employees in individualistic cultures as these cultures value independence and self-autonomy (Kumar & Sankaran, 2007).

CI also requires ongoing learning supported by a training environment (Deming, 1993b). Supportive leadership style, another style that is prevalent in collectivistic cultures, tend to provide this ongoing learning and training environment for the followers (Wendt et al., 2009). Rather than giving orders and being results-oriented, Supportive Leadership tends to mentor and improve subordinates' skills set until they gain confidence and competence to work without leader's direction (Wendt et al., 2009). Same is not true for individualistic cultures as supportive leadership does not fit individualistic cultures (Wendt et al., 2009). Moreover, since sharing information and caring about fellow members is the norm of collectivistic cultures, learning from others and helping others in difficult situations to sustain the organisation would be prevalent in such cultures (Kumar & Sankaran, 2007) while the opposite is likely to be the case in individualistic cultures because individuals are more self-oriented (Winkler et al., 2008).

For the above reasons, it is argued that collectivistic cultures tend to provide more acceptance for CI activities compared to individualistic cultures. Thus:

H_{10}: There is a greater acceptance for continual improvement (in a PDCA context) in collectivistic cultures than in individualistic cultures.

As mentioned earlier (section 4.3.2), the PDCA approach remains the most widely used approach in implementing CI. How IDV relates to each step in the PDCA cycle is theorised as follows.

PLAN vs IDV

Directive leadership prevalent in collectivistic cultures emphasise on being task-oriented; clear goals and targets are set by the leaders, along with proper action plans for the employees (Flynn & Saladin, 2006; Wendt et al., 2009) in order to achieve on time completion of tasks. Further, Flynn and Saladin (2006, p. 589) argued that higher-level planning, such as "strategic planning" is more conducive in collectivistic cultures than in individualistic cultures, as collectivistic cultures provide a suitable environment for directive leadership behaviour. It is argued that the same is true for lower-level planning, such as Plan (more technically precisely, LDQMSP) in a PDCA context. Thus:

H_{10a}: There is a greater acceptance for Plan (in a PDCA context) in collectivistic cultures than in individualistic cultures.

DO vs IDV

As mentioned earlier, Do in a PDCA context refers to implementing the PLAN for improvement. The directive nature and close supervision on the part of superiors in collectivistic cultures facilitate better implementation of plans. Supportive leadership, which is also prevalent in collectivistic cultures, enables subordinates to carry out the planned activities, thanks to the training and learning environment created by the leaders. Further, employees in collectivistic cultures value respect and being loyal to their leaders creating a harmony among fellow members in working towards a common goal by executing action plans (Hofstede, 2011; Wendt et al., 2009). Moreover, group relationships in collectivistic cultures such as sharing and harmony creates a link between different divisions in the organisation overcoming the possible barriers for learning to implement plans (Naor et al., 2010). Thus, it is argued that the collectivism is positively related to DO, in a PDCA context. These arguments lead to the following sub-hypothesis:

H_{10b}: There is a greater acceptance for Do (in a PDCA context) in collectivistic cultures than in individualistic cultures.

CHECK vs IDV

As mentioned earlier, Check in PDCA context concerns measurement and analysis for conformance and performance (Sokovic et al., 2010). As directive leadership prevalent in collectivistic cultures is autocratic and is often based on leader-made decisions, strict tight monitoring of results becomes ubiquitous in such cultures (Wendt et al., 2009). Such tight monitoring of results favours measurement and analysis for conformance and performance and hence it is argued that collectivistic cultures tend to accept measurement and analysis techniques more readily compared to individualistic cultures (Jung et al., 2008). This is further supported by the findings of Jung et al. (2008, p. 630). They found that measurement and analysis are significantly negatively related to individualism and that "hard TQM elements" such as mechanical and physical quality control are more accepted in collectivistic cultures (on the other hand they found that "soft TQM elements" such as employee empowerment are more accepted in individualistic cultures). Thus:

H_{10c}: There is a greater acceptance for Check (in a PDCA context) in collectivistic cultures than in individualistic cultures.

ACT vs IDV

Finally, as mentioned earlier, ACT in PDCA context means taking corrective actions on nonconformances and making preventive actions to prevent the occurrence of nonconformances. The point in question is whether directive leadership that is synonymous with collectivistic cultures, favour Act. As mentioned earlier, autocratic leaders rely on their own opinions and observations for decision-making (Wendt et al., 2009). Such leadership characteristic hinders the employee initiatives to act and directive leaders do not encourage employee empowerment to take immediate action. This is supported by Wendt et al. (2009) who assert that "directive leader behaviour put employees in a dependent role, facilitating them to wait for the manager before acting …". However, because employees are loyal and they respect their leaders (in collectivistic cultures), they tend to follow the instructions and orders given by leaders, which means that Act is not hindered in collectivistic cultures (Hofstede, 2011; Wendt et al., 2009).

ACT in PDCA is more about correction and prevention of recurrence of nonconformances, timely action and effective communication among various divisions. Directive leaders are time-based managers (Wendt et al., 2009); sharing and harmony prevalent in collectivistic cultures facilitate communication among organisational divisions, mutual understanding among fellow members, and effective clarification of the processes (Naor et al., 2010). Hence, ACT seems to go hand in hand with collectivistic cultures. Opposite could be true for individualistic cultures because these cultures value employee's own initiatives and judgement, which may not be effective always. Further, less loyalty to leaders and less harmony among fellow members may undermine corrective action and preventive action of nonconformances (Naor et al., 2010; Robert et al., 2000; Wendt et al., 2009). Thus:

H_{10d}: There is a greater acceptance for Act (in a PDCA context) in collectivistic cultures than in individualistic cultures.

3.4.3 Effect of Uncertainty Avoidance on CI

Hofstede (2011) defined uncertainty avoidance (UAI) as the extent to which members in a society feel uncomfortable and threatened when faced with unknown and unstructured situations. Although Hofstede represented UAI as a continuous variable, for the sake of comparing and categorising societies UAI can be represented as a categorical variable such as low, moderate and high (Flynn & Saladin, 2006; Lagrosen, 2003). In addition to PDI, UAI seems to be the most influential dimension in explaining the cross-cultural differences of management phenomena including deployment of quality management practices such as CI (Hofstede, 1991; Lagrosen, 2003; Mathews et al., 2001). Therefore, studying the effect of UAI on CI in different countries in relation to PDCA approach — an unexplored area — remains an attractive proposition.

Literature focused on the effect of UAI suggests that both the behaviour of the leaders as well as their followers in handling an uncertain situation together with leader's expectation over subordinates and vice versa is the main factors that contribute for the effectiveness of CI strategies (Alves et al., 2006; Hofstede, 1983).

People in high UAI cultures show high intolerance to unexpected and unstructured situations (Hofstede, 2011). They feel highly anxious about unseen future and therefore their leaders attempt to take precautions to prevent possible risks; they take control over the tasks and processes to mitigate potential consequences that would affect their normal lives, including work life (Hofstede, 2011). Therefore, leaders in high UAI societies tend to practice a "vertical-leadership" style, maintaining formalised and structured organisational hierarchies to manage the organisations (Hofstede, 1980b, Jung et al., 2008). In contrast, leaders in low UAI societies do not show serious concerns about mitigating possible risks (i.e. they feel comfortable in facing unforeseen and unstructured situations) because people in such societies feel less anxious about facing unexpected and unstructured situations (Hofstede, 2011). Hence, low UAI societies are more flexible and are usually associated with flat hierarchies (Alves et al., 2006). Hofstede (1980b, p. 47) asserts that "younger people are suspect and ordinary citizens are incompetent compared with the authorities" in high UAI cultures, which can be translated to organisational level as superiors do not trust their subordinates in handling critical tasks and decision making. Further, leaders in high UAI cultures tend to show more aggressive attitudes compared to their counterparts in low UAI cultures (Alves et al., 2006). Since employees in high UAI societies are less empowered and less entrusted, the society expects them to obey their leaders' decisions (Alves et al., 2006;

Hofstede, 1980b). Employees (followers) in low UAI cultures on the other hand are more empowered and delegated (Alves et al., 2006) because their leaders show more “positive feelings” towards their followers and are relaxed and comfortable in giving more independence to their followers to make decisions.

Employees in high UAI cultures entail greater security and stability in their career and their future (Alves et al., 2006; Hofstede, 2011). They put more trust on their leaders to control the uncertainty. As Hofstede (2011, p. 10) put it, “teachers are supposed to have all the answers” which can be generalised as leaders having to have solutions to all the problems. Therefore, employees in high UAI cultures expect their superiors to put more formal structures in place characterised by formal rules and procedures to follow (Hofstede, 1980b). In addition, employees in high UAI cultures are expected to work hard and continuously improve their competence by acquiring knowledge through the formal structures put in place by their superiors to secure their carrier (Alves et al., 2006; Hofstede, 1980b). However, members in low UAI cultures feel competent towards change and show more curiosity towards taking risks and challenges (Hofstede, 2011). Job stability and security is not a key concern in these cultures and employees do not depend on leaders to secure their careers. In these cultures, strict rules and/or procedures, and formal structures are less welcomed by the employees (Hofstede, 1980b).

For the above reasons, it is argued that there is a greater acceptance for CI in high UAI cultures. This leads to the following hypothesis:

H_{11}: There is a greater acceptance for continual improvement (in a PDCA context) in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

The nexus between UAI and each component on PDCA is argued as follows:

PLAN vs UAI

As mentioned earlier, members in high UAI cultures rely on solid plans being put in place by their superiors to execute the tasks. People in these cultures require more formal structures to mitigate uneasiness and anxiety towards ambiguity (Alves et al., 2006; Hofstede, 1991). They prefer to follow strict rules and procedures that are aligned to clear goals, objectives and procedures. In addition, leaders in such cultures do not insist on employee empowerment leaving planning in the hands of the leaders (Alves et al., 2006; Hofstede, 1991). In contrast, people in low UAI cultures are curious about unfamiliar situations and are willing to take risks/challenges (i.e. lower level of planning for risk). Thus:

H_{11a}: There is a greater acceptance for Plan (in a PDCA context) in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

DO vs UAI

Implementing the planned activities and procedures (i.e. Do), is positively related with UAI due to the following reasons. Firstly, since leaders in high UAI cultures practise a "vertical leadership style" for the most part, they tend to exercise greater control over a situation by allocating well-defined tasks, responsibilities and authority to their followers. Secondly, employees in high UAI cultures put more trust on their superiors and obey the orders of the superiors, including obeying work instructions and procedures. Thirdly, leaders as well as followers in high UAI cultures insist on experiential knowledge to execute plans for CI. Fourthly, in exchange for job security and life-long employment in the organisation, employees tend to be work hard. The opposite of all of the above is true for low UAI cultures. For example, employees in low UAI cultures would be less comfortable with formal procedures, and people tend to practice more general skills development and hard work on the part of employees is not a virtue as such (Hofstede, 1980b). Thus:

H_{11b}: There is a greater acceptance for DO (in a PDCA context) in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

CHECK vs UAI

Monitoring, measuring, analysis and evaluation of what have been done (i.e. Check), need access to information as well as enthusiasm on the part of employees for analysis and evaluation. High intolerance for ambiguity and risk makes members of high UAI cultures being more dependent on forecasting and predicting outcomes (Hofstede, 2001). Thus, leaders as well as followers in high UAI societies show high propensity to gather more information (Morrison, 2002), specifically information gathered from the patterns of the past data. This in turn requires conducting more intensive monitoring and measuring. On the other hand, members in low UAI cultures are less enthusiastic about predictability and order because they tend to accept the things as they come (Hofstede, 2001). Formal procedures and bureaucracies such as check sheets and tally charts are less welcomed in low UAI societies, which implies that low UAI can hinder monitoring and measuring activities (Hofstede, 1980b).

Although Check (in a PDCA context) is less all-encompassing that Measurement, Analysis and Knowledge Management construct used in TQM and Business Excellence, past research on the nexus between the said construct and UAI can be used as further evidence of the nexus between CHECK and UAI. Jung et al. (2008) showed a positive relationship between Measurement, Analysis and Knowledge Management and UAI. Similarly, Mathews et al. (2001) found that high UAI cultures (e.g. Portugal) tend to practice "management-by-fact" approaches where they reported adoption of more "quality tools" and statistical techniques related to monitoring and measurement related activities. Also, Morrison (2002) posited that members in high UAI cultures seek more information to deal with the uncertainty. Thus:

H_{11c}: There is a greater acceptance for Check (in a PDCA context) in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

ACT vs UAI

Implementing actions to mitigate and prevent the nonconformities in addition to continual improvement (i.e. Act), needs robust decision-making processes. High UAI cultures search for more information (Morrison, 2002) which facilitates the adoption of fact-based decision-making approaches. Further, as mentioned earlier Mathews et al. (2001) reported that high UAI cultures choose a more fact-based management approach, compared to low UAI cultures. In addition, management involvement becomes important in the decision-making processes in high UAI cultures, in that managers do not overly rely on their subordinates in decision making (Alves et al., 2006; Mathews et al., 2001); rather managers would seek specialists' advice (when needed) in important decisions (Hofstede, 1991). Since managers in low UAI cultures put more trust over their subordinates (and in fact empower them to take decisions) ACT in a low UAI culture is very much reliant on the employees' ability and motivation (Mathews et al., 2001). Thus, it is argued that management involvement in problem solving and decision-making is high in high UAI cultures relative to low UAI cultures, which translates to greater acceptance of ACT in high in UAI cultures.

Ashford and Cummings (1983) found that the extent of seeking feedback on action is associated with the degree of uncertainty among people in a society. Consequently, people in high UAI cultures seek more feedback from their customers as well as subordinates compared to their counterparts in low UAI cultures (Ashford & Cummings, 1983; Morrison, 2002), which provides important suggestions and information for product development and quality improvement. Thus:

H_{11d}: There is a greater acceptance for Act (in a PDCA context) in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

3.4.4 Culture vs QMS Results

In this section, the researcher argues that Hofstede's dimensions PDI, IDV, and UAI are directly causally related to quality performance. Based on the theorisation used earlier (e.g. section 4.3.1), Quality Performance refers to three key results areas: Customer Satisfaction, Product Quality Improvement, and Reduction of Nonconformities. Each key results area was treated as a separate variable as in section 4.3.

Of the three key results areas of quality performance, arguably Customer Satisfaction is the most conceptually sophisticated variable to comprehend. Product Quality Improvement (e.g. improving the quality of design) and Reduction of Nonconformities (e.g. improving the quality of conformance) are activities that take place in a factory. In manufacturing, Customer Satisfaction always takes place outside the factory (this is not the case in services); the customer could be from the same country as the manufacturer or as is often the case, a foreigner (Xu, Blankson, & Prybutok, 2017). Customer Satisfaction is an emotional experience and the quality of the product, quality of the services provided by the manufacturer (the manufacturer could be from the customer's country or from a foreign country), and the quality of the services provided by the intermediary (the agent, who is usually from the customer's country) could all contribute towards customers' satisfaction/dissatisfaction. Thus, cross-cultural differences in the supply chain could be a factor in Customer Satisfaction (Liu & McClure, 2001; Morgeson, Sharma, & Hult, 2015).

3.4.4.1 Effect of PDI on QMS Results

The literature on the relationship between PDI and Customer Satisfaction shows conflicting results. Some researchers assert that PDI has negative effect on Customer Focus and Satisfaction (Anwar & Jabnoun, 2006; Flynn & Saladin, 2006). Others (e.g. Jung et al., 2008; Kim & Aggarwal, 2016) argue the opposite. For example, Jung et al. (2008) reported that PDI is positively related with TQM elements including “Customer and Market Focus” on the grounds that high PDI cultures exploit power differences in the society, which makes easier for the organisation to create a Customer Focus via the employees, leading to Customer Satisfaction. It appears that the literature is consistent on the claim that if an organisation can create a Customer Focus, Customer Satisfaction will follow automatically (Kim & Aggarwal, 2016). Since employees in high PDI cultures are obedient to their superiors, Jung et al. (2008) and Kim and Aggarwal (2016) argue that the subservient nature of employees makes it easy for an organisation to create a focus on the customers because the employees are able to deal with a wide variety of customers. This is also supported by Frazier, Gill, and Kale (1989), who argues that empoyees in high PDI cultures, unlike their low PDI cunterparts, can more readily tolerate difficult customers such as agrresive customers.

Practical examples can be given from two high PDI nations — Japan and Sri Lanka — on traditions of treating customers. The famous Japanese way of hospitality “Motenashi” exemplifies the politeness of the Japanese service providers and the lengths they go in showing how import the customers are to them (Nakamura & Gotoh, 2009). Sri Lanka, a popular tourist destination in Asia now is well known for the hospitality and friendliness of people in that country, whether it in a service encounters or otherwise (Teare, Bandara, & Jayawardena, 2013).

The above reasoning leads to the following sub-hypothesis related to QMS Results:

H_{12a}: There is a greater acceptance for customer satisfaction in high power distance cultures than in low power distance cultures.

As discussed earlier, decision-making power is centralised around the superiors in high PDI cultures (Flynn & Saladin, 2006; Hofstede, 2011; Lagrosen, 2003). Further, leaders in high PDI cultures can use their privileges to gain access to information for quality improvement and therefore fact-based decision-making is facilitated in these cultures. This also means that there is a greater level of leadership engagement in product and process improvement[16] in high PDI cultures than in low PDI cultures. It has also been shown that quality improvement implementation decisions work faster in high PDI cultures than in low PDI cultures because in high PDI cultures, followers rarely question decisions taken by their leader (Hofstede, 2011; Jung et al., 2008). In addition, ability to take swift corrective and preventive action can reduce defective products being passed on to the customers as well as product failures in use, leading to customer satisfaction (Ho, Koh, Chung, Wong, & Soon, 2007; Summers, 2010).

Researchers also show that there is a greater usage of statistical methodologies and techniques for quality improvement in high PDI cultures than in low PDI cultures (Wacker & Sprague, 1998). Closer supervision in conjunction with higher usage of statistical tools for quality control can reduce product nonconformities.

For above reasons, it is argued that there is a greater acceptance for product quality improvement and reduction of nonconformities in high PDI cultures than in low PDI cultures, leading to following sub hypotheses related to QMS Results:

H_{12b}: There is a greater acceptance for product quality improvements in high power distance cultures than in low power distance cultures.

H_{12c}: There is a greater acceptance for reduction of nonconformities in high power distance cultures than in low power distance cultures.

Concatenating H_{12}a, H_{12}b, and H_{12}c lead to the following parent hypothesis:

H_{12}: There is a greater acceptance for QMS Results in high power distance cultures than in low power distance cultures.

3.4.4.2 The Effect of IDV on QMS Results

Hofstede (2011, p. 11) asserts that relative to individualistic cultures, in collectivistic cultures, “relationship prevails over tasks”. Caring for people and loyalty is high among people in collectivistic cultures compared to their counterparts in individualistic cultures. Also, in collectivistic cultures, the leadership advocate paternal behaviours (Wendt et al., 2009) and people in the organisation show an emotional attachment to their group members

[16] This is a requirement espoused in TQM and BE literature (e.g. see Flynn & Saladin, 2001; Schroeder et al., 2008).

(in terms of family, organisation and society), sacrificing their own interest and goals in favour of success of their fellow members (Hofstede, 2011). These characteristics prevalent in a collectivistic culture create mutual understanding between leaders, followers and their customers; the organisation would go over and above formal procedures and relationships to fulfil their customer needs. Flynn and Saladin (2006, p. 591) also supports this notion in that they asserted that people in a collectivistic culture are programmed in such a way that "they focus on *context more than content* in a conversation". In addition, Flynn and Saladin (2006) opined that ability of focusing on circumstances when dealing with customers facilitate the suppliers in collectivistic cultures in grabbing more information from the customers that suppliers in individualistic cultures would fail to capture; consequently, they argue that suppliers in collectivistic cultures can build better relationships with the customers. Further, they assert that characteristics such as caring, sharing, harmony and peacefulness among organisational members in a collectivistic culture — as opposed to an individualistic culture — increases the likelihood of maintaining a strong professional relationship with the customers. Above reasoning leads to the following sub-hypothesis related to QMS Results:

H_{13a}: There is a greater acceptance for customer satisfaction in collectivistic cultures than in individualistic cultures.

Employees in collectivistic cultures are integrated into groups and keep strong relationships with their team members (Hofstede, 2010). Consequently, teamwork and cooperation within and between departments is high in collectivistic cultures than in individualistic cultures (Naor et al., 2010). In addition, people in collectivistic cultures insist on harmony among their group members and show respect for each other's ideas (Hofstede, 1991). Internal corporation and respect among team members as well as between team members and external stakeholders (e.g. suppliers and customers) are necessary for CI teams (e.g. "quality circles", kaizen events) to improve product quality and process performance (Anderson et al., 1994; Boer, Berger, Chapman, & Gertsen, 2017; Deming, 1986; Jayamaha et al., 2014). These characteristics are also necessary to overcome the obstacles in adopting cross-functional teams among divisions and plants (Naor et al., 2010). Use of cross-functional teams fosters the aggregation and conjunction of experts' knowledge within a group. This provides opportunities to identify product/process improvement needs, quality problems as well as optimum solutions for these, resulting in defect reductions as well as improved functional performance of products (Gamage, Jayamaha, & Grigg, 2017). Above reasoning suggests that collectivistic cultures are more able to effect product quality improvements and nonconformities reduction than individualistic cultures. The following empirical studies that use IDV as an independent variable also support this proposition.

Power et al., (2010) hypothesised that collectivistic cultures prevalent in eastern cultures tend to invest more, among other things, on quality improvement programmes and that this enables them to achieve significant positive outcomes through their manufacturing plants than what individualistic Western countries achieve through their manufacturing plants. Further, adopting the GLOBE framework, Naor et al. (2010) found that collectivism (at individual and societal levels) promotes manufacturing performances improvements better than individualism. They operationalised manufacturing performance using the indicators product quality improvement, reduction of scrap, and reduction of defects. They argued that these outcomes in turn result in greater customer satisfaction.

The above theoretical reasoning and empirical findings lead to the following sub-hypotheses related to QMS Results:

H_{13b}: There is a greater acceptance for product quality improvements in collectivistic cultures than in individualistic cultures.

H_{13c}: There is a greater acceptance for reduction of nonconformities in collectivistic cultures than in individualistic cultures.

Concatenating H_{26a}, $H_{26b,}$ and H_{26c} lead to the following parent hypothesis:

H_{13}: There is a greater acceptance for QMS Results in collectivistic cultures than in individualistic cultures.

3.4.4.3 The Effect of UAI on QMS Results

Customer feedback is important in order to measure customer satisfaction and the effectiveness of product improvement (Hill & Alexander, 2017; Igba, Alemzadeh, Gibbons, & Henningsen, 2015; Peterson & Wilson, 1992). Value that the decision makers put on customer feedback increases with the amount of associated uncertainty (Ashford & Cummings, 1983; Dönmez & Grote, 2018). Subsequently, people in high UAI cultures tend to seek for more customer feedback than their counterparts hailing from low UAI cultures

(Ashford & Cummings, 1983; Morrison, 2002). This should lead to the high level of customer satisfaction as well as increased opportunity to effect product quality improvements.

Quality management literature views customer-orientation at two levels: micro level (internal customers) and macro level (external customers) (Grace & Lo, 2015; Hsu & Shen, 2005). Consequently, customer satisfaction also can be viewed at the same two levels (i.e. internal customer satisfaction and external customer satisfaction). Employees in high UAI cultures tend to be more comfortable with structured organisational hierarchies and standardised procedures than employees in low UAI cultures (Hofstede, 2011; Johns, 2017)). This could mean that the former has a greater chance of being satisfied with their work environment than the latter, especially when working in functionally arranged organisational structures, which tend to be tall and structured by definition (Dalton, Todor, Spendolini, Fielding, & Porter, 1980; Kono, 2016). Further, structured reporting channels increase traceability, including employees knowing exactly who has the necessary information required for quality improvement (e.g. who has data on machine stoppages, who monitors the predictability and capability of the manufacturing process, and who has data on customer feedback). This in turn provides better outcomes for internal and external customers. Above reasoning leads to the following sub-hypothesis related to QMS Results:

H_{14a}: There is a greater acceptance for customer satisfaction in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

High UAI cultures adhere to predicting and forecasting methodologies compared to low UAI cultures (Hofstede, 2001). Consequently, members in high UAI cultures tend to analyse and evaluate the patterns of past data, which enable identification of potential problems in processes, products, and services (e.g. analysis of patterns of machine breakdown, monthly sales, and monthly customer complaints). This "statistical thinking" orientation enables operators to understand and reduce variation, which is the key to product quality improvement and reduction of nonconformities (Grigg & Walls, 2007; Snee & Hoerl, 2018). Further, improving product quality in the design and reducing nonconformities lead to increased customer satisfaction levels.

Many CI concepts and practices that are being implemented around the world are shaped by the Japanese culture, which is a very high UAI culture. For example, Just-in-time (JIT) a

Japanese rooted philosophy refers to meeting customers' (internal and/or external) requirements exactly on time based on the customer demand signal in order to add value to the customer by reducing waste (Hirano, 2019). JIT requires rules and order (e.g. scheduling rules, Kanban boards and rules), which is inherent in the (high UAI) Japanese society (Hirano, 2016). Another Japanese concept that operates within JIT is "Poka Yoke" (mistake proofing), which draws defects levels to a true zero through preventive actions (Shingo, 1986; Vinod, Devadasan, Sunil, & Thilak, 2015). JIT, Poka Yoke and other rule-bound procedures that fit the high UAI Japanese culture results in almost zero nonconformities, increased product quality, and consequently, increased customer satisfaction.

Some empirical research to support the fit between high UAI and high manufacturing performance (product quality and defects reduction included) are as follows. Naor et al. (2010) were able to support their hypothesis, which stated that "UAI is positively related to manufacturing performance" (i.e. increased UAI leads to increased manufacturing performance). Mathews et al. (2001) found that UAI makes organisations to adopt more tools and techniques for quality improvement, which when combined with the right ingredients (e.g. leadership support) leads to improved product quality.

The above theoretical reasoning and empirical findings lead to the following sub-hypotheses related to QMS results:

H_{14b}: There is a greater acceptance for product quality improvements in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

H_{14c}: There is a greater acceptance for reduction of nonconformities in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

Concatenating H_{27a}, $H_{27b,}$ and H_{27c} lead to the following parent hypothesis:

H_{14}: There is a greater acceptance for QMS Results in high uncertainty avoidance cultures than in low uncertainty avoidance cultures.

3.4.5 Comparison of Regions based on Mean Acceptance Scores of the Theoretical Constructs

In sub-sections 4.4.1 through to 4.4.4 national culture dimensions appeared as independent variables (predictors) and the theoretical constructs Plan (LDQMSP), Do, Check, Act, and

QMS Results appeared as dependent variables (response variables). Since the focal interest is on the acceptance of ISO 9001:2015 across nations and regions, and a national culture needs to be identified through several dimensions (this study used only PDI, IDV, and UAI) which is cumbersome, the easiest way to tackle this cumbersomeness is to resolve national culture dimensions — and even other possible national-level variables that affect PDCA and QMS — into a single factor which could be either country or region. Assuming homogeneity across regions (in this study the Australasian countries Australia and New Zealand are similar, but they are different to other countries in the study sample, the South Asian countries India and Sri Lanka are similar, but they are different to other countries in the study sample, Greece is different to other countries in the study sample), consolidating similar countries as regions means more cases per factor level, which means, an increase in statistical power (Cohen, 1992).

Assuming that the culture is the key determinant of acceptance of workplace practices (in this study, LDQMSP, Do, Check, Act, and QMS Results), the expectations for each practice is as follows:

Plan (LDQMSP)

- The mean score of Plan (LDQMSP) for Australasia is expected to be lower than that of South Asia (basis: H_{9a} and H_{10a}).

- The mean score of Plan (LDQMSP) for Greece is expected to be higher than that of Australasia. This is because Greece sits between Australasia and South Asia as far as PDI and IDV are concerned, but Greece's IDV is above all the other countries in the study sample. Thus, based on H_{11a}, the mean score of Greece for Plan is expected to be higher than that of Australasia.

Do

- The mean score of Do for Australasia is expected to be lower than that of South Asia (basis: H_{9b} and H_{10b}).

- The mean score of Do for Greece is expected to be higher than that of Australasia. This is because Greece sits between Australasia and South Asia as far as PDI and IDV are concerned, but Greece's IDV is above all the other countries in the study sample. Thus, based on H_{11b}, the mean score of Greece for Do is expected to be higher than that of Australasia.

Check

- The mean score of Check for Australasia is expected to be lower than that of South Asia (basis: H_{9c} and H_{10c}).

- The mean score of Check for Greece is expected to be higher than that of Australasia. This is because Greece sits between Australasia and South Asia as far as PDI and IDV are concerned, but Greece's IDV is above all the other countries in the study sample. Thus, based on H_{11c}, the mean score of Greece for Check is expected to be higher than that of Australasia.

Act

- The mean score of Act for Australasia is expected to be lower than that of South Asia (basis: H_{9d} and H_{10d}).

- The mean score of Act for Greece is expected to be higher than that of Australasia. This is because Greece sits between Australasia and South Asia as far as PDI and IDV are concerned, but Greece's IDV is above all the other countries in the study sample. Thus, based on H_{11d}, the mean score of Greece for Act is expected to be higher than that of Australasia.

QMS Results

- The mean score of QMS Results for Australasia is expected to be lower than that of South Asia (basis: H_{12} and H_{13}).

- The mean score of Act for Greece is expected to be higher than that of Australasia. This is because Greece sits between Australasia and South Asia as far as PDI and IDV are concerned, but Greece's IDV is above all the other countries in the study sample. Thus, based on H_{14}, the mean score of Greece for QMS Results is expected to be higher than that of Australasia.

3.5 CONCLUSION

This chapter covered development of hypotheses that are required to answer RQ1 and RQ2. Answering RQ1 enables the researcher to achieve research objective 1 (also research objective 2 indirectly), while answering RQ2 enables the researcher to achieve research objective 3.

To answer RQ1, the ISO 9001:2015 process model was converted to an empirically testable theoretical model that explains QMS Results. The empirically testable theoretical model was derived in two stages. First, the extant literature was used to formulate the hypotheses involving the theoretical constructs of the theoretical model. Next, the key clauses of the standard were aligned with the theoretical constructs (again based on extant literature) for the purpose of representing the theoretical constructs as latent variables.

In order to answer RQ2, the researcher hypothesised the six relationships ($H_9 \sim H_{13}$) between three Hofstede's national culture dimensions PDI, IDV, and UAI (Hofstede, 2011) as explanatory variables and the determinants of QMS Results (CI and QMS Results itself as dependent variables (hence 3*2 = 6 relationships). In keeping with the theoretical model that was developed to answer RQ1, Plan (more precisely LDQMSP) was operationalised via ISO 9001:2015 clauses 4 through to Clause 7, Do, Check, and Act were operationalised via ISO 9001:2015 clauses 8, 9, and 10 respectively (section 3.4). This led to several sub-hypotheses. Since the focal interest in RQ2 is on the acceptance of ISO 9001:2015 across nations and regions, a theoretical basis for comparing mean scores of CI (actually, the determinants of

CI, which are Plan/LDQMSP, Do, Check, and Act) and QMS Results across regions was also established in this chapter (section 3.4.5).

The next chapter (Chapter 4) describes how the researcher went about in collecting data to test the hypotheses and how a survey instrument was developed to collect data in the first place. Thus Chapter 5 covers the methodology of the study.

CHAPTER 4
METHODOLOGY

4.1 INTRODUCTION

This chapter covers the broad strategy that the researcher used in answering the research questions to achieve the research objectives. The next section (section 4.2) reviews different paradigms being used in social research in order to articulate the researcher's own paradigm. Section 4.3 explores alternative research approaches being used in social research in order to select the research approach that fits the researcher's paradigm. Section 4.4 covers the development of the questionnaire that was used to collect primary data required to test the research hypotheses. Section 4.5 outlines the procedures and strategies adopted by the researcher to collect primary data. Section 4.6 describes how the data were processed/handled before they were used in the data analysis. Section 4.7 briefly describes the statistical techniques used to answer RQ1 and RQ2. Finally, section 4.8 concludes the chapter, summarising the key points.

4.2 RESEARCH PARADIGMS

Unlike hard scientists, not all social scientists subscribe to the same "worldview" on the world around them. Like hard scientists, social scientists make certain assumptions about the nature of the (social) phenomenon being studied (Bryman, 2012; Guba & Lincoln, 1994). The research paradigm adopted by a researcher reflects his/her "worldview" and the approach they adopted in studying the phenomenon (Rehman & Alharthi, 2016). Assumptions that researchers make about the nature are known as *ontological considerations* (Bryman, 2012; Lincoln, Lynham, & Guba, 2011). Guba and Lincoln (1994) identified major four paradigms: *positivism*, *post-positivism*, *critical theory,* and *social constructivism;* the fifth paradigm *pragmatism* is also gaining traction, although pragmatism is not a new paradigm (Kaushik, Walsh, & Lai, 2019; McDermid, 2008). Of particular concern for researchers is whether the researcher takes the phenomenon as given, in which case the researcher would have no control over it (the positivistic ontology), or whether the researcher considers social actors as part of the phenomenon being studied (the social constructivist ontology), which results in two contrasting ontological stances (Bailey, 2008). While ontology is an important element in a research paradigm, a paradigm also includes an underlying epistemology, an axiology, and a corresponding methodology (Lincoln et al., 2011; Rehman & Alharthi, 2016). *Epistemology* concerns justification of knowledge claims; *axiology* concerns the value nature of the information gathered by the researcher (e.g. value free versus value-laden depending on the particular paradigm); finally, methodology concerns the procedures and strategies used to acquire knowledge (Bryman, 2012; Guba & Lincoln, 1994).

4.2.1 The Positivistic Paradigm

Positivistic ontology holds that reality, or the truth of the world is objective in that reality exists free or independent of the researcher who is observing the phenomenon (Aliyu, Bello, Kasim, & Martin, 2014). Consequently, researcher's view or belief does not "intervene" the worldly phenomenon (i.e. researcher remains value free), leading to value free style of research reporting (Aliyu et al., 2014; Jayamaha, 2008). Positivistic epistemology holds that knowledge claims should be made using scientific methods: formulating hypotheses, taking precise measurements, and testing the corresponding hypotheses to acquire knowledge through deductive reasoning (Lawson, 2000; Schrag, 1992). This reasoning is formally known as hypothetico-deductive reasoning or hypothetic-deductive reasoning (Lawson, 2000).

A variant of positivism is *post-positivism;* post-positivists subscribe to the core beliefs held by positivists, but they concede that absolute truth is impossible to establish, and at best, what is comprehendible is the approximate truth (Lincoln et al., 2011; Perlesz & Lindsay, 2003; Wildemuth, 1993). Consequently, post-positivists rely on "triangulation" strategies to achieve optimal outcomes, by adopting multiple avenues to converge to the approximate truth (Cox & Hassard, 2005); this may include using multiple streams of data and/or different methods to search the approximate truth (Cox & Hassard, 2005; Inglehart, 1997; Wildemuth, 1993).

4.2.2 The Social Constructivist Paradigm

Social constructivism, also known as interpretivism, is the antithesis of positivism; social constructivist ontology holds that reality does not exist without the observer; social constructivist epistemology holds that knowledge is socially constructed in that reality is constructed partly on peoples' experience and their values, and hence subjective — that is, value-laden (Fox, 2001; Lincoln et al., 2011; Rehman & Alharthi, 2016). Consequently, social constructivist methodologies heavily rely on investigating the opinion of people and beliefs (people being considered part of the phenomenon being studied), rather than hypothetic-deductive quantitative methodologies (Astley, 1985; Salomon, 1997).

4.2.3 The Pragmatic Paradigm

Pragmatism is a paradigm, but pragmatists are not paradigm locked (e.g. objectivism vs subjectivism) and takes a pragmatic "philosophical and/or methodological approach" in gaining knowledge and/or studying a phenomenon (Creswell, 2009; McDermid, 2008). Pragmatists typically rely on a "mixed methods approach", based on the notion that "what works best" to answer the research questions guides the methodology (Creswell, 2009; Kaushik et al., 2019).

4.2.4 The Critical Theory Paradigm

Critical theory paradigm was advanced by a group of German philosophers (often called the Frankfurt school) gaining inspiration from historians and philosophers such as Max Weber and Karl Marx (Caza & Caza, 2008). In critical theory, history and historical events are put in the limelight, in that history serves at a point of reference (Caza & Caza, 2008; Held, 1980). The critical theoretic epistemology holds that while knowledge is conditioned by the history, claims about truth can be judged "independently of immediate social (e.g. class) interests" (Held, 1980, p. 15). Consequently, critical theorists engage in "critical dialogs" involving key historical events and contemporary thinking to synthesise solutions to social issues — for example, emancipation of an oppressed social class (Held, 1980; Peoples, 2011).

4.2.5 The Paradigm Chosen

In Chapter 03 (building of testable theoretical models), through hypothetic-deductive reasoning, the researcher makes her paradigm evident to the reader. However, it is important to work through all dominant research paradigms and reason why certain paradigms were not considered for this study. The social constructivism does not fit this researcher's research objectives, which involve designing precise measurement instruments and testing cause-effect relationships. Critical theory is too philosophical, and this research is not rooted in historical events of social nature. Pragmatism looks a contender because in this study, the researcher sought the opinion of people, which is subjective. However, the purpose of engaging with people was to draw upon the knowledge of *practitioner-experts* to design an instrument to measure the unknowns (variables). This is analogous to an engineer consulting the users before designing a new product. Consequently, engagement with practitioner-experts and gathering information from them did not challenge the researcher's ontology. This left the researcher to think hard whether she is a positivist or a post-positivist. A question within this question was does it matter? The researcher concluded that her paradigm is post-positivism, because of certain triangulation strategies that she adopted in answering her research questions (e.g. literature, site visits, field-training, experts' input, and of course statistical modelling).

4.3 APPRAISAL OF ALTERNATIVE RESEARCH APPROACHES AND THE CHOSEN APPROACHES

The researcher identified five research approaches that fit a post-positivist paradigm: experimental designs, cross-sectional designs, longitudinal designs, case study designs, and comparative designs (Bryman, 2012). Each approach is reviewed in turn to select the most suitable approach/approaches for the proposed study.

4.3.1 Experimental Designs

An experimental design involves experimental manipulation of subjects to test the causal hypotheses (Bryman, 2012; Campbell, Stanley, & Gage, 1963; Cohen, Lindvall, & Costa, 2003; De Vaus, 2001). The strength of an experimental design is its ability to exclude alternative explanations for the observed relationships (Campbell et al., 1963; De Vaus, 2001). However, this approach does not suit the researcher's study because of the following difficulties: (a) excessive time lags between changing the causes and observing their effects (i.e. the time factor), (b) difficulties in changing the causes in organisational settings, and (c) existence of multiple hypothesised relationships.

4.3.2 Cross-Sectional Designs

In a cross-sectional design, a researcher collects quantitative data from several cases (e.g. through a questionnaire) at a single point in time (Blaikie, 2009; Bryman, 2012; De Vaus, 2001). This approach overcomes the difficulties associated with the experimental design. The disadvantage of this method, although it is the most widely used method in social research to test theories, is the difficulty of excluding rival explanations (Bryman, 2012; Cooper & Schindler, 2014). However, proponents of third generation statistical techniques (e.g. structural equation modelling) argue that these issues can be mitigated by formulating sound hypotheses and specifying (parameterising) the models correctly (Anderson & Gerbing, 1988; Bullock, Harlow, & Mulaik, 1994; Greenland & Brumback, 2002).

4.3.3 Longitudinal Designs

Longitudinal designs enable data to be collected from a panel of respondents, at least on two different points in time (Bryman, 2012). Longitudinal designs are also sometimes called panel surveys, when data are collected through a survey instrument. A longitudinal design is used in social research to measure a "social change," and thereby establish the effectiveness of a certain intervention (Bryman, 2012; De Vaus, 2001; Venkatesh & Davis, 2000). Because of time ordering of measurements (i.e. allowing the cause to happen before the effect), longitudinal designs provide clearer evidence of the effect (Bryman, 2012; Schindler & Cooper, 2001). However, time limitations and practical difficulties in recruiting subjects from multiple countries make this approach almost impossible to be used in the proposed research.

4.3.4 Case Study Designs

A case study design is defined as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2013, p. 13). Yin (2013) argues that case studies are particularly effective when the phenomenon under study is broad and complex, where full depth of investigation is needed. As such, case studies have found to be particularly effective in answering 'why' type of research questions of social nature (Dubé & Paré, 2003; Yin, 2013). Since case studies have diverse applications such as describing social phenomena, operationalising concepts, developing propositions and testing theory, case studies are receptive to both positivistic and constructivist epistemologies (Dubé & Paré, 2003).

4.3.5 Comparative Designs

A comparative study is a special case of a case study design where two or more social cases are studied by comparing them with each other to understand how a specific circumstance has affected a social phenomenon (Bryman, 2012; Flyvbjerg, 2006; Ragin, 1989).

4.3.6 Selection of the Most Appropriate Approaches

The researcher excludes experimental designs and longitudinal designs due to difficulties in implementing these approaches in the proposed study. Although case studies sit well with positivism, case studies are not appropriate when one is testing an established theory — the researcher's case of anchoring the major clauses of ISO 9001:2015 on PDCA to test the validity and generalisability of the contents in ISO 9001:2015 clauses is an example — for whatever reason. Also, case studies are not designed to make broad generalisations across populations based on sample data (Yin, 2013). Given the research objectives, case studies were thus not considered, although researcher used international experts on ISO 9001:2015 to develop the survey instrument. The comparative design was excluded due to the scope of the proposed study. Consequently, the cross-sectional design approach was chosen as the most appropriate approach to answer the research questions to achieve the research objectives, because the focus of the research is on scientific generalisation of the hypotheses.

4.4 QUESTIONNAIRE DEVELOPMENT

According to the ISO, the theoretical basis of ISO 9001:2015 — stipulated through the key clauses of the standard — is the ISO 9001:2015 process model, which in turn is claimed to be reflecting the well-known PCDA approach to continual improvement. The constituents of the ISO 9001:2015 process model are the key clauses of ISO 9001:2015 (Clauses 4 through to 10) and the implied relationships involving these key clauses. Consequently, operationalising the key clauses of ISO 9001:2015 was one of the key phases of the research design, and a questionnaire was used exactly for this purpose. To better understand how the questionnaire fits into theory testing, the reader may also refer to the researcher's theoretical model represented as Figure 3.1 and the hypotheses and sub-hypotheses outlined in Chapter 03.

ISO 9001:2015 is a practitioner-based standard, and at the beginning of the doctoral journey (to be more specific, till a good three months into the second year of the doctoral journey), the researcher had virtually no exposure to the practical world of quality management.[17] Therefore, the researcher used a three-pronged (but sequential) strategy to develop her questionnaire. First, the researcher went to the industry (three factories in three companies) and spent a whole day in each factory to get a general flavour of things happening in the production floor and in the quality department (section 4.4.1). Next, the researcher enrolled herself in an ISO 9001:2015 auditor training course to learn the standard thoroughly, particularly the practical aspect of site visits and auditing (section 4.4.2). Finally, the researcher adopted a panel of international experts on ISO 9001:2015 to develop the questionnaire iteratively, using a Delphi-like approach (section 4.4.3).

4.4.1 Industry Familiarisation

Sri Lanka (the researcher's native country) was chosen for industry familiarisation (visits to factories) for two reasons. Firstly, because the researcher is a Sri Lankan, it was perceived that the factory managers and quality managers would empathise her for her lack of hands on experience in quality management (the researcher would introduce herself as a statistics lecturer from University of Kelaniya, Sri Lanka, reading her PhD at Massey University, New Zealand). Secondly, it was easier for the researcher to combine industry familiarisation with the next activity (ISO 9001:2015 lead auditor training), which was also held in Sri Lanka.

Researcher visited three manufacturing factories in Sri Lanka. Each factory visit lasted one full day. Of the three factories visited, two were manufacturers of rubber-related products, while the other was a non-alcoholic beverage manufacturer. The objective of these visits was to gain an understanding of what a quality management system means to quality practitioners. In each site visit, the researcher was taken around the factory floor by an assistant to the factory manager to show the production processes. This enabled the researcher to observe how product quality and conformance to specifications are checked throughout the production process. Since all three factories were ISO 9001 certified, the documentation processes followed a common structure outlined in ISO 9001:2008, although the actual content varied between the factories. The quality manuals were inspected, and the researcher learnt how non-conformities are identified and reported for corrective and/or preventive

[17] The researcher is a statistician by trade; although statistics and quality go hand in hand, the researcher did not have any exposure to quality management prior to her doctoral study.

actions, how communication is facilitated within and across divisions. The researcher also gained some knowledge about various visual displays (production and data displays) being used in the factories (e.g. monthly performance summaries, downtime information, red-amber-green colour coding system, safety notices).

4.4.2 ISO 9001:2015 Lead Auditor Training

The researcher completed the "Certified Quality Management Systems (ISO 9001:2015) Auditor/Lead Auditor Training Course" (Course No 18126) successfully (see Appendix 2 for proof). This course was certified by the Chartered Quality Institute (CQI) and the International Register of Certificated Auditors (IRCA).[18] As mentioned earlier, the course was held in Sri Lanka (in August 2017). The course was conducted by a leading figure[19] in quality management in the Asia Pacific Region. The course was held over five full days, comprising of over forty hours of lectures, workshops and study presentations. Apart from ISO 9001:2015, the training programme focused on potential auditor errors (e.g. misinterpretation of ISO 9001:2015 requirements), personal attitudes and behaviours that an auditor should possess, and important ethical issues upon which an auditor is bounded (e.g. protecting the privacy of the auditing organisation and honouring the trust the auditee places on the auditor at all times). Perhaps importantly, through the course, the researcher gained practical experience on conducting ISO 9001:2015 auditing in manufacturing environments by participating as an audit observer in audits conducted by a group of audit experts.

4.4.3 The Delphi Study

Delphi method is a method developed by the RAND Corporation in the United States in 1950s; the purpose of this method (initially) was to study how technology affects warfare (RAND Corporation, 2019). Delphi method is a convenor-led expert consensus reaching method. In this method, consensus is reached in an iterative fashion, wherein the experts anonymously respond to the questionnaires directed to them (by the convenor) in each round. From round 2 onwards, the experts receive feedback from the convenor in some statistical form, conveying the group response. This is to seek further refinement of responses for the

[18] The headquarters of CQI is based in London and IRCA is owned by CQI and is also based in London.
[19] The president of the Asia Pacific Quality Organisation (APQO), at the time of writing the thesis.

purpose of seeking near consensus on the task at hand (for details on Delphi method see Okoli & Pawlowski, 2004; Skulmoski, Hartman, & Krahn, 2007).

In the researcher's study, consensus was sought on the following: *the best way, a set of agreement-seeking statements can be written down under each key clause of ISO 9001:2015 — ideally no more than six short statements per clause — to reflect the essence of each clause.* Given that there are seven major clauses of ISO 9001:2015, the objective of the researcher was to develop a questionnaire that operationally defines the seven clauses in about 40 statements ($7*6 = 42 \approx 40$), keeping in mind that further three to five statements need to be included in the questionnaire to reflect QMS Results of a firm. The Delphi panel members were made aware at the very outset that the questionnaire that would be developed with their help would be administered to ISO 9001ceritifed firms in five countries.

Apart from brevity, the Delphi panel members were also informed that they need to use simple English (at least for the sake of English as a foreign language respondents) and avoid ISO 9001:2015 jargon as much as possible, without compromising what the researcher wants to achieve. What the researcher wanted to achieve was to develop a questionnaire that can reliably measure the level of compliance (in a scale of 1 to 7) against the seven major clauses of ISO 9001:2015, as perceived by a respondent, for his/her organisation, along with perceived QMS Results. Avoiding ISO 9001:2015 jargon was deemed necessary to minimise bias (including providing leading questions) in the responses as the researcher would collect data from firms that are very familiar with the ISO 9001:2015 jargon. How Delphi panel members were recruited and what was done in each round of questionnaire development are described next.

4.4.3.1 Round 1

The researcher recruited *seven high profile ISO 9001:2015 lead auditors* in four countries — one from Australia, three from New Zealand, one from the UK, and two from Sri Lanka — to participate in the first round of questionnaire development. The researcher acknowledges the help given by the researcher's doctoral supervisors in introducing the researcher to the seven lead auditors. The panel included presidents of gatekeeping organisations for quality in Australia, New Zealand, and Sri Lanka. The first round of deliberations took place in the month of July 2017. Each Delphi member was asked anonymously to suggest no more than six statements per clause to capture the essence of the seven major clauses (Clause 4 through Clause 10) of ISO 9001:2015. An introduction to the researcher's project, necessary instructions as well as a draft statement for selected few clauses were provided in the invitation letter to the experts. Part I of Appendix 3 shows a sample letter of invitation to participate along and the project brief, while Part II of Appendix 3 shows the specification for the first round of the Delphi study. A draft statement (questionnaire item) was included in round 1 to enable the experts to better understand the style of the statements that the researcher requires for her questionnaire.

The responses received from each expert were analysed by the researcher to select the statements that express similar meaning (high convergence) for each clause. The dissimilar statements were isolated (low convergence) to be considered in the next round alongside statements that have high convergence. Next, the statements that have high convergence were merged to form a single statement — hereinafter referred to as merged statements — without compromising the meaning or losing the information included in individual statements. Note that few merged statements had to be shortened (these looked too long after merging) to avoid near redundant words.

The draft questionnaire that went into the second round contained 72 statements, which included eight statements added by the researcher (based on extensive literature review) to represent different aspects of QMS Results. Of the 64 statements (72 minus 8) generated from round one results, 43 statements (67%) were merged statements and 21 statements (33%) were statements that came from only one expert (standalone statements/low convergence statements).

An important side conversation that took place between the researcher as the information seeker and the New Zealand and Sri Lankan Delphi panel members as information providers was the merit of development of the questionnaire. Since all the respondents are to be ISO 9001 certified, the researcher wanted to know whether there would be enough variability of the response choices to conduct statistical analyses; because the questionnaire would be designed to capture ISO 9001 implementation (or integration) depth, the researcher speculated that nearly all the responses would end of with ”strongly agree” choices. The response the researcher received from the experts was that although she is likely to get a number of “agreed” and “strongly agreed” responses (in the Likert scale being used, 6 and 7 respectively) she is likely to get responses with lesser levels of agreement. The experts also advised that managers are generally honest and critical about what they do, and ISO 9001 certified means just passing a test and not excelling at something. In translating this verbal information to the language of statistics, the researcher concluded that there would be adequate variation in the data to conduct meaningful statistical analyses.

4.4.3.2 Round 2

Since statistical analysis would be involved in round 2 in reaching consensus, the researcher recruited seven additional experts to participate in round 2. Consequently, the draft questionnaire containing 72 statements was sent out to 14 experts[20] (augmented Delphi panel members) anonymously, requesting each panel member to rate each of the 72 items in a 1-2-3 categorisation scale, where 1 means “the statement represents *an essential aspect of the clause”*; 2 means ‘a *nice to have but not essential* statement”; **3** *means “not a critical aspect of the clause”.* Panel members were also advised to change the wordings of any survey item if they feel that emending a statement is absolutely necessary (they were asked to use the track changes option of Microsoft Word).

Once round 2 responses were received (unfortunately one respondent did not respond), they were analysed and evaluated based on the following procedure. First, the number of questions carrying a rating “1” for each measurement domain were counted to determine how many high agreement survey items each clause secures (see Table 5.1). A high agreement was taken as at least 10 out of 13 respondents (77%) agreeing that a survey item is essential. The lower bound cut-off figure of 10 was calculated based on the procedure described by Lawshe, (1975), using the content validity ratio (CVR)[21] and the calculated lower bound CVR for an assumed error rate (technically $\alpha = 0.05$, but researchers seem to flex this rate). The lower bound CVR prescribed in the literature is arbitrary but a CVR > 0.50 is deemed essential for content validity (Gilbert & Prion, 2016). The researcher’s cut off figure of a minimum of 10 respondents (out of 13) agreeing that a survey item is “essential”, returns a CVR of 0.54,

[20] One expert who contributed in the round 1 could not meet the researcher’s deadline to complete the tasks from round 2 onward.

[21] CVR = (n_e -0.5N)/(0.5N), where N is the total number of respondents and n_e is the number of respondents who gave a rating of 1 (essential).

which is > 0.50. More stringent lower bound CVRs of 0.70 (Tilden, Nelson, & May, 1990) and 0.80 (Davis, 1992) have been prescribed in the literature, but these increase the minimum of respondents having to agree (out of 13) as "essential" to 11 and 12 respectively.

Table 4.1: Statistical Summary of Round 2 Results

Measurement Domain (ISO 9001:2015 Clause)	Total Number of Survey Items Included in Round 2	Number of High Agreement (> 77%) Items
Clause 4: Scope*	6	3
Clause 5: Leadership	10	5
Clause 6: Planning	9	5
Clause 7: Support	10	7
Clause 8: Operation	11	8
Clause 9: Performance Measurement	9	5
Clause 10: Improvement	9	3
QMS Results	8	1
Total	72	37

* Instead of the label "Scope" the label "Organisational Context" has also been used by the researcher sometimes to refer to Clause 4

For the measurement domain that has only one high agreement item (i.e. QMS Results as shown in Table 4.1), survey items carrying a rating "2" were also taken into reckoning to increase the number of survey items; this was deemed necessary to increase the content validity of Results.[22] More specifically, the pass criterion was lowered to > 77% agreement when a rating 2 was also counted as a rating of "1" to increase the agreement proportions for each of the 8 items in the Results domain. After this, it was observed that two additional survey items returned a > 77% ratio, resulting in 3 measurement items for QMS Results. Before dispatching the questionnaire to the panel members in Round 3, the researcher

[22] In the strict scheme of statistics adding items in this fashion will not increase content validity, if anything, it decreases content validly, based on the CVR criterion. There are times a statistician needs to use intuition, and this was one occasion the researcher used her intuition.

ensured that the number of measurement items remained in the questionnaire to capture each of the domains were adequate and are consistent with the numbers used in previous research studies to operationalise similar measurement domains.

4.4.3.3 Round 3 (the Final Round)

After considering the edits suggested by the experts[23] and the feedback/suggestions given in the Round 2, and based on the item selection criterion used by the researcher to process Round 2 responses (section 4.4.3.2), a 39-item draft questionnaire[24] was supplied to each of the 13 panel members, with a view to achieve a close-enough consensus to finalise the questionnaire. Additional space was provided in the draft questionnaire for any feedback/suggestions. All thirteen panel members agreed that the 39 items concisely capture the underlying domains of the key clauses of ISO 9001:2015 as well as QMS Results, and that the number of items representing each key clause is reasonably consistent with what each clause covers and what product outcomes one could expect in implementing ISO 9001:2015 (QMS Results).

4.4.4 Finalisation of the Questionnaire to Collect Survey Data and Pilot Testing

Finalised questionnaire consisted of two parts. Part I consisted of five survey items that captured the type, sector, size, maturity, and quality maturity of the respondent's organisation (Part I of the questionnaire did not have any expert input). Maturity refers to number of years in business, while quality maturity refers to number of years an audited QMS has been in existence. Part II consisted of 39 questionnaire items (developed with the help of the Delphi panel as explained earlier) to capture the essence of the key clauses of ISO 9001:2015 as well as QMS Results. Of the 39 survey items, 3 covered Clause 4, 5 covered Clause 5, 5 covered Clause 6, 7 covered Clause 7, 8 covered Clause 8, 5 covered Clause 9, 3 covered Clause 10, and 3 covered QMS Results. As mentioned earlier, each of the 39 questionnaire items provides a statement, for which, the agreement of the respondent is sought in a 7-point Likert Scale: strongly disagree (=1), disagree (=2), somewhat disagree (=3), neither disagree nor agree (=4) somewhat agree (=5), agree (=6), and strongly agree (=7).

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[23] Only few edits (suggested two experts only).

[24] 39 because 2 more survey items over and above the 37 isolated earlier (Table 4.1)

One question that the researcher had to resolve in administering the questionnaire was the English proficiency of respondents in non-native English-speaking countries: Greece, India, and Sri Lanka. A well-known US language education academy "EF" who ranked English proficiency of 100 non-native English-speaking countries lately, ranked Greece as a high English proficiency country (rank = 22), India as moderately English proficiency country (rank = 34), and Sri Lanka as a very low English proficiency country (rank = 78) (EF, 2019). Consequently, it was decided that a language translation of the questionnaire from English to another language is necessary only for Sri Lanka, because India appears at the upper end of the moderate spectrum[25] and Greece appears as a high English proficiency country. In Sri Lanka, Sinhala is the most widely spoken language.[26] The researcher translated the questionnaire from English to Sinhala; the researcher's primary supervisor, who is of Sri Lankan origin checked the Sinhala translation for accuracy and consistency. To further validate translation accuracy, the researcher got the Sinhala version back translated to English through a Sri Lankan quality professional. After tallying the contents of the back translation with the original, it was concluded that the Sinhala translation accurately reflected the contents in the original questionnaire, and no further refinements are necessary for the Sinhala translation.[27]

Having almost finalised the questionnaire, it was *pilot tested* using 10 quality managers belonging to 10 manufacturing organisations of which 5 were from New Zealand and the rest were from Sri Lanka. The feedback of the respondents was considered and very minor emendations were made to the questionnaire based on the feedback. The feedback also revealed that the average questionnaire completion time is 15 minutes (New Zealand average was found to be 14 minutes approx. while the Sri Lanka average was found to be 16 minutes approx. and according to the five Sri Lankan respondents, the Sinhala translation was not

[25] EF ranked 100 countries for English proficiency and the Netherland ranks #1. In EF's categorisation, very high proficiency means rank 1-14; high means 15-25; moderate means 30-46, low means 47-69 and very low means 70-100.

[26] Researcher has a Sri Lankan origin and her language is Sinhala which majority (over 80%) of the country read, speak and understand the language.

[27] In Sri Lanka, the problem is that there is a very wide gap between managers who handle technical affairs (quality management included) and blue-collar workers as far as English proficiency is concerned. The former group is fluent in English, partly because most managers have tertiary educational qualifications conducted in English, and partly because English reading and writing skills are required for their job.

required by them). None of the respondents involved in pilot testing the questionnaire reported any difficulty in understanding the questions nor did they identify repetitive questions. Figure 5.1 briefly illustrates the steps that were followed in developing the survey instrument.

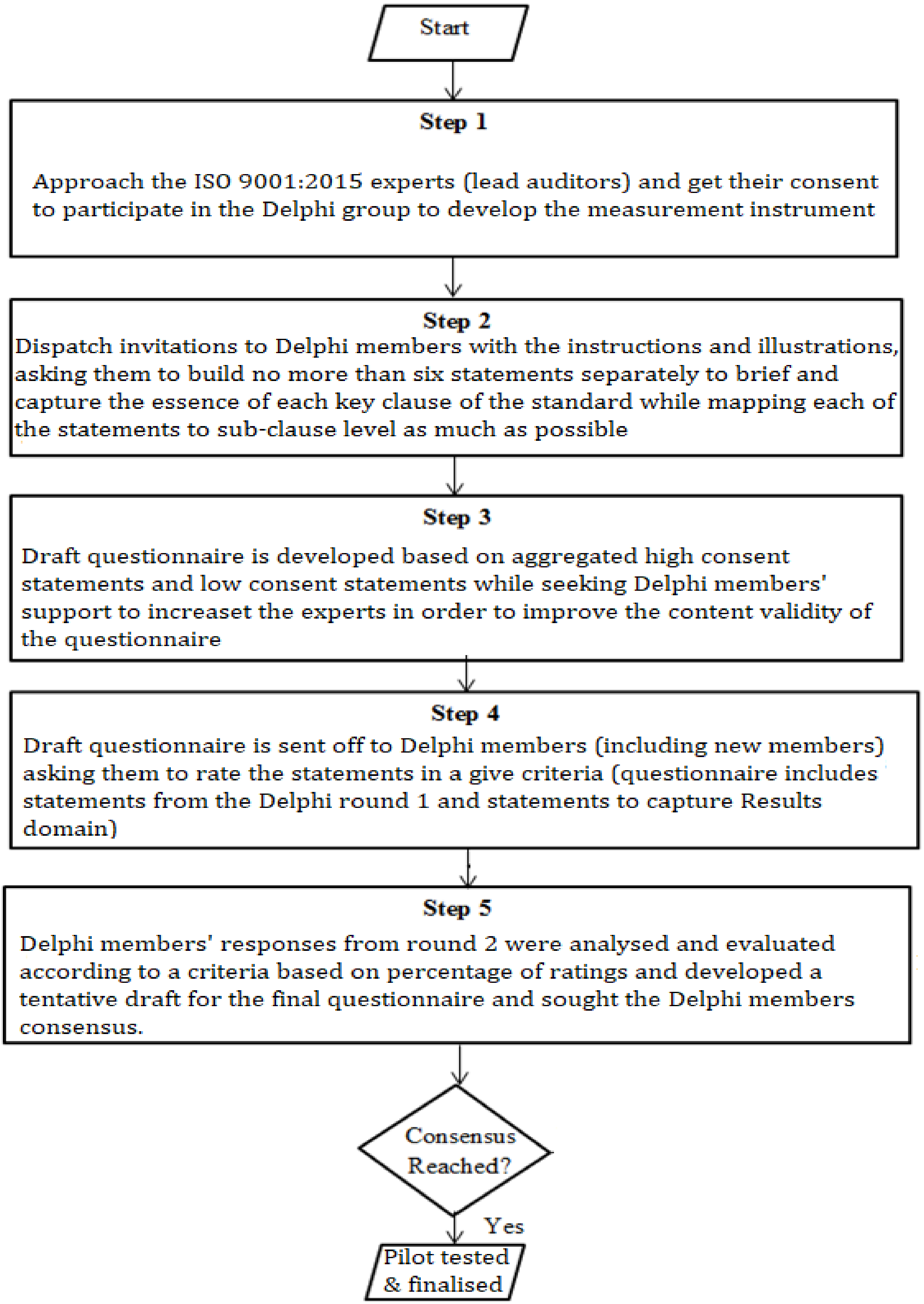

Figure 4.1: Illustration of steps followed in developing the questionnaire

4.5 DATA COLLECTION

4.5.1 Selection of countries

The first task in data collection is selecting countries for primary data collection. Low power distance countries New Zealand and Australia were selected due to proximity, high probability of respondent response, and ease of communication. High power distance countries India and Sri Lanka were selected because these countries are culturally distinct from New Zealand and Australia. Ease of communication was also a factor.[28] Greece was chosen because Greece happens to be a very high uncertainty avoidant country (the other four countries in the sample happen to be medium uncertainty avoidant countries, based on Hofstede's scale).

4.5.2 Sample Sizes, the Mode and Method of Administering the Survey Instrument and Ethical Considerations

4.5.2.1 Sample Size Calculations

To determine the sample size, one needs to know how many cases need to be collected from each country. As there are five countries, the total sample sizes would be five times, the per country sample. For comparing national cultures, Hofstede et al. (2010) suggested a minimum of 20 cases from each country. Based on this rule of thumb, the minimum sample size required is 100 cases. However, sample size in statistics is typically calculated based on power analysis relevant to the statistical models being used, assuming certain α and β risk rates, typically, $\alpha = 0.05$ and $\beta = 0.20$; with latter is the same as 0.80 statistical power (Chin, 1998; Cohen, 1992). As outlined in Appendix 6, several statistical techniques will be used in this study to achieve the research objectives. The most complex model that involves path modelling is Model 2 (Figure 4.3 in Chapter 04), where the construct "Operation" is being predicted by 3 predictors. For statistical models involving national culture dimensions, again the number of predictors is three (PDI, IDV, and UAI). Consequently, the sample size would be dictated by the three-predictor regression model that is expected to have the lowest R^2 (or effect size f^2, where $f^2 = R^2/(1-R^2)$). Based on prior research, the national culture has a weak relationship with quality (around $R^2 = 0.05$). Assuming an expected R^2 of 0.05, the minimum

[28] The two high profile Sri Lankan Delphi-panel members were very helpful in this regard.

sample size turns out to be 209 cases for a three-predictor regression model, based on the power analysis procedure described by Cohen (1992), for regression analysis.29 Thus the minimum sample size aimed at was 210 cases, with 40 to 50 cases from each country.

4.5.2.2 Method of Administering the Survey Questionnaire

The survey questionnaire was administered electronically via the "Google forms" platform by providing the link containing the survey to the invitees, soliciting them to participate in the survey, through a bulk invitation using the mail merging function of MS Outlook (see Appendix 4 for a printed copy of the questionnaire). An electronic platform such as Google forms is necessary when many invitations need to be sent out to participate in a study (Kumar & Naik, 2016). Assuming a 10% response rate, in order to receive 210 responses, one needs to invite 2100 potential respondents, which is indeed a large volume of invitations. To hide the countries involved in the study from the respondents, five separate Google forms were maintained for each country. Wherever possible, the invitations were directed to the right person, but this was possible only for Australia, New Zealand and Sri Lanka. However, when invitations were sent out to a general email (e.g. the one meant for inquires), the recipient was asked to forward the invitation to the person in charge of product quality, such as the quality manager. The time given to a recipient to complete the survey was one month, although an extension of time had to be granted for Indian and Sri Lankan respondents, due to their sluggish initial response. A first reminder was sent out to the recipient after two weeks since the questionnaire was dispatched, and another reminder was sent out two days before the closing date of the survey. Busy periods or inactive periods[30] were avoided in launching the survey; the survey was active from late February 2018 through to June in 2018, in stages (e.g. Greece was invited last). The researcher was able to collect 240 responses eventually from the five countries, resulting in a 10.2% response rate, which was deemed acceptable for a web-based survey involving busy executives (Manfreda, Bosnjak, Berzelak, Haas, & Vehovar, 2008).

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[29] The reader may verify this figure using any online calculator (e.g. see https://www.danielsoper.com/statcalc/calculator.aspx?id=1), assuming default risk settings, and f 2= 0.0526, which is R^2 = 0.05.

[30] Easter holidays for Australia and New Zealand; first three weeks of April in Sri Lanka due to Sinhala and Tamil New Year holidays.

4.5.2.3 Ethical Considerations

Protecting the interests of human subjects is as important in social research as it is in medically research, because the subjects can be manipulated (deliberately or otherwise) by the way in which they have been used in the research (Babbie, 1989; Israel & Hay, 2006). In this study, human participation was involved on two occasions. Firstly, the researcher had to engage with quality experts in designing the questionnaire. These experts (Delphi panel members) were very senior quality professionals and in power relationships, they were at a vantage position as the researcher is just beginning her career as a quality expert. Next, the researcher administered a quantitative questionnaire aimed at middle/senior managers in manufacturing organisations (e.g. the quality manager). Participation in the survey was entirely voluntary and no minors or adults with intellectual limitations were involved in the study. In addition, the anonymity of the respondents was preserved always via the design of the survey (this applied to the Delphi panel also) and where relevant (e.g. questionnaire development), the researcher shared information with the participants. This coupled with the quantitative nature of the large sample survey meant that the data collection was conducted under a *low-risk* ethics clearance (see Appendix 5 for proof).

4.5.3 The JAS-ANZ Register of ISO 9001 Certified Organisations

In identifying potential Australian and New Zealand respondents, and to a much lesser extent Indian and Sri Lankan respondents, the researcher used a database belonging to the Joint Accreditation System for Australia and New Zealand (JAS-ANZ) to obtain the names of ISO 9001 certified organisations that have been ISO 9001 certified by certification bodies accredited by JAS-ANZ. JAS-ANZ is one of the largest accreditation bodies in the Asia Pacific region for accrediting certification bodies. JAS-ANZ maintains publicly available registers that record the names and other limited information31 of organisations that have been certified against various standards by JAS-ANZ accredited certification bodies. In addition, full contact details of the certification bodies that JAS-ANZ has accredited are also available publicly (this database was useful to screen Indian respondents). Because data

[31] The following limited information were retrievable from JAs-ANZ website: Name of the Certified Organisation, Suburb/City, Country, Type of Certification, Status (Active or Not), Certificated Operation (i.e. certified for doing what), Date Certified and Name of the Certification Organisation.

collection took place at a time when several companies were transitioning from the old standard (ISO 9001:2008) to the new standard (ISO 9001:2015), the researcher considered both ISO 9001:2008 certified organisations32 as well as ISO 9001:2015 certified organisations in retrieving contact information from the JAS-NZ register. Further, since the scope of the research was limited to manufacturing, some exhaustive key words related to manufacturing — "manufacturing", "production", "Process" — were used to filter information. Once the limited contact details were extracted from the JAS-ANZ register on Australian and New Zealand ISO 9001 certified manufacturing organisations, full contact details (the name of the contact person, designation, email, phone number) of each of these organisations were searched online (websites, directories etc.), and in the case of New Zealand, phone calling the front offices when necessary.

4.5.4 The Australian Sampling Frame

Thanks to the JAS-ANZ register of ISO 9001 certified organisations, names of 720 Australian ISO 9001 certified organisations were gathered from the JAS-ANZ database; on paper, nearly all of them are expected to be in manufacturing as the researcher used keywords to maximise the likelihood of retrieving manufacturing organisations. Of the 720 company names, the researcher was able to find the full contact details of 600 Australian organisations via Google search. Finally, an email was sent to the 600 organisations, explaining the purpose of the research and data collection, along with the link containing the questionnaire, soliciting their support in participating in the survey. Upon administering the survey, 49 companies responded (response rate = 8.2%).

4.5.5 The New Zealand Sampling Frame

The approach used to prepare the New Zealand sampling frame was equivalent (but not identical) to that used in preparing the Australian sampling frame. The researcher was able to retrieve contact details of 300 ISO 9001 certified organisations; on paper, nearly all of them were expected to be manufacturing organisations based on keywords used in obtaining the names of the organisations from the JAS-ANZ register. Prior to administering the survey, the researcher tried her best to get the contact names and their email addresses from the front offices (via phone or email), in cases where it was difficult to find the name and contact email

[32] At the time of retrieval of names and addresses from the JAS-ANZ register.

of a person responsible for quality. In addition, the researcher contacted respondents prior to administering the survey (via email) soliciting their support. Of the 300 people contacted prior to the survey, 31 pledged support by way of confirming their willingness to participate and 11 others also responded positively. Upon administering the survey, 45 companies responded (response rate = 15%).

4.5.6 The Greek Sampling Frame

Since the JAS-ANZ register did not cover very many ISO 9001 certified Greek organisations, researcher obtained the names and contact details of ISO 9001 certified companies from the "Greek Financial Directory" published by a Greek service company named ICAP. The researcher purchased both the printed version and the e-version (CD ROM) of the directory from ICAP. The directory contained details such as the name of the company, key contact personnel and their emails, the size of the company and so forth, under ISO 9001 certified sub-category of companies. The researcher was able to isolate 790 companies — believed to be manufacturing based on keyword search — and the researcher retrieved the following data fields from the ICAP directory: company name, name(s) of key contact staff, designation, email and phone numbers. As in the case of other countries, an email invitation was sent out to each company (only one invitation per company) to participate in the survey. Of the 790 companies invited, 64 responded, returning a response rate of 8.1%.

4.5.7 The Sri Lankan Sampling Frame

The researcher selected manufacturing organisations that have been ISO 9001 certified by the Sri Lanka Standards Institute (SLSI) only. SLSI is a public sector organisation in Sri Lanka with high integrity, and it is the premier certification body in Sri Lanka, although few other certificate awarding bodies (CABs) such as Bureau Veritas are also held in high esteem by the Sri Lankan industry. Another advantage in relying on SLSI certified organisations was the fullest corporation of their director general and his deputy. The researcher was provided a list of 200 ISO 9001 certified manufacturing companies by the SLSI (status: active) along with contact details: company name, contact person's name, designation, contact email, and the phone number. Like in the case of New Zealand, the researcher dispatched emails to contact personnel available to her, prior to the survey to seek their support. While only four replied to the researcher's email indicating their willingness to participate in the survey, emailing respondents prior to administering the survey was a blessing in disguise because the researcher received more than 20 returned emails from the mail marshal. The researcher found that this was due to people leaving their organisation (the researcher was able to get the correct contact details by phoning the companies concerned).

The initial response to the survey from the respondents was discouraging, because only a handful of invitees responded. For this reason, the researcher sought help from the deputy director general of SLSI (she was also in charge of ISO 9001 and 14001 standards in SLSI). Because the deputy director general contacted each of her former clients and requested them to support the researcher's study, the number of responses increased from 7 to 48 within a week (response rate = 24%).

4.5.8 The Indian Sampling Frame

As in the case of Sri Lanka, the researcher exercised caution in selecting the right candidates to participate in the survey. However, unlike in the case of Sri Lanka, it was not known to the researcher who the most recognised CABs are. Consequently, the researcher used the JAS-ANZ registers to find out who the top five Indian CABs are. Although all five CABs were approached personally via phone (the help given by the supervisor is greatly appreciated), only one party agreed to give the full contact details of their clients (another party kept the researcher interested but they backed up at the last moment). The researcher was able to obtain full contact details of 470 ISO 9001 certified companies via a CAB that was based in the state of Haryana. Haryana is a manufacturing rich state in India (India has 28 states); according to Wikipedia, Haryana produces 67% of passenger cars, 60% of motor bicycles, 50% of tractors, and 50% of refrigerators made in India.[33] Also this Northern Indian sate can assumed to be representative of the Indian culture based on language, history, and tradition of India.

As in the case of Sri Lanka, the initial response to the survey was disappointing (only six responded) and about 30 email addresses that the researcher used were found to be incorrect (it was difficult to find correct email addresses of these). The intervention of the CEO of the CAB increased the number of responses up to 34 (crude response rate = 7.2%; true response

[33] Source: https://en.wikipedia.org/wiki/Haryana

rate ≈ 7.7%) which was 6 cases below the target minimum sample[34]. Although it would have been possible to collect data from six more Indian respondents in an ad hoc manner, researcher assumed that this might do more harm (bias) than good.

4.5.9 Assumptions Made in Data Collection and Analysis

The following assumptions were made in collecting the data. In research, assumptions are conditions that are impossible to validate, but are likely true (Bryman, 2012; Cooper & Schindler, 2014).

1. Each respondent has sufficient knowledge on their QMS and its achievements to respond to the survey.
2. The respondents would respond to the survey without prejudice.
3. All the respondents in the new countries — Australia and New Zealand — that allow naturalisation of foreign immigrants respond to the questionnaire from the point of view of the values of their adopted countries (this applies to non-natives).
4. In the case of India where only the state of Haryana participated (as mentioned in the previous section, Haryana is a manufacturing heavy state) in the survey, the responses would not be significantly tainted by manufacturing excellence (relative to the remaining states of India) or regional culture.[35]
5. The proportion of ISO 9001:2015 certified companies (the great majority) to ISO 9001:2008 certified companies (the minority) are approximately the same in each country sample.[36]
6. Although the country samples are not probability samples, they are representative enough to make meaningful statistical inferences.[37]

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[34] At least 40 cases per country ideally, although total minimum sample size of 209 is what the power analysis indicates.

[35] Hindi is the state language in Haryana and majority of the Indian states use Hindi and similar Indo-Aryan languages as frequently spoken language.

[36] The data collection was made at a critical juncture where most ISO 9001:2008 are expected to have transitioned to ISO 9001:2015 but it was difficult to verify this accurately.

[37] The researcher tried her best to tally the profile of organisations responded with those in the sampling frame for each country, but this was not always possible to collecting information of each and every organisation in the sampling frame.

4.6 DATA SCREENING, DATA IMPUTATION AND TESTS CONDUCTED BEFORE THE DATA ANALYSIS

4.6.1 Data Screening and Missing Data

Firstly, data contained in the five data sets (because the researcher used a separate Google form for each country, the data were stored in five separate sheets) were screened to check for any unusual entries (such as out of range values for Likert scaled statements). Further, feedbacks and comments were thoroughly investigated in order to identify any reasons for missing data (e.g. the respondent mentioning that some statements in the questionnaire are not relevant for their organisation), but no such reason was found. The researcher also checked for monotone data records — cases across which do not show response variation — as authors suggest that such data records may become candidates for deletion in the screening phase (Hair Jr et al., 2016). As such, 11 data records were deleted (the details in the next chapter).

Missing data were found. This is a typical problem encountered in survey research (Hair Jr et al., 2016). Several approaches to deal with missing values can be found in the literature. The commonly used methods are *pairwise/case-wise deletion*, *replace with mean*, *multiple imputation (MI)*, and *expected maximisation (EM)*. In general, if missing data percentage is greater than 15% for a given data record (i.e. a case or a row in the dataset) the recommendation is to remove the data record (Hair Jr et al., 2016). For the researcher's study, the percentage of missing data was found to be less than 3% for the worst data record (the row that contains the largest number of empty cells). Therefore, applying any advanced imputation technique was not needed. The technique "replace with the mean" was chosen to impute missing data. Thereafter, the five datasets (one for each country) were merged to compose the final dataset, which as mentioned earlier contained 240 usable responses. Also, the additional data filed "country name" was included in the merged dataset.

4.6.2 Normality Testing

Although all major statistical analyses that the researcher conducted — partial least squares path analysis and partial least squares regression — were non-parametric and hence *free from the assumption of "normally distributed data"*, in keeping the suggestion given by Hair Jr et al. (2016), the researcher examined the shapes of data distributions both at individual survey item level as well as aggregated level (ISO 9001:2015 clause-level); Minitab 18 software was used for this purpose. While the data were found to be negatively skewed,[38] given the non-parametric nature of the analysis, the skewness was deemed acceptable.

4.6.3 Testing for Absence of Nonresponse Bias

As the name implies, non-response bias refers to potential biasing of the results due to under-representation of a sub-population of the overall population (Hair, Black, Babin, & Anderson, 2010). Although the research design reduced the likelihood of substantial non-response bias (e.g. avoiding sensitive questions, preserving confidentiality/anonymity of the respondents, and avoiding awkward questions such as asking the respondents to compare their results with the industry average), the responses were scrutinised to exclude non-response bias with the aid of survey items used in Part I of the survey. More specifically, the researcher compared the profiles of the respondents against those in the sampling frames, wherever possible. The proof of absence of substantial non-response bias is given in Chapter 05 (section 5.3.1).

4.6.4 Testing for Absence of Substantial Common Method Bias (CMB)

Common Method Bias (CMB) occurs due to the variance that is attributable to the design and administration of the data collection method rather than the actual variables (or constructs) being used in the data analysis (MacKenzie & Podsakoff, 2012; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The researcher demonstrated absence of substantial CMB via Harman's Single Factor Test (Mat, 2014; Podsakoff et al., 2003) and the Full Collinearity Test (Kock, 2015). The proof of absence of substantial non-response bias is given in Chapter 05 (section 5.3.2).

4.7 STATISTICAL HYPOTHESIS TESTING AND REGRESSION MODEL TESTING TO ANSWER RQ1 and RQ2

Description of statistical techniques that were used in testing the hypotheses (including justification of techniques) and regression models is important in a doctoral study, but that is beyond the scope of a chapter that is dedicated to methodology. This is because methodology should cover only the broader research strategy that was used in achieving the research

[38] The mean and the mode being on the high side of the Likert scale; more so at individual survey item level.

objectives (Bryman, 2012; Cooper & Schindler, 2014). Only a brief account of choice of appropriate techniques is given in this chapter (details are given in Appendix 6).

As mentioned in Chapter 03, the researcher developed empirically testable theoretical models to answer the two research questions. Answering RQ1 requires testing a *path model* that is derived from the ISO 9001:2015 process model. Answering RQ2 requires testing a series hypothesis that involves Hofstede's national culture dimensions as independent variables (predictors) and Plan, Do, Check, Act as dependent variables. The statistical modelling involved in answering RQ2 falls under multiple linear regression involving collinear predictors.

4.7.1 Testing the path model to answer RQ1

Of the two dominant methods available in testing path models, namely the *covariance based structural equation modelling* (CBSEM) and *partial least squares structural equation modelling* (PLS-SEM), the researcher selected the latter for the following reasons:

- Unlike CBSEM, PLS-SEM is not an asymptotic (large sample) method (Chin, 1998; Hair Jr et al., 2016).
- PLS-SEM does not rely on the normally distributed data for statistical inference, whereas CBSEM does rely heavily on multivariate normal distribution of variables included in the correlation/covariance matrix, for statistical inference (Chin, 1998; Hair Jr et al., 2016; Kline, 2011); a multivariate normal distribution is something that is hard to accomplish in many studies (Kline, 2011).
- Testing of researcher's hypotheses require the soft-modelling assumption of treating constructs as linear composites of their indicators, rather than common factors. This is because of the newness of the researcher's constructs (Chin, 1998; Hair Jr et al., 2016), with the possible exception of QMS Resuts. For example, the exogenous construct LDQMSP is not a mature concept in relation to the entire QMS. However, "Plan", the counterpart of LDQMSP is a mature concept in relation to a specific quality improvement project. In fact, explaining and testing what PDCA means to the entire QMS is something novel that has not been answered/tested before.

4.7.2 Testing Models to Answer RQ2

Due to high correlation between the two Hofstede dimensions PDI and IDV, and the ensuing predictor collinearity problem, the standard ordinary least squares multiple linear regression (OLS-MLR) method was deemed unsuitable (details in the Appendix 6) for testing the hypotheses related to RQ2. These hypotheses posit relationships between Hofstede's national culture dimensions (predictors) and five theoretical constructs: Plan (LDQMSP), Do, Check, Act, and QMS Results (response variables), which are themselves correlated. Due to collinearity involving predictors, the partial least squares regression (PLSR) technique was used to fit regression models to data. One of the advantages of PLSR over OLS-MLR is that unlike the latter, the former reduces the dimensionality of the data to avoid over-fitting and related issues such as unstable parameter estimates and variance inflation associated with OLS-MLR, when highly correlated predictors are involved (Abdi, 2010; Geladi & Kowalski, 1986).

In addition to the above mentioned hypothetic deductive approach, as part of the analysis required to answer RQ2, the mean scores of the five constructs in three regions — Australasia, South Asia, and Greece — were compared using one-way analysis of variance (ANOVA).

4.8 CONCLUSION

This chapter covered the broad strategy that the researcher used in answering the research questions to achieve the research objectives. Of the research paradigms in contention, the positivistic paradigm (post positivism to be more precise) was chosen, given the hypothetic-deductive nature of the study. Data collection procedures and strategies were outlined in detail in this chapter, and that included leveraging on the knowledge of subject experts to design a questionnaire (via a Delphi-like method), procedures and strategies adopted in developing the sampling frames and increasing the response rates. In addition, the chapter covered how the researcher handled the data before the statistical analyses. The next chapter presents and discusses hypothesis test results on the model that was used to answer RQ1.

CHAPTER 5

RESULTS AND DISCUSSION PART I: ISO 9001:2015 AS A FRAMEWORK ON CONTINUAL IMPROVEMENT OF THE QUALITY MANAGEMENT SYSTEM

5.1 INTRODUCTION

This chapter presents the empirical results and discussion on the theoretical model that was posited to represent the ISO 9001:2015 process model (details in Chapter 03). In the language of structural equation modelling (SEM), the researcher's model is a latent variable path model (the statistical theory on path models is covered in Appendix 6). The results and the accompanying discussion covered in this chapter answer the first research question, which in effect achieves the first two research objectives of this study. For the convenience of the reader, the first research question and the two corresponding research objectives are reproduced as follows.

RQ1: How does meeting the requirements stipulated in the key clauses of ISO 9001:2015 (Clauses 4 through to 10) predict and explain the expected outcomes of ISO 9001 implementation (QMS Results) via the PDCA approach?

The above research question was partitioned into the following three sub-questions (section 2.8) to better structure the findings:

RQ1a: What does "PDCA for the entire QMS" really mean?

RQ1b: How can the key clauses of ISO 9001:2015 be best aligned to PDCA theoretically?

RQ1c: What is the relationship between the key clauses of ISO 9001:2015, PDCA, and QMS Results?

This chapter is organised as follows. Section 5.2 provides the descriptive statistics of key variables based on the survey data collected. Section 5.3 provides evidence of absence of two forms of biases — the nonresponse bias and common method bias — that survey research is sometimes associated with. Section 6.4 covers the empirical test results of the theoretical model. Section 6.5 provides the discussion on the findings. Finally, section 6.6 provides the summary of the findings and show how the relevant research objectives were achieved.

5.2 DESCRIPTIVE STATISTICS

Descriptive statistics from the very basis of a quantitative analysis because these present the basic features of the data in an efficient manner (Holcomb, 2016). As mentioned in Chapter 5, the survey resulted in 240 responses (from 240 organisations) from the five countries covered in the study. As mentioned in the previous chapter, for inferential statistics purposes, 11 responses were removed, as they seemed suspect (see Table 5.1).

5.2.1 Descriptive Statistics on Organisations and Respondents

Table 5.1 depicts respondents' occupation by country. The data are consistent with the sampling frames being used. For example, in the case of New Zealand and Sri Lanka, the researcher was able to contact most of the organisations in the sampling frame (in the case of Sri Lanka indirectly through the Sri Lanka Standards Institution) to know exactly to who the invitation needs to be sent to. This apparently has resulted in remarkably similar occupation profiles for the two countries. For the remaining countries, the researcher had to rely on publicly available contact information, which resulted in a different occupational representation. For example, as mentioned in Chapter 05, for Greece, the researcher used the Greek Financial Database to compose the sampling frame. This database contained only the contact emails of the top executive(s), which explains why as many as 52% responses for Greece came from top managers. Subject to the assumption that the respondent has knowledge about the quality management system to answer the questionnaire (see section 4.5.8 for the full set of assumptions), dissimilar occupation profiles of the five countries should not affect the quality of the data.

Table 5.1: Respondents' Occupation by Country

Country / Designation	New Zealand	Australia	Greece	India	Sri Lanka	Total
Quality Manager	23 (52%)	21 (43%)	18 (28%)	10 (29%)	26 (54%)	98 (41%)
GM/MD/CEO	05 (11%)	18 (37%)	33 (52%)	07 (20%)	07 (15%)	70 (29%)
Operations Manager	05 (11%)	02 (4%)	04 (6%)	01 (3%)	04 (8%)	16 (7%)
Quality Controller	01 (2%)	01 (2%)	02 (3%)	08 (24%)	01 (2%)	13(6%)
Sales/Mkt./Fin. Manager	04 (9%)	03 (6%)	02 (3%)	0	03 (6%)	12 (5%)
HR Manager	01 (2%)	0	02 (3%)	01 (3%)	0	04 (2%)
Management Rep.	0	0	0	02 (6%)	02 (4%)	0
Other	05 (11%)	04 (8%)	03 (5%)	04 (12%)	05 (11%)	21 (9%)
Missing	01 (2%)	0	0	01 (3%)	0	02 (1%)
Total	45 (100%)	49 (100%)	64 (100%)	34 (100%)	48 (100%)	240 (100%)

Note: As mentioned in the previous chapter, out of the 240 cases responded, 11 responses had to be excluded due to zero variance (in all cases either all 6s or all 7s). More specifically, out of the 45 New Zealand cases, 1 had to be discarded; out of the 49 Australian cases, 4 had to be discarded; out of the 64 Greek cases, 3 had to be discarded; out of the 34 Indian cases, 1 had to be discarded; and finally, out of the 48 Sri Lankan cases, 2 had to be discarded.

Figure 5.1 depicts the representation of the companies[39] by size, for each country as well as for all five countries (total). The following definition provided by the European Commission (2015) was used to categorise companies by size:

< 10 staff is micro,

≥ 10 and < 50 staff is small,

≥ 50 and < 250 staff is medium; and

> 250 staff is large

Figure 6.1 indicates that there is a good representation of small and medium manufacturing companies for each country relative to large manufacturing companies, except in the case of Sri Lanka, where there is a substantial representation of large companies (half of the companies represented the large category for Sri Lanka). Again, this does not necessarily

[39] Unless stated otherwise, the researcher uses the terms company and organisation interchangeably throughout this thesis. Also, a company could be private or public.

show any response bias because the proportions for each country (based on incomplete publicly available information on companies in the sampling frames) approximately represent the proportions corresponding to sampling frames of each country. Sri Lanka is a small country with a limited customer base. Only large organisations that cater to the high-end consumer goods to local markets and international markets pursue ISO 9001 certification. If this is also the case in India, having no representation of micro size companies from India and Sri Lanka make sense.

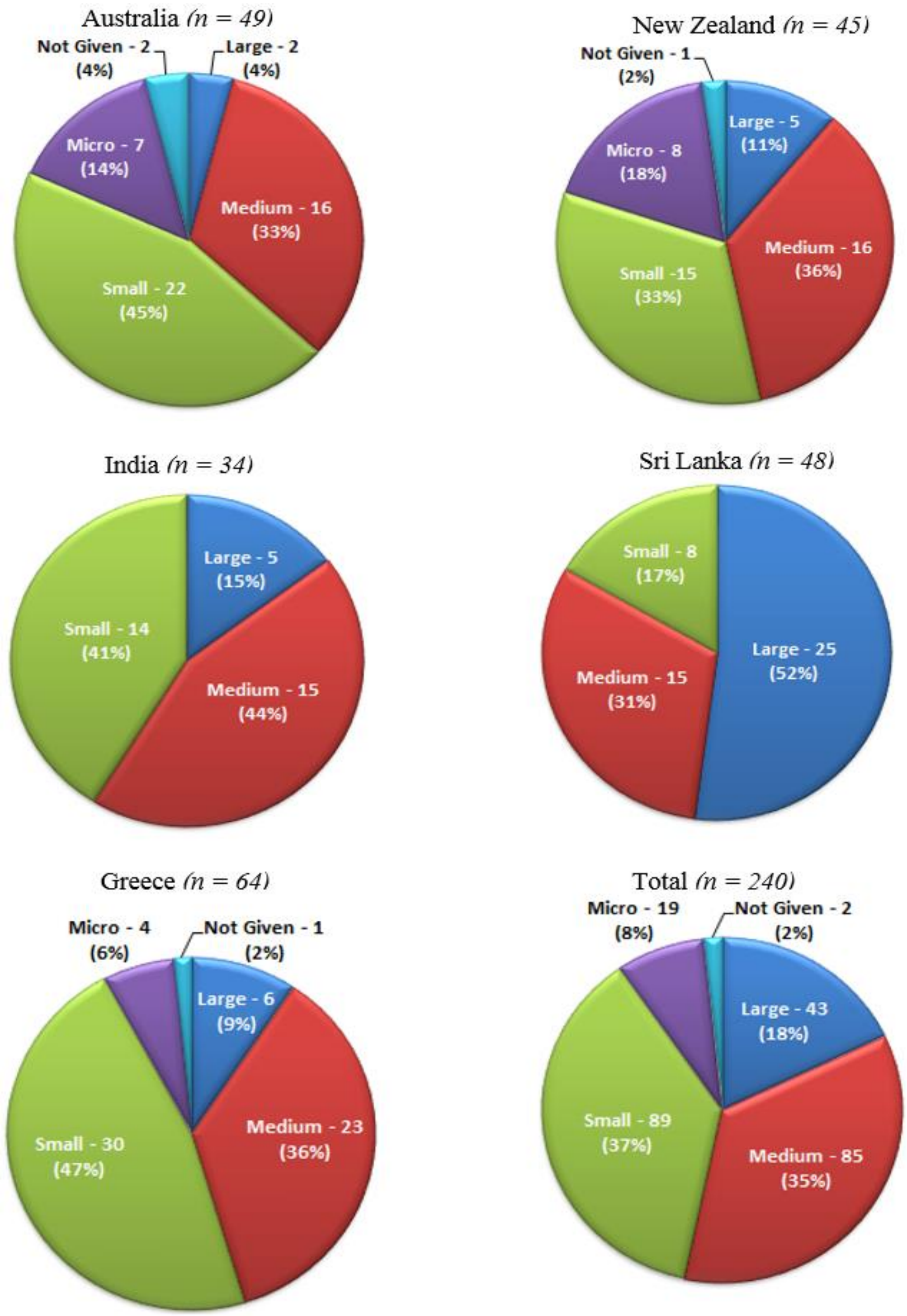

Figure 5.1: The size of the companies based on full time employees

Table 5.2 depicts the most highly represented (top five) industry types for each country. Australia and New Zealand have similarity, in terms of industry type. Incidentally, “food and kindred products” are not among the top five for New Zealand, despite food and beverage industry being a big industry in New Zealand. The same can be said about Sri Lanka for apparel and finished products, the number one export of that country. Again, the researcher would like to emphasise that the pattern of industry representation by type of industry is consistent with the pattern found in the sampling frame (based on incomplete publicly available information on companies in the sampling frames) for each country, and therefore, these patterns do not necessarily suggest any nonresponse bias (more about nonresponse bias in section 5.3.1).

Coming back to food and beverage (F&B) industry in New Zealand, and apparel in Sri Lanka, the two countries rely on other methods and mechanisms of quality assurance rather than third party certification of the quality management system (QMS) against ISO 9001 for the said two industries. There are very strict quality risk management standards for the F&B industry in New Zealand through *hazards analysis and critical control point* (HACCP) approaches as well as what can be regarded as industry specific good operating practices, making ISO 9001 less critical for the F&B industry in New Zealand (Worsley & Scott, 2000). In the case apparel for Sri Lanka, there are tight second party (customer) auditing systems for quality management systems. For example, a large customer such as Nike and Victoria’s Secret would invariably audit the QMS of their supplier on a regular basis and these audits often act as more recognised testimonies on quality assurance rather than an ISO 9001 certificate issued by a third party (Knutsen, 2004).

Figure 5.2 depicts the age of the companies by country, in the form of box plots. It is clear from Figure 5.2 that companies representing India are younger (on average) than companies representing the other four countries. Figure 5.3 depicts quality maturity of the companies by country, in the form of box plots. This figure implies that while Indian companies return a lower value compared to other countries (based on sample means), the mean differences are less pronounced.

Table 5.2: Most Highly Represented (Top 5) Industries by Country

Country	Industry Type as Given in ANZSIC 2006*
New Zealand	Fabricated metal products (6, 15.0%) Electronic and other electrical equipment and components (6, 15.0%) Miscellaneous (6, 15.0%) Not listed** (5, 12.5%) Apparel and other finished products (4, 10.0%)
Australia	Fabricated Metal Products (11, 29%) Electronic and other Electrical Equipment and Components (6, 16%) Miscellaneous Manufacturing Industries (5, 31%) Food and Kindred Products (4, 11%) Not Listed** (4, 11%)
India	Textile Mill Products (4, 15%) Leather and Leather Products (4, 15%) Not listed** (4, 15%) Electronic and other Electrical Equipment and Components (3, 11%) Rubber and Miscellaneous Plastics (3, 11%) Petroleum Refining and Related Industries (3, 11%)
Sri Lanka	Food and Kindred Products (14, 32%) Rubber and Miscellaneous Plastics (9, 21%) Stone, Clay, Glass, and Concrete Products (5, 12%) Chemicals and Allied Products (3, 7%) Not listed** (3, 7%)
Greece	Food and Kindred Products (11, 22%) Chemicals and Allied Products (8, 16%) Not listed** (8, 16%) Fabricated Metal Products (5, 10%) Electronic and other Electrical Equipment and Components (5, 10%)

* The names of industry type have been shortened in most cases for ease of reporting

** “Not listed” means none of the industries listed in the ANZSIC 2006 classification

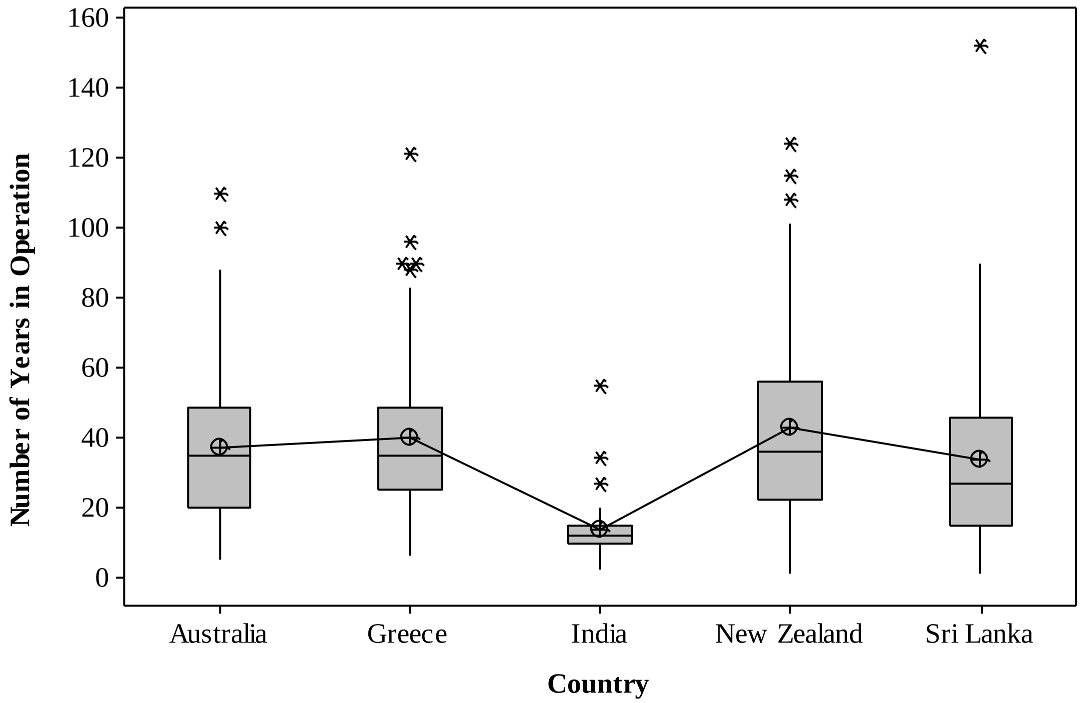

Figure 5.2: The age of the companies by country

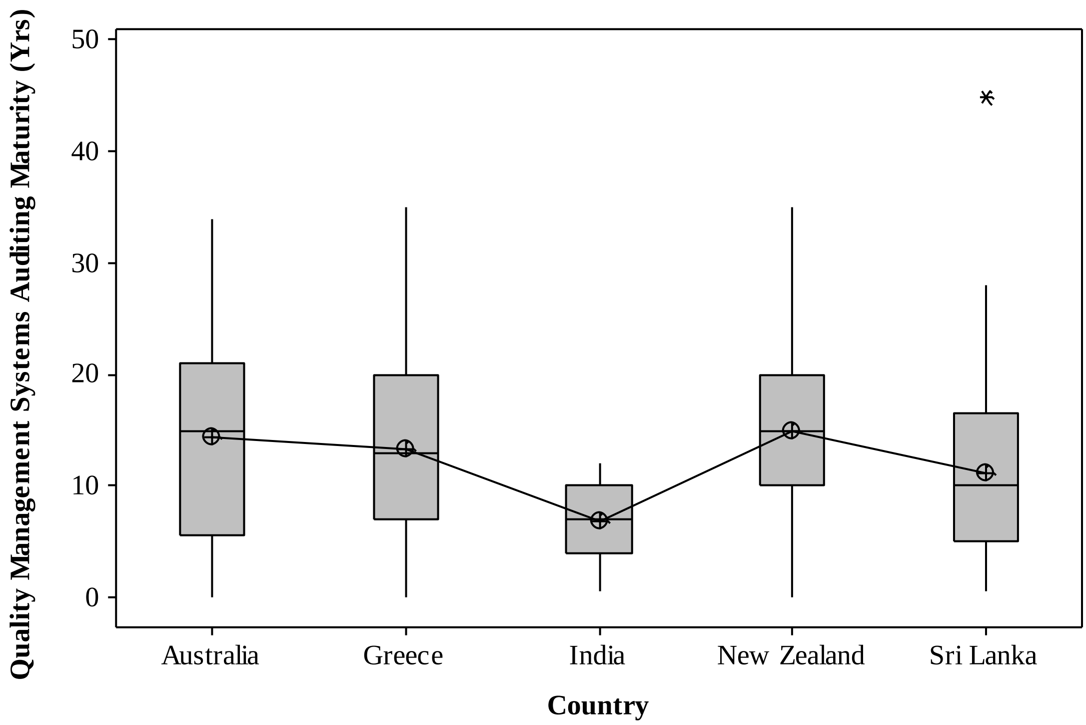

Figure 5.3: The quality maturity of the companies by country

5.2.2 Descriptive Statistics of the Theoretical Variables

Table 5.3 depicts the descriptive statistics of the theoretical variables used in the study for each country, upon removing the 11 cases that were deemed suspect. The last three rows represent the statistics on the three facets of outcomes (QMS Results) of the QMS while the remaining rows represent the statistics on the enablers of the outcomes, based on the ISO 9001:2015 process model. The dispersion (standard deviation) of the data for each variable seems to be quite satisfactory (i.e. there is reasonable variability in the responses) for each country. However, mean scores range between 4.8 and 5.9, which suggest that the data are negatively skewed. This study uses partial least squares methods (partial least squares path modelling and partial least squares regression) to analyse the data; since partial least squares methods do not rely on parametric assumptions (Chin, 1998; Hair Jr et al., 2016) for statistical inference (explained in Chapter 05), it is argued that skewness does not have a detrimental effect in interpreting the findings.

Table 5.3: Average Variable Scores ± SD by Country

Variable \ Country	New Zealand *(n = 44)*	Australia *(n = 45)*	Greece *(n = 61)*	India *(n = 33)*	Sri Lanka *(n = 46)*	Overall *(n = 229)*
Scope	5.741 ± 0.748	5.713 ± 0.782	5.754 ± 0.735	5.889 ± 0.685	5.928 ± 0.837	5.799 ± 0.758
Leadership	5.600 ± 0.748	5.653 ± 0.827	5.626 ± 0.808	5.908 ± 0.681	5.722 ± 0.859	5.671 ± 0.793
Planning	5.382 ± 0.824	5.344 ± 0.934	5.544 ± 0.811	5.713 ± 0.697	5.528 ± 0.863	5.498 ± 0.834
Support	5.386 ± 0.831	5.346 ± 1.042	5.538 ± 0.792	5.790 ± 0.631	5.658 ± 0.779	5.532 ± 0.835
Operation (DO)	4.769 ± 0.943	4.858 ± 0.998	5.000 ± 0.975	4.984 ± 0.756	4.905 ± 0.928	4.907 ± 0.9294
Evaluation (CHECK)	5.246 ± 0.952	5.256 ± 0.927	5.494 ± 0.942	5.806 ± 0.653	5.657 ± 0.879	5.477 ± 0.910
Improvement (ACT)	5.415 ± 0.924	5.333 ± 1.208	5.749 ± 0.879	5.916 ± 0.588	5.529 ± 0.910	5.586 ± 0.944
QMS Results	5.262 ± 1.188	5.298 ± 1.066	5.769 ± 0.692	5.897 ± 0.745	5.609 ± 0.802	5.566 ± 0.932
Customer Satisfaction	5.364 ± 1.150	5.581 ± 1.052	5.734 ± 0.814	5.909 ± 0.843	5.587 ± 0.933	5.629 ± 0.967
Product Quality Improvement	5.356 ± 1.417	5.266 ± 1.292	6.000 ± 0.796	6.000 ± 0.750	5.783 ± 0.867	5.692 ± 1.089
Reduction of Nonconformities	5.067 ± 1.388	5.047 ± 1.327	5.574 ± 0.957	5.727 ± 0.839	5.457 ± 0.887	5.376 ± 1.123

Results shown in Table 5.3 also indicate that there is more parity in the scores between neighbours across the Tasman sea (Australia and New Zealand) than between the neighbours across the Sethusamudram canal (India and Sri Lanka), with Indian respondents outscoring their neighbours (and other countries too) in nearly all the theoretical variables.[40]

5.3 EVIDENCE OF ABSENCE OF SUBSTANTIAL BIASES

As discussed earlier in the section 5.6, biasing of results is not an uncommon problem in survey research (Armstrong & Overton, 1977; MacKenzie & Podsakoff, 2012; Podsakoff et al., 2003). Two common sources of bias are examined in this section: *nonresponse bias* and *common method bias*.

In addition to above, it was decided by the researcher that the five respondents who gave a 7 (strongly agree) rating for all the survey items would not bias the results. A rating of 7 is not in any way fully equivalent to 100% in a ratio scale. A “7” is one of the seven choices the researcher has been given to the respondents and choosing a 7 for all items in the questionnaire merely represents super-excellent achievement in the test conducted by the researcher. Pragmatically, 5 respondents out of 240 (2%) achieving super-excellence[41] cannot be viewed as unusual.

5.3.1 Nonresponse Bias

As mentioned in Chapter 05, nonresponse bias results when a sub-set of potential respondents who do not respond to a survey do systematically differ from the actual respondents. This causes numerous issues including erroneous inferences and misleading conclusions over the population parameters (Armstrong & Overton, 1977; Barclay, Todd, Finlay, Grande, & Wyatt, 2002). In this research, precautions were taken to avoid possible nonresponse bias during the design phase of the questionnaire by carefully wording the survey items. The members of the Delphi panel who contributed towards development of questionnaire items were instructed to avoid ISO 9001 rich language to the extent possible; furthermore the Delphi panellists were encouraged to develop simple and succinct statements to avoid complexity, as complex statements would potentially put-off certain managers (e.g. managers in countries that use English as their second language);

[40] Reporting the statistical significance of a difference (*p* values) is not relevant in a section on descriptive statistics.
[41] Ultra-excellence as perceived by the respondent.

in addition, the researcher moderated and edited the questionnaire development process throughout the three Delphi phases being used.

Comments and feedback received from respondents during the pilot testing stage of the questionnaire were also useful in avoiding potentially ambiguous statements, although only minor changes were needed, and that too, for few questionnaire items. Further efforts were taken during the questionnaire administration, such as ensuring the confidentiality of the respondents and their companies as well as avoiding busy periods or inactive periods (e.g. first three weeks of April is an inactive period in Sri Lanka and some parts in India due to religious/cultural festivals) to launch the survey. Taking precautions to avoid nonresponse bias was deemed extremely important because unlike in typical surveys, tallying demographic characteristics of the sampling frame with those of the respondents (e.g. size, manufacturing industry subgroup, quality maturity, age etc.) was difficult, in part due to complexity (five countries and a large number of companies to deal with) and in part due to incomplete publicly available information on companies invited for the study (however, see below).

The 240 responses collected from the five countries resulted a 10.2% of overall response rate, which was deemed acceptable for a web-based survey involving busy executives (Manfreda et al., 2008)[42]. In the case of India and Sri Lanka (high power distance nations), the researcher experienced first-hand what difference a person of authority can make. Prior to requesting the deputy director general of the Sri Lanka Standards Institute — the largest certificate awarding body (CAB) in Sri Lanka — to request their clients to respond to the researcher's invitation to participate in the survey, only seven responses were received. Similarly, prior to requesting the CEO of a large Indian CAB to intervene (a similar arrangement to the one made for Sri Lanka), only six responses were received. Responses began to arrive thick and fast when the two respective authorities in the subcontinent sprang into action! In the case of Australia, New Zealand, and Greece, no such third-party directive was ever needed.

An attempt was made to compare demographic characteristics of so called "early bird respondent organisations" (organisations that responded to the survey quickly) and "late

[42] The 10.2% response rate was based on the following statistics. For New Zealand, out of the 300 invited, 45 responded (15%); for Australia, out of the 600 invited, 49 responded (8.2%); for Greece, out of the 790 invited, 64 responded (8.1%); for India, out of the 470 invited, 34 responded (7.2%); for Sri Lanka, out of the 200 invited, 48 responded (24%); overall, out of the 2360 invited, 240 responded (10.2%).

respondent organisations" of each country to check whether or not the characteristics of the two groups differ. This was not possible for India and Sri Lanka because nearly all the data came together after the third-party intervention. If the early-late demographic characteristics differ significantly, according to Barclay et al. (2002), it is reasonable to assume that a survey could be tainted with nonresponse bias. Comparison between early respondents and late respondents — in term of size and quality maturity[43] — of New Zealand, Australia and Greece suggest that there is no statistically significant difference between the two groups (at $\alpha = 0.05$). Appendix 7 shows the results for Greece, as an example. The conclusion is that there is no strong reason to believe that a significant nonresponse bias exists in the responses.

5.3.2 Common Method Bias (CMB)

As mentioned in Chapter 05, common method bias (CMB) is a form of systematic error that results in variation that is mostly attributable to the method being used to collect the data, than due to the true variation attributable to the constructs — for example, explained variation in ANOVA (Podsakoff, MacKenzie, & Podsakoff, 2012). Since CMB threaten the quality of the inferences on hypothesis test results, it is important to demonstrate (after the fact) that there is no significant CMB in the survey responses. Two statistical methods – *Harman's single factor test* and *full collinearity test* – were conducted to test CMB and the results are shown below.

5.3.2.1 Harman's Single Factor Test for CMB

According to the Harman's single factor criteria (Harman, 1976), CMB is said to exist if the following two conditions exist: (a) only one component being extracted in the initial (un-rotated) factor solution on principal components analysis of survey questions belonging to the theoretical variables (in this study, all survey items contained in part II of the questionnaire), and (b) the first component (PC1) extracting a significant proportion of the total variability of the measures (in the un-rotated factor solution). While different authors have prescribed what proportion of total variation being extracted by the first component can be deemed significant, the one being prescribed by Podsakoff et al. (2012) — greater than 50% of total variation — is being frequently cited. Results in Table 5.4 on PCA results show that while six factors have been extracted, the first factor (component) extracts little under 50% (49.385% to 3dp) of the total variation in the data

[43] By quality maturity, the researcher means how long independent QMS audits have been taking place.

(measures). Overall, Harman's single factor test results suggest that no serious issues on CMB exist on the data. Since all constructs in the researcher's two theoretical models (see Figures 6.5 and 6.7) converge to CI, one expects strong correlations between the elements (clauses) as well as the sub-elements (indicators of the clauses) of ISO 9001, which means that one would expect the first principal component (PC1) in an un-rotated factor solution to extract a significant amount of total variation via PCA; on the same token, one would not expect many factors (components) to emerge because at a higher abstraction level, CI itself is a single construct (Jayamaha et al., 2014).

As mentioned earlier, Harman's single factor test is the simplest and commonly used statistical test to test for CMB, although it is not the best test on CMB (Favero & Bullock, 2014; Podsakoff et al., 2003). For this reason, a supplementary test on CMB was considered. Accordingly, the "full collinearity assessment approach" prescribed by Kock (2015) was conducted (the next subsection).

Table 5.4: Harman's Single Factor Test Results

Component (Factor)	Eigenvalue	% of Total Variance	Cumulative %
1	19.260	49.385	49.385
2	2.359	6.048	55.433
3	1.887	4.838	60.272
4	1.231	3.156	63.428
5	1.046	2.682	66.110
6	1.002	2.569	68.679
The Kaiser criterion (Kaiser, 1960) of Eigenvalue > 1.0 was used in extracting factors.			

6.3.2.2 Full Collinearity Assessment Test for CMB

Full collinearity test assesses if two or more latent variables in the theoretical model do explain the same underlying concept, within a collinearity assessment framework. If this happens to be case, Kock (2015) argues that redundancy occurs not due to constructs (latent variables) but due to data suffering from CMB.

As mentioned in the previous chapter, the 39 questionnaire items that capture data to test the theoretical model posited in Chapter 3 belong to the seven key causes of ISO 9001:2015 and QMS Results. Table 5.5 shows how the 39 questionnaire items have been assigned to the key clauses of ISO 9001:2015 and QMS Results along with their bivariate correlations. These correlations have been calculated based on factor scores. The correlations show that clauses 4 through to 7 are strongly correlated ($r > 0.7$), which is something that one can expect, given that all these causes belonging to the exact same construct, which is Leadership Driven Quality Management System Planning (LDQMSP). However, it appears that clause 9 (Performance Evaluation) has strong correlations with three clauses belonging to LDQMSP. Given that LDQMSP represents Plan in a PDCA context (for the overall QMS) and Performance Evaluation represents Check in a PDCA context, these strong correlations may mean that there could be few worries about construct validity (more technically precisely, discriminant validity), a matter that would be dealt with in detail later on (section 5.4.1.2).

Table 5.5: Correlations Between the Key Clauses of ISO 9001:2015 Plus QMS Results

	Clauses Representing the Construct "LDQMSP"							
	Clause 4	Clause 5	Clause 6	Clause 7	Clause 8	Clause 9	Clause 10	QMS Results
Clause 4 (Scope) *3 questionnaire items*	--							
Clause 5 (Leadership) *5 questionnaire items*	0.772	--						
Clause 6 (Planning) *5 questionnaire items*	0.710	0.806	--					
Clause 7 (Support) *7 questionnaire items*	0.673	0.835	0.802	--				
Clause 8 (Operation) *8 questionnaire items*	0.603	0.666	0.639	0.687	--			
Clause 9 (Performance Evaluation) *5 questionnaire items*	0.622	0.759	0.784	0.796	0.667	--		
Clause 10 (Improvement) *3 questionnaire items*	0.522	0.670	0.652	0.720	0.633	0.670	--	
QMS Results *3 questionnaire items*	0.461	0.533	0.537	0.631	0.532	0.596	0.654	--

Figure5.4 depicts the five latent variables (constructs) in the theoretical model (Plan/LDQMSP, Do/Clause 8, Check/Clause 9, Act/Clause 10, and QMS Results) as linear predictors of some random construct, along with variance inflation factors (VIF values) of the predictors. The goal here is to assess collinearity among the five predictor latent variables, based on *factor scores*, using the prescribed VIF cut-off thresholds for absence of collinearity issues. The factor scores were generated by SmartPLS software, based on the indicators assigned to each factor, except in the case of the random construct (scores of this random construct were generated via the Rand() function in Excel).

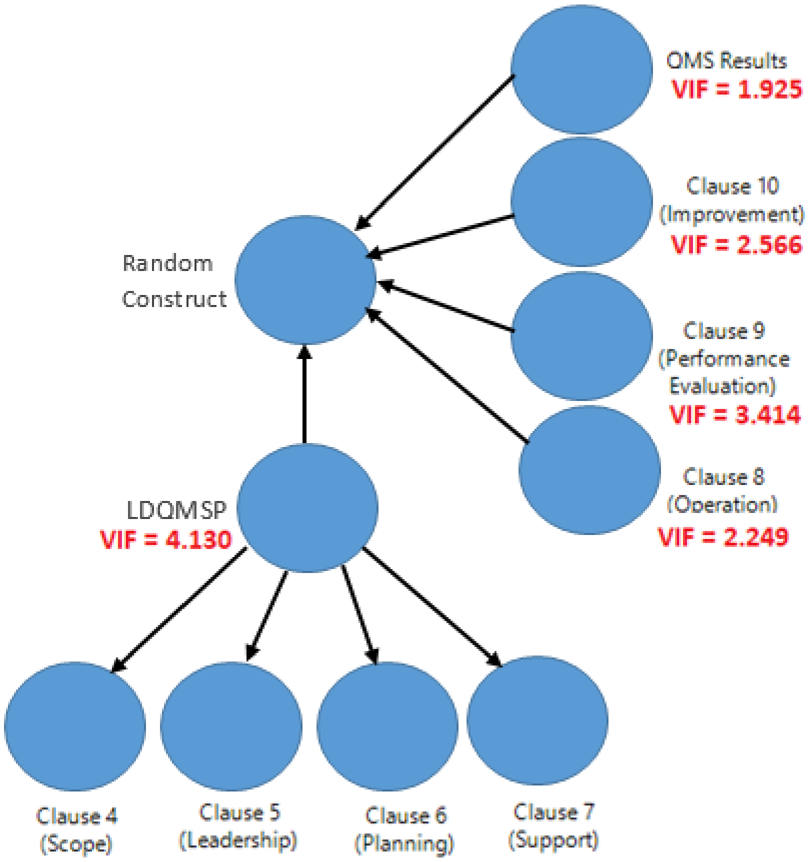

Figure 5.4: Model assessing the CMB based on full collinearity test

The VIF values depicted in Figure 5.4 indicate that there is no strong evidence of collinearity involving the latent variables based on the VIF = 10.0 threshold (liberal) and the VIF = 5.0 threshold (conservative). However, the VIF values of LDQMSP and Performance Evaluation could be seen as problematic by a very conservative researcher based on the VIF = 3.0 threshold (see Hair et al., 2010 for VIF threshold values). ISO 9001:2015 is an integrated management system (Tricker, 2016). Therefore, one expects all the elements of the standard (i.e. the clauses) to be markedly correlated with one another. As mentioned earlier, a close examination on discreetness of constructs is examined later, under discriminant validity. Thus, unless one is very conservative, the full collinearity test suggests that there is strong evidence of CMB based on the criterion prescribed by Kock (2015).

The conclusion is that neither the Harman's single factor test nor the full collinearity test suggest compelling evidence of presence of CMB. In the next section and beyond, the researcher presents the hypothesis test results on the theoretical models on the grounds that the data are not biased.

5.4 TEST RESULTS OF THE MODEL POSITED TO ANSWER RQ1

The researcher's theoretical model which explains how QMS Results are caused by meeting the s requirements stipulated in ISO 9001:2015 is shown in Figure 3.2 in Chapter 03. This model was developed by logically arranging the ISO 9001:2015 clauses (Clause 4 through to Clauses 10) to represent the PDCA cycle with "do" and "Act" causing QMS Results. As the theoretical model implies, PDCA cycle is much more complex than envisioning that Plan leads to Do; Do leads to Check; Check leads to Act; and Act, leads to improvement through iterative cycles of PDCA to cause QMS Results. The theoretical model posits several mediation paths that mediate the above-mentioned relationships.

Figure 5.5 depicts the full mode l — the outer model, which is the measurement model and the inner model, which is the structural model representing the hypotheses — along with estimated parameters. Prior to interpreting these results, it is necessary to demonstrate that the scales being used to operationalise the constructs of the model are reliable and valid (Chin, 1998; Hair Jr, Sarstedt, Hopkins, & Kuppelwieser, 2014). This leads to assessing the measurement model via methods used in *partial least squares structural equation modelling* (PLS-SEM) (technical details in Appendix 6).

5.4.1 Assessing the Quality of the Measurement Model

The adequacy of the measurement scales has been demonstrated via *scale reliability analysis* and *construct validity analysis*. As mentioned in Appendix 07, reliability (more precisely, internal consistency reliability) estimates the consistency of the measures of a construct, whereas validity establishes the fact that the measures that operationalise the constructs measure what they are supposed to measure (i.e. the constructs). *Cronbach's alpha* and *composite reliability* estimates have been presented to demonstrate the internal consistency reliability of the scales, while convergent *validity* and *discriminant validity* results have been presented to demonstrate construct validity in SEM (Gefen & Straub, 2005; Hair Jr et al., 2014). In addition, because overall goodness of fit (global fit) indicators of the model are now being increasingly used in PLS-SEM studies (Henseler, Hubona, & Ray Pauline, 2016), these figures are also reported. One advantage with these global fit measures is that these figures can be interpreted using the same cut-off thresholds used in more established covariance based structural equation modelling (CBSEM).

5.4.1.1 Internal Consistency Reliability

Table 5.6 depicts the Cronbach's alpha estimates and composite reliability estimates of the scales being used to operationalise the five constructs in the model. As depicted in Table 5.6, Cronbach's alpha estimates and composite reliability estimates of all five constructs easily meet the reliability thresholds: ≥ 0.7 is acceptable; ≥ 0.80 is good; and ≥ 0.90 is excellent (Nunnally, 1978, p. 245). If anything, very high reliability coefficients of Do (≈ 0.95) may mean that there is a great deal of overlap between the eight survey questionnaire items that were used to operationalise that construct, which is also Clause 8 of ISO 9001:2015 (Carmines & Zeller, 1979; Nunnally, 1978). In any case, because Cronbach's alpha estimates and composite reliability estimates return excellent figures, it is concluded that the measurement scales are internally consistent and reliable.

Table 5.6: The Reliability Statistics for the Constructs in Conceptual Model 1

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
LDQMSP	0.927	0.948	0.820
Do	0.949	0.958	0.740
Check	0.835	0.890	0.669
Act	0.832	0.899	0.748
QMS Results	0.851	0.910	0.771

5.4.1.2 Construct Validity

In PLS-SEM, construct validity is assessed via two forms of validity: *convergent validity* and *discriminant validity* (technical details in Appendix 07).

Convergent Validity

Convergent validity is said to be shown if the measures that are theoretically assigned to a construct do share a substantial portion (> 50%) of the variability (variance) of that construct (Hair Jr et al., 2014; Chin, 1998). The measure average variance extracted (AVE), along with the factor loadings (outer loadings) of the measures were used to examine the convergent validity of each construct in the model (technical details of convergent validity including the definition of AVE is given in Appendix 07). As shown in Table 5.6, the AVE values stand well above the 0.5 minimum value prescribed in the literature for convergent validity (Hair Jr et al., 2014; Chin, 1998). Moreover, the loadings of the measures of the five constructs easily exceed the minimum value of 0.707 (see Figure 6.8) prescribed in the literature for convergent (Hair Jr et al., 2014; Chin, 1998). Thus, both AVE values and factor loadings (> 0.707 and p < 0.001) demonstrate the convergent validity of the constructs used in the model.

Discriminant Validity

Discriminant validity is said to be shown if the measures that are theoretically assigned to a construct do correlate more strongly with their theoretical constructs than with other constructs (Hair Jr et al., 2014; Chin, 1998). Currently, the three are three accepted approaches to examine discriminant validity: the loadings > cross-loadings criterion, Fornell-Larker criterion (Fornell & Larker, 1981), and the hetero-trait mono-trait (HTMT) ratio of correlations criterion (Henseler, Ringle, & Sarstedt, 2015). The latter being more robust and fool proof than the two other liberal approaches (Ab Hamid, Sami, & Mohmad Sidek, 2017; Franke & Sarstedt, 2019; Hair Jr, et al., 2017; Henseler et al., 2016; Henseler, Ringle, & Sarsted, 2015).

Table 5.7 shows the loadings-cross-loadings matrix of the measures. The figures highlighted in a column representing a construct (e.g. LDQMSP) are the loadings: the association between the construct and its measures. The remaining figures under each column are the cross loadings: the association between a construct and a measure that is not theoretically assigned to that construct. The cross-loadings > loading criterion, as the inequality sign implies, requires loadings to be greater than cross-loadings for discriminant validity. The results shown in Table 5.7 clearly suggest that this criterion is being met rather easily.

Table 5.7: Evidence of Discriminant Validity based on Cross-Loadings

Measure	LDQMSP	Do	Check	Act	QMS Results
Scope	**0.846**	0.597	0.586	0.516	0.454
Leadership	**0.941**	0.664	0.728	0.672	0.532
Planning	**0.915**	0.640	0.769	0.653	0.536
Support	**0.917**	0.686	0.765	0.718	0.629
OPR1	0.591	**0.817**	0.552	0.526	0.444
OPR2	0.589	**0.870**	0.568	0.537	0.426
OPR3	0.583	**0.825**	0.571	0.527	0.442
OPR4	0.584	**0.856**	0.507	0.538	0.467
OPR5	0.550	**0.803**	0.495	0.472	0.411

Measure	LDQMSP	Do	Check	Act	QMS Results
OPR6	0.736	**0.975**	0.672	0.648	0.546
OPR7	0.599	**0.848**	0.563	0.502	0.418
OPR8	0.670	**0.879**	0.592	0.600	0.490
EVA2	0.650	0.457	**0.790**	0.452	0.446
EVA3	0.567	0.446	**0.782**	0.491	0.521
EVA4	0.697	0.657	**0.866**	0.592	0.536
EVA5	0.668	0.571	**0.830**	0.658	0.474
IMP1	0.627	0.523	0.572	**0.875**	0.554
IMP2	0.567	0.539	0.529	**0.875**	0.562
IMP3	0.649	0.582	0.651	**0.845**	0.584
RES1	0.532	0.457	0.511	0.552	**0.842**
RES2	0.536	0.466	0.572	0.608	**0.900**
RES3	0.507	0.478	0.504	0.567	**0.891**

As evidenced in Table 5.8, the square roots of AVE of any of the five constructs in the model exceeds the correlations a construct has with the remaining constructs[44], which is the Fornell-Larker criterion that needs to be met for discriminant validity (Fornell & Larcker, 1981).[45] However, closer examination of figures reveal that the square root of Check (= 0.818) is very close (but do not exceed) to the correlation Check has with LDQMSP (= 0.792). The situation thus far is that the correlations easily met the loadings > cross-loadings criterion but when it came to the Fornell-Larker criterion, while the criterion was met, there was once correlation that was very close to exceeding the square root of AVE, which definitely warrants examination of the HTMT correlations for final clearance on discriminant validity.

Table 5.8: The Correlations Between Constructs and the Square Root of AVE of Constructs

Construct	LDQMSP	Do	Check	Act	QMS Results
LDQMSP	0.906				
Do	0.716	0.860			
Check	0.792	0.659	0.818		
Act	0.712	0.635	0.678	0.865	
QMS Results	0.598	0.532	0.603	0.656	0.878
Note: The diagonal elements show the square root of AVE of a construct. The off-diagonal elements show the actual correlations between constructs.					

[44] For example, the square of AVE is 0.906. This figure is greater than 0.716, 0.792, 0.712, and 0.598, which are the correlations LDQMSP has with Do, Check, Act, and QMS Results respectively.

[45] Technical details on discriminant validity assessment are given in Appendix 07.

Table 5.9: Discriminant HTMT Ratios of Correlations

Construct	LDQMSP	Do	Check	Act	QMS Results
LDQMSP					
Do	0.759				
Check	**0.891**	0.729			
Act	0.803	0.711	0.801		
QMS Results	0.669	0.590	0.716	0.778	
Note: The 95% bootstrap confidence intervals of the above ratios do not include or exceed 1.000.					

Table 5.9 depicts the HTMT ratios of correlations under review. Two sub-criteria have been prescribed in the literature (Hair Jr et al., 2017; Henseler et al., 2015). One is that the ratios should be significantly less than 1 at 5% significance level (i.e. 95% confidence intervals should not include or exceed 1.000). The results meet this sub-criterion. The second sub-criterion is that point estimates the ratios should be below a certain upper bound value. Henseler et al. (2015) who introduced the HTMT approach to test discriminant validly recommend an upper bound HTMT ratio of 0.90 as being adequate, although a more conservative figure of 0.85 would provide more assurance on the discreteness of the constructs. The results shown in Table 5.9 shows that all ratios meet the < 0.90 criterion, but one ratio (= 0.891) fails to meet the < 0.85 criterion, which is the most stringent criterion currently available on discriminant validity. This implies that while the operationalisations of LDQMSP and Check show just-adequate levels of discreetness, they can further be improved. The reader will note from Figure 5.5 that one measure belonging to the construct Check (EVA1 to be specific) has not been considered. The main reason for deleting this measure is to meet the HTMT ratio of correlations < 0.90 criterion (deletion of EVA1 also increased internal consistency reliability of the construct Check).

Considering all the test results on internal consistency reliability, convergent validity, and discriminant validity, it is concluded that the operationalisations of the constructs fulfil the requirements of construct validity.

5.4.2 Assessing the Quality of the Structural Model

As mentioned in Appendix 07 (section 7.4.4), collinearity assessment of endogenous constructs of the path model is a necessary first step in assessing the quality of the structural model (see Figure 5.6 for the structural model only, along with estimated standardised structural regression coefficients). In the theoretical model, there are three sets of causal predictive relationships:

- Do is being predicted by LDQMSP
- Check is being predicted by LDQMSP and Do
- Act is being predicted by LDQMSP, Do, and Check
- QMS Results is being predicted by Do and Act

Of the above, all but the first relationship involved multiple predictors. As such, existence of potential collinearity issues involving these multiple predictors was examined, using the variance inflation factors of the predictors. As depicted in Table 5.10, the VIF values for the predictor constructs happen to be far lower than the threshold value 4.0 used in this study (technical details in Appendix 6), thus demonstrating absence of serious collinearity issues in the causal predictive relationships.

Table 5.10: Collinearity Diagnostics Involving Multiple Regression Models

<table>
<tr><th colspan="2">First Set of Multiple Regression Equations
(LDQMSP and Do predicting Check)</th><th colspan="2">Second Set of Multiple Regression Equations
(LDQMSP, Do, and Check predicting Act)</th></tr>
<tr><th>Predictor</th><th>VIF</th><th>Predictor</th><th>VIF</th></tr>
<tr><td>LDQMSP</td><td>2.050</td><td>LDQMSP</td><td>3.259</td></tr>
<tr><td>Do</td><td>2.050</td><td>Do</td><td>2.152</td></tr>
<tr><td colspan="2"></td><td>Check</td><td>2.811</td></tr>
<tr><th colspan="2">Third Set of Multiple Regression Equations
(Do and Act predicting QMS Results)</th><td colspan="2"></td></tr>
<tr><th>Predictor</th><th>VIF</th><td colspan="2"></td></tr>
<tr><td>Do</td><td>1.667</td><td colspan="2"></td></tr>
<tr><td>Act</td><td>1.667</td><td colspan="2"></td></tr>
</table>

As the second step of assessing the quality of the structural model (technical details in Appendix 6), the size of the path coefficients, their significance (p values) and confidence intervals were examined along with the R2 values of endogenous constructs. Figures 5.5 and 5.6 (Figure 5.5 depicts the full model while Figure 5.6 depicts the structural model only) depict the size of the path coefficients (standardised structural regression coefficients), and the R2 values of the endogenous constructs. Table 5.11 depicts the size of the path coefficients, their p values, their 95% confidence intervals, and the effect sizes in terms of Cohen’s f2. As evidenced in Figure 5.5 (also Table 6.11), the estimated path coefficients for the model relationships vary between 0.190 (*Do* → *Check*) and 0.719 (*LDQMSP* → *Do*). As shown in the Table 5.11, all the eight path coefficients are significant at the 0.05 level, with some returning $p < 0.001$.

Moreover, the relevance of the path relationships in the path model (Figure 6.6) becomes even more evident from the significance (p values) of the total effects (total effect = direct effect + indirect or mediated effects, if any) depicted in Table 5.12. The results suggest that the total effects of all hypothesised relationships are significant at 0.05 level. Also, the R^2 values associated with the endogenous constructs (Figure 6.6), which range from 0.453 to 0.644, suggest "large effects", based on size classification prescribed by Cohen (1992), in terms of Cohen's f^2. Based on Cohen (1992, p. 157), the lower-bound f^2 value for a *large effect* (a practically large combined predictor-response relationship in multiple regression) is 0.35, which translates to an R^2 value of 0.259; similarly, the lower-bound f^2 value for a *medium effect* (a practically medium combined predictor-response relationships) is 0.15, which translates to an R^2 value of 0.130; also, the lower-bound f^2 value for a *small effect* (a practically small combined predictor-response relationships) is 0.02, which translates to an R^2 value of 0.020.[46] The above, said some hypothesized paths return very low values of standardized regression coefficients (albeit, $p < 0.05$) based on Cohen's f^2 values (e.g. *Do* → *QMS Results*). The practical implication of this is discussed later.

5.4.3 Assessing the Overall Goodness-of-fit Model

Until recently, a widely accepted global goodness-of-fit (GoF) measure for PLS-SEM was not available, which was one of the shortcomings of this method. The latest literature (e.g. Henseler et al., 2016) suggest that this shortcoming has been made good by developers of PLS-SEM software. Of several sororate global GoF measures (these are actually surrogating the global GoF measures used in CBSEM) that have been recently developed for PLS-SEM, at the time of concluding this research in 2020, only one global GoF measure — standardized root mean square residual (SRMR) — seems to have received wide acceptance, according to Henseler et al. (2016, p. 9). Henseler et al. suggest the same SRMR $\leq$ 0.08 criterion prescribed by Hu and Bentler (1999) for an "acceptable fit" for CBSEM. Since the researcher's model returned an SRMR of 0.058, it is concluded that that the overall GoF of the model to data is quite acceptable.

[46] Cohen (1992, p. 157) defines his f^2 for regression analysis as $f^2 = R^2/(1-R^2)$.

Having shown that the measurement model, structural model, and the overall model meet the quality criteria prescribed in the literature, in the next section, the researcher discusses the results from theoretical and practical standpoints.

Based on the hypothesised theoretical model, only Do and Act have direct effects on QMS Results (see Figure 3.2 or 5.5 or 5.6). One can always raise the question why LDQMSP and Check have no direct effect on QMS. Through conceptual reasoning, it is easy explain why LPQMSP should not directly relate to QMS Results. The answer is, as explained in the model development stage (section 3.3.2 in Chapter 03), no plan achieves results, unless the plan is being implemented; thus, at least the Do stage is necessary for LDQMSP to bear fruit. However, the conceptual reasoning provided by the researcher on why Check should not directly relate to QMS Results (see section 3.3.2) can be challenged. The researcher argued that checking itself makes no direct impact on QMS Results, unless appropriate action is taken (this action comes only in the Act stage). Using the assertions of Deming (1993a) and others (e.g. Gorenflo & Moran, 2011; Moen & Norman, 2010), one can argue that a considerable amount of learning takes place at the Check stage, and therefore, this learning can directly affect QMS Results. For this reason, a *robustness analysis of the model* was conducted by adding additional paths from LDQMSP → QMS Results and Check→ QMS Results to check whether the theoretical reasoning provided by the researcher for exclusion of these paths is supported by data.

The robustness analysis of the modified model (details in Appendix 8) revealed that the induced LDQMSP → QMS Results path is nonsignificant (p = 0.445), and so is the induced Check→ QMS Results path (p = 0.116). Somewhat surprisingly, the analysis revealed that the Do→ QMS Results path now becomes nonsignificant (0.425). The analysis revealed that either the pair of Do and Act must be retained as explanatory variables of QMS Results, or the pair Check and Act must be retained as explanatory variables of QMS Results. The reader may refer to Appendix 8 to know why the researcher selected the hypothesized Do→ QMS Results path (H7) in favour of the Check → QMS Results path (this path is of course not any hypothesised relationship), in addition to the hypothesised Act → QMS Results path (H8), which always remained highly significant (p < 0.001).

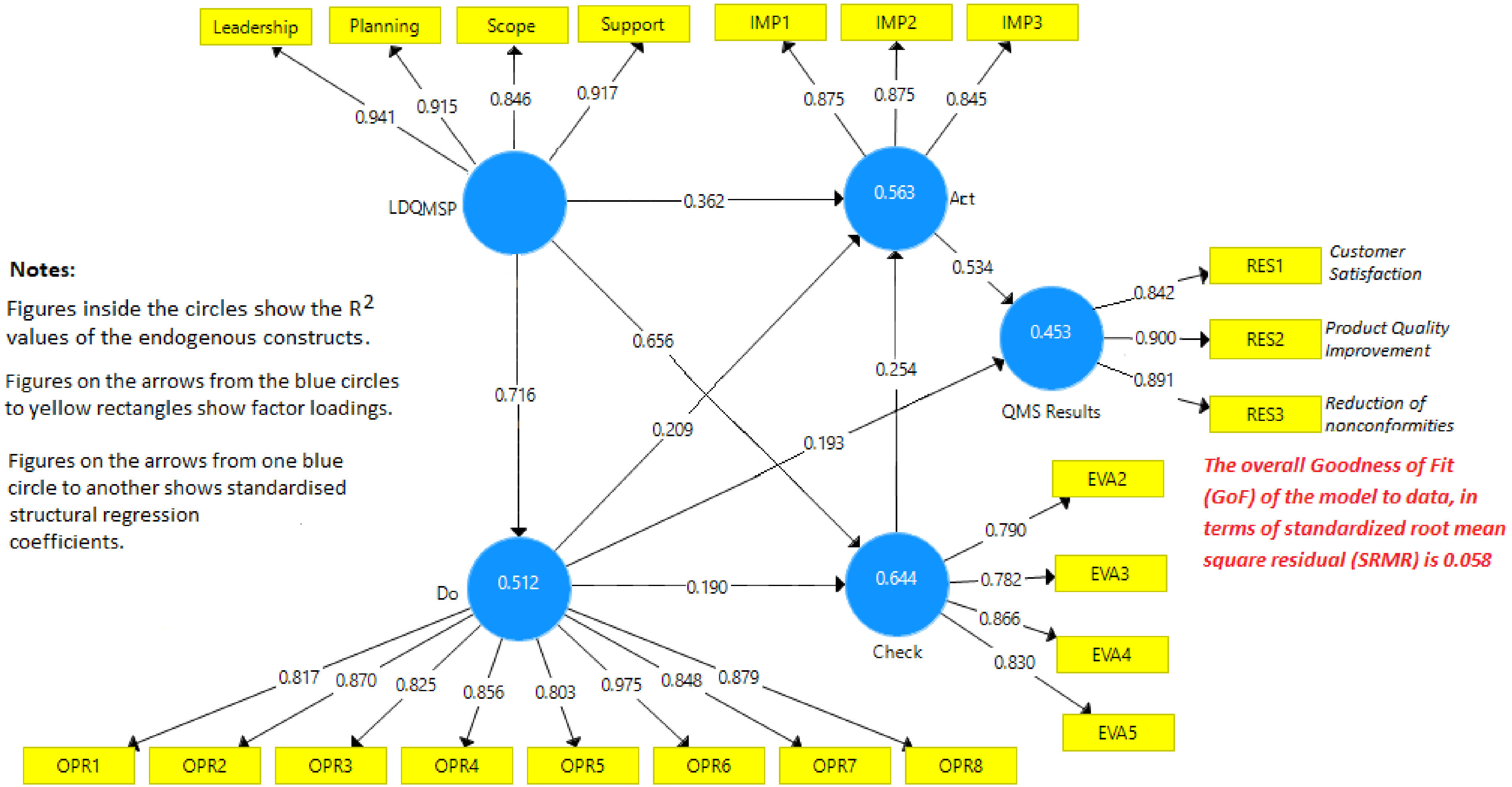

Figure 5.5: Estimated parameters of the full model

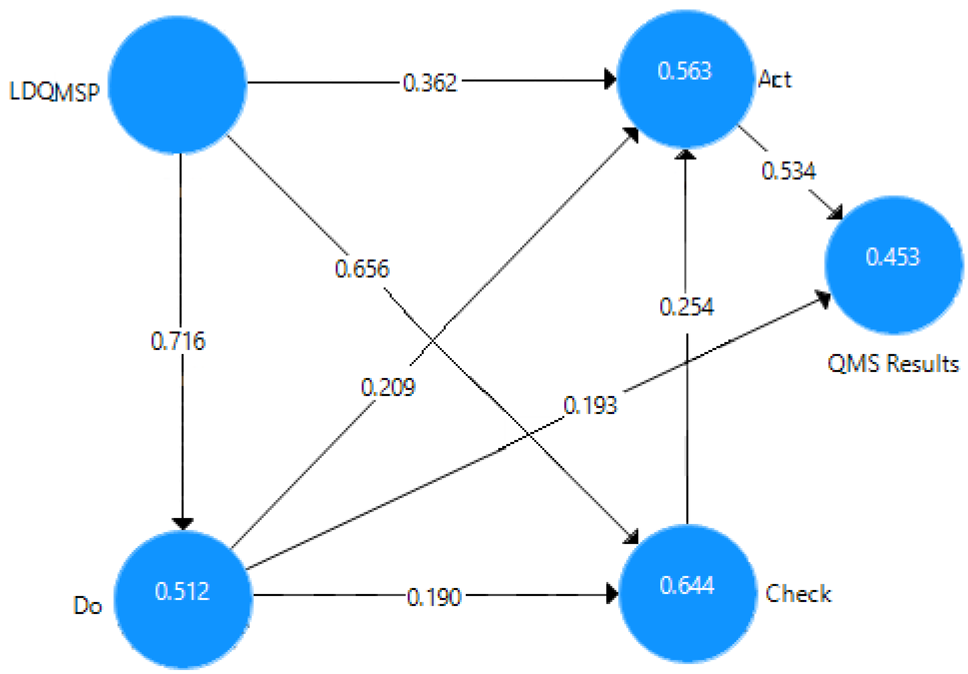

Figure 5.6: Estimated standardised structural regression coefficients and the R2 values

Table 5.11: Significance of Path Coefficients and their 95% Confidence Intervals

Hypothesised Relationship	Estimated Coefficient	* Effect Size f^2	*p* value	95% CI
H_1: LDQMSP → Do	0.716	1.050	0.000	0.649 ~ 0.779
H_2: Do → Check	0.190	0.049	0.035	0.016 ~ 0.365
H_3: LDQMSP → Check	0.656	0.590	0.000	0.489 ~ 0.814
H_4: Check → Act	0.254	0.053	0.022	0.037 ~ 0.468
H_5: Do → Act	0.209	0.046	0.017	0.043 ~ 0.388
H_6: LDQMSP → Act	0.362	0.092	0.001	0.137 ~ 0.561
H7: Do → QMS Results	0.193	0.040	0.045	0.004 ~ 0.372
H8: Act → QMS Results	0.534	0.310	0.000	0.380 ~ 0.700

* Based on Cohen (1988, pp 413-414), a standardized regression coefficient of: 0.10 is a small effect from the predictor, 0.30 is a medium effect from the predictor, 0.50 is a large effect from the predictor. Accordingly, effect sizes < 0.10 are very small effects, which are shown in red font.

Table 5.12: The Direct, Indirect, and Total Effects and the 95% Confidence Intervals of Total Effects

Relationship	Estimated Direct Effect	Estimated Indirect Effect	Estimated Total Effect	95% CI of Total Effect
LDQMSP → QMS Results	-	0.518	0.518	0.440 ~ 0.596
Do → QMS Results	0.193	0.137	0.330	0.174 ~ 0.480
Check → QMS Results	-	0.136	0.136	0.017 ~ 0.293
Act → QMS Results	0.534	-	0.534	0.380 ~ 0.700
LDQMSP → Act	0.362	0.350	0.712	0.638 ~ 0.781
Do → Act	0.209	0.048	0.257	0.100 ~ 0.425
Check → Act	0.254	-	0.254	0.037 ~ 0.468
LDQMSP → Check	0.656	0.136	0.792	0.724 ~ 0.851
Do → Check	0.190	-	0.190	0.016 ~ 0.365
LDQMSP → Do	0.716	-	0.716	0.649 ~ 0.779

5.5 A DISCUSSION OF PATH MODELLING RESULTS

5.5.1 Parameter Estimates of the Model from a Theoretical and Practical Standpoint

No scholar would be bold enough to challenge the validity of the PDCA approach to quality improvement as a general theory on CI. As reviewed in Chapter 02, the PDCA approach was initially articulated by Walter Shewhart in an alternative form (Shewhart's Specification → Production → Inspection cyclical concept) and subsequently improved to the current form by W Edwards Deming (Moen, 2009). Japan embraced all of Deming's teachings including the PDCA cycle, and their phenomenal industrial success that began in the 1960s is the living proof of the effectiveness of PDCA cycle. The western world and other parts of the world have also embraced PDCA as an approach to CI for manufacturing, service, and other types of industries. This research is not about testing the validity of PDCA as an approach to cause results in a project-by-project basis (the small PDCA analogy used in Chapter 04). Rather, the focus of the study PDCA for the entire QMS (the big PDCA analogy used in Chapter 04). All eight hypotheses that constitute the theoretical model were supported by data (see Table 5.11) at 0.05 significance level, but what does that really mean, theoretically and practically?

What the researcher's model empirically examines is whether the QMS requirements stipulated in ISO 9001:2015 seem to be founded upon the PDCA approach (big PDCA) to improve QMS Results (customer satisfaction and product results). The test results covered in the previous section answers this in the affirmative. In positivistic terms, what the researcher has examined is the validity of the ISO 9001:2015 clauses as building blocks that explain the PCDA approach of the entire QMS:

- Setting policies, objectives, and requirements of the QMS as well as processes to deliver QMS Results (this is Plan in a PDCA context for the entire QMS)
- Implementing and controlling the processes planned at the Plan stage (this is Do)
- Evaluating the performance of processes and outcomes (QMS Results) against what was planned (this is Check), and
- Taking appropriate action to improve processes and outcomes (this is Act).

As mentioned earlier, the model consists of four predictor-response relationships in the form of regression models — one for each of the four endogenous constructs. Furthermore, *LDQMSP* has been modelled as an exogenous latent variable[47] that reflects Scope (Clause 4 of ISO 9001:2015), Leadership (Clause 5 of ISO 9001:2015), Planning (Clause 6 of ISO 9001:2015), and Support (Clause t of ISO 9001:2015). Thus, the discussion begins with this exogenous latent variable generated from the *factor scores* of Scope, Leadership, Planning, and Support. The discussion on the predictor-response relations will follow thereafter.

5.5.1.1 The Exogenous Latent Variable "Leadership Driven QMS Planning"

Factor loadings clearly indicate that all four indicators of LDQMSP do correlate strongly with their assigned construct (Figure 5.5). Leadership returns the highest factor loading (0.941) followed by Support (0.917), Planning (0.915) and Scope (0.846). Although the differences between the four factor loadings were small, the factor loading Leadership was found to be higher than loadings of the remaining three indicators of LDQMSP at 10% level, based on the calculation procedure given by Steiger (1980), on dependent samples.48 This

[47] In a path model, an exogenous variable is a variable that is not been predicted by the other variables in the path model. In model 1 (Figure 6.5), LDQMSP is an exogenous variable.

[48] Many online calculators are available to compare dependent correlations based on the method given by (Steiger, 1980), The researcher used the following URL for the calculations: http://www.psychmike.com/dependent_correlations.php

basically implies that Leadership is slightly more important to LDQMSP than Planning, Support, and Scope. However, from a practical perspective, these differences are negligible.

5.5.1.2 Do (Operation) as Function of LDQMSP

The path model (Figure 5.6) suggests that DO is being caused by *LDQMSP* directly and that a substantial proportion (51.2%) of the variability of Do is being explained by LDQMSP. This should not come as a surprise, because as the systems driver, it is the responsibility of the leadership to ensure that that everything that is being planned for the QMS is being implemented to continually improve process and outcomes[49].

5.5.1.3 Check (Performance Evaluation) as a Function of Do (Operation) and LDQMSP

The path coefficient from Do → Check is only 0.190 (very small, but a statistically significant effect), but the path coefficient from LDQMSP → Check is as high as 0.656 (large, and of course a statistically significant effect). The two constructs LDQMSP and Do together explain 64.4% of the variability of Check. The important message to practice is that although Check naturally follows from Do, Check is significantly dependent on LDQMSP than Do. This makes sense because checking is only as good as what has been planned. In the system planning stage, the leadership and the organisation must determine the key processes, how they are interconnected in delivering the outcomes, and the resources (support) that are needed to support the key processes — all of which are reflected in the measures (indicators) of the construct LDQMSP.

5.5.1.4 ACT (Improvement) as a Function of Check (Performance Evaluation), Do, and LDQMSP

The path coefficient from Check → Act is 0.254 (Cohen's $f^2 = 0.053$), which is higher than the path coefficient from Do→ Act (Cohen's $f^2 = 0.046$), but both path coefficients are much less than the path coefficient from LDQMSP → Act, which is 0.362 (Cohen's $f^2 = 0.092$). The practical implication of this is that while Act naturally follows Check, Act is more influenced by LDQMSP than Check and Do. This implies that what needs to be done (Act)

[49] Engagement of people (ISO 9000 principle # 3) and the Process approach (ISO 9000 principle #4) means a direct involvement leadership driven activity on the Operation.

in relation to a set of planned processes required to realise a certain quality objective,[50] which the standard calls Improvement (Clause 10) is very much dependent on what was planned more so than what was done (Do) and what transpired in the Check stage. This makes sense from a practical perspective. Deming argued that most organisational learning in PDCA implementation takes place at the Check stage, which is the very reason why he preferred the word Study rather than Check (details in Chapter 02). This may be very true for an individual quality improvement project (e.g. implementing a plan to reduce cycle time of a production line), but for the entire QMS, learning takes place from all three preceding phases of Act, and not just Check.

5.5.1.5 QMS Results as a Function of DO (Operation) and ACT (Improvement)

In this study QMS Results is treated as a latent viable that reflects three aspects of results: customer satisfaction, product quality improvement, and reduction of non-conformities (see Figure 5.5 for example). The hypothesis test differences for loadings showed that Product Quality Improvement (measure RES2) and Reduction of Non-conformities (measure RES3) correlate more strongly with QMS Results than with Customer Satisfaction (measure RES1). This makes sense because customer satisfaction occurs in part after achieving product quality improvement and reduction of product non-conformities.

The path coefficients from DO → QMS Results (0.193) is much smaller than the path coefficient from ACT → QMS Results (0.534). From a practical perspective this means that QMS Results are heavily influenced by Improvement than with just Doing what has been planned. In fact this falls in line with continual improvement thinking of Deming and Japanese quality advocates such as Ishikawa: when an improvement takes place on processes and outcomes (e.g. a better functional performance of a particular product), customer expectations rise, needing never ending cycles of improvement to stay in business (Hackman & Wageman, 1995; Sitkin, Sutcliffe, & Schroeder, 1994; Summers, 2010).

[50] An example for a quality objective may be to increase the market share by 10% within one year of implementing the (new) plan.

5.5.1.6 The Practical Implication and Practical Validity of PDCA for the Entire QMS

The test results clearly showed that PDCA is much more complex than just imagining that Plan leads to Do; Do leads to Check; Check leads to Act; and Act leads to Results. Apart from the LDQMSP (Plan) → Do direct link, the direct links (Do→ Check and Check→ Act) within the Plan → Do → Check → Act sequence were not as strong as the links between LDQMSP → Check, and LDQMSP → Act. That means LDQMSP is central to everything, including improvement (Act). This is also evident from the total effects estimates of LDQMSP on Act (0.712) compared to Do (0.257), and Check (0.254). From a practical perspective this is not surprising because PDCA, whether it is for a standalone quality improvement project or for the entire QMS, Plan is always heavily "front-loaded", as was transpired in the literature review (see Table 2.2 in section 2.4.3). This is also evident from the fact that as many as four clauses of ISO 9001:2015 do map to Plan, but only a single clause maps to Do (Clause 08) or Check (Clause 09) or Act (Clause 10).

The respondents of this study are ISO 9001 certified organisations. In general, organisations scored highly not only on the enablers of QMS Results — that is Plan, Do, Check and Act — but also on the three indicators of QMS Results; this coupled with high R^2 values associated with cause and effect links in Figures 5.5 and 5.6 imply that the ISO 9001 certified organisations have been able to achieve good results through QMS-wide PDCA activity, which the ISO 9001 QMS standard purports to signify.

5.5.2 Comparing the Model with Deming's Theory on CI

Having demonstrated that the model predicts and explains CI via the PDCA process, it makes sense to compare it with other models and theories on CI — most notably Deming's model/theory on quality management. Deming himself did not articulate a theory on quality improvement that fits academic parameters, although scholars and practitioners take Deming's 14 points as Deming's theory or the Deming management method (DMM) (Anderson et al., 1994; Anderson, Rungtusanatham, Schroeder, & Devaraj, 1995; Garcia, Grisales, & Papic, 2017; Gershon & Currall, 1995).

Arguably, no quality advocate emphasised the importance of CI as much as Deming did, which makes Deming's teachings on quality management (i.e. the DMM) a prime candidate to compare against. The DMM is based on the premise that improvement (in manufacturing product quality improvement) is necessary to capture the market at lower price to stay in business to enable the societies to grow through more jobs, which Deming called the "chain reaction" (Deming, 1986). The researcher admits at the very outset that while Deming's theory is an organisational theory (a theory on organisational change and organisational learning) neither the researcher's model nor the ISO 9001:2015 process model represents an organisational theory. For example, while Deming explains how leaders influence the organisational culture and learning, neither the researcher's model nor the ISO 9001:2015 process model explains how leaders influence their followers to achieve organisational outcomes. Keeping this in mind, the researcher compares her model with the model developed by Anderson et al. (1994) on the DMM (see Figure 5.7).

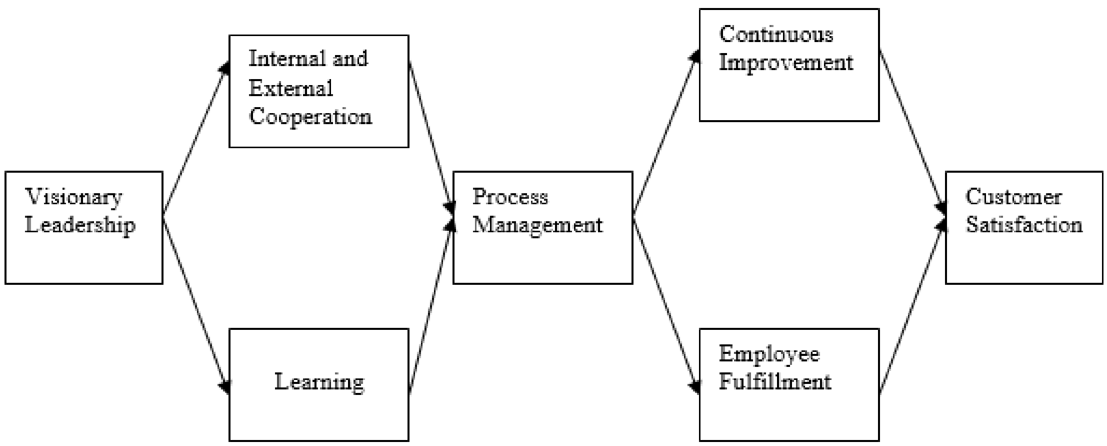

Figure 5.7: The structural model underlying the DMM (Source: Anderson et al., 1994, p. 481)

Although the researcher's model posits that Leadership (via "PLAN" in a PDCA context) relates to Do directly, Deming's model posits that Leadership does relate to Processes (Do in the researcher's model) through two parallel mediators: Internal and External Corporation; and Learning. Some (but not many) aspects of Deming's conceptualisation of Internal and External Cooperation are embedded in the construct *LDQMSP* in the researcher's model. For example, the measure Scope belonging to LDQMSP captures internal and external stakeholder engagement. Similarly, some (but not many) aspects of Deming's conceptualisations of "learning" are embedded in the measure Support belonging to LDQMSP. Learning, as articulated by Deming (Figure 6.6), is broad concept. It covers acquiring both explicit knowledge and tacit knowledge. The explicit knowledge is the knowledge that can be gained and transferred easily by formal (codified) learning while tacit knowledge is the highly individualised knowledge that is hard to communicate formally (Nonaka, 2008; Nonaka, Takeuchi, & Umemoto, 1996). ISO 9001:2015 and therefore researcher's model covers acquiring explicit knowledge only, through mechanisms such as documentation (e.g. quality manuals, documented procedures) and formal training. Deming makes a special reference to tacit learning/knowledge (Deming referred as "profound knowledge"); he refers to intrinsic knowledge acquired through lessons, failures, successes and experiences that cannot be codified or verbally expressed (Deming, 1993a).Though versions that preceded ISO 9001:2015 have not emphasised the importance of tacit knowledge, in fairness to ISO 9001:2015, the standard attempts to cover this aspect in Clause 7 (Support) under subclause 7.1.6 (Organisation Knowledge). The standard signifies the importance of inherent organisational knowledge but that is limited to some footnotes.

While Deming emphasised *Employee Fulfilment* as a mediator that affects Customer Satisfaction through Process Management, no such mediator (a mediator that solely captures employees' intrinsic motivation to perform) exists in the researcher's model. It is important to note that ISO 9001 has been criticised for its lack of emphasis on employee satisfaction (e.g. see Tang & Kam, (1999)). Although the current standard addresses employee satisfaction directly, it stipulates the requirement of having to provide and improve the workplace environment and deal with issues such as social, physical and psychological factors (under the Clause 7).

The constructs that represent the DMM (Figure 5.7) are much broader and abstract in scope than the five constructs that represent the researcher's model. The researcher's model only represents PDCA for the entire QMS and its effect on product results and customer satisfaction (collectively QMS Results), which is only two of several high-level performance dimensions organisations monitor and improve upon. The conclusion is that the Deming model is a more holistic model on CI than the researcher's model on CI, which limits only to PDCA. Table 5.13 summarises the similarities and difference between the researcher's model and the model on the DMM advanced by Anderson et al. (1994).

Table 5.13: The Similarities and Differences between the Researcher's Model and the model on the DMM Advanced by Anderson et al. (1994)

Similarities	Differences
Both models take the position that Leadership is the driver of CI and customer satisfaction	Deming provides a broader scope on Leadership: creating a learning organisation as well as an organisation that values respect and teamwork (internal and external cooperation). The researcher's model is confined to PDCA (albeit for the entire QMS)
Both models consider Customer Satisfaction as an endpoint, via improvement	Employee fulfilment (intrinsic motivational needs) through work is central to Deming; in the researcher's model, employee training is treated as a mechanistic task that is required for managing the planned processes
Both models follow the process approach, in taking a systems perspective	The construct Process Management as applied to the DMM (Figure 5.7) is broader in scope than Do (Operation) in the researcher's model

5.5.3 Comparing the Model with Other Management Frameworks that Emphasise CI

Apart from the DMM, there are other management models that explain achievement of excellence through quality improvement, particularly through CI. This section compares the researcher's model with management frameworks that emphasise CI to achieve organisational outcomes. Baldrige Excellence Framework (BEF) developed in the United States of America is one such management framework. In comparing the researcher's model with the BEF, one needs to keep in mind that the BEF is meant to improve corporate performance and not just some limited facets of operational performance as envisaged through ISO 9001 implementation.

Both the researcher's model and the BEF posit that the leadership is the driver of the whole system in achieving business results through CI (Badri et al., 2006). Further, similar to the researcher's model, the BEF also considers results as the end expectation (Badri et al., 2006; Flynn & Saladin, 2001; Jayamaha et al., 2009), although the BEF covers a broader scope under "Results", such as people-related results, and leadership and governance-related results. The researcher's model is more comparable with the early versions of the BEF such as the version empirically tested by Badri et al. (2006). As the researcher hypothesised in formulating her model, the early versions of the BEF hypothesised customer satisfaction (via stakeholder and market focus) and quality results as the endpoints of CI. In testing a subsequent version of the BEF, Jayamaha et al. (2009) showed that customer focus acts as a mediator in achieving business results.

Unlike the researcher's model on the underlying theory of ISO 9001, the BEF spans through a broader scope of improvement, not just CI aimed at product results and customer satisfaction. For example, while ISO 9001 focuses on quality planning related to products and processes, the BEF emphasises on strategic planning that develops strategic objectives and action plans according to customer demand (Badri et al., 2006). While BEF places emphasis on employee fulfilment as a critical success factor of corporate performance (Badri et al., 2006; Flynn & Saladin, 2001; Jayamaha et al., 2009), the researcher's model does not cover employee fulfilment in a holistic way, because ISO 9001:2015 does not emphasise high-level human motivational needs.

5.5.4 The Findings on Model in the Light of Prior Empirical Research on ISO 9001

While there have been a plethora of ISO 9001 implementation studies that examine the relationship between ISO 9001 implementation and effectiveness (details in section 2.6 of Chapter 02), only very few studies attempted to make some form of validity claim of ISO 9001 (details in section 2.5 of Chapter 02).

Similar to what the researcher conceptualised, Psomas et al. (2012) posited customer satisfaction, nonconformity reduction and continuous improvement as implied objectives of ISO 9001 implementation (Psomas et al. referred to these as ISO 9001 QMS effectiveness). Consequently, like the researcher, Psomas et al. considered improvements in customer satisfaction and product results (via reducing nonconformities) as outcomes of an effective QMS. Both the researcher and Psomas et al. (2012) posit that ISO 9001 implementation achieves the said outcomes. However, unlike the researcher, Psomas et al. do not attempt to explain directly (i.e. through constructs and hypotheses involving the constructs) how the requirements stipulated in the ISO 9001 standard achieves outcomes of an effective QMS.

Thus, Psomas et al., like many other researchers (see sections 2.5.1 and 2.5.3 of Chapter 02), only attempt to examine the validity of ISO 9001 indirectly.

The literature review (see section 2.5.3 of Chapter 02 for details) revealed that the only piece of research that seems to have attempted to test the theoretical validity of ISO 9001 (the year 2000/2008 versions) somewhat directly, was the study published by Lin and Jang (2008). However, Lin and Jang took ISO 9001 principles as the building blocks of their theory as opposed to the actual QMS requirements stipulated in ISO 9001 (i.e. the key clauses of ISO 9001). The downside of building a theory based on ISO 9001 principles is that it becomes hard to reliably distinguish ISO 9000 principles from other quality management principles such as TQM principles. Therefore, it becomes difficult to argue that the model posited by Lin and Jang does explain ISO 9001 implementation effectiveness. However, the authors seem to have circumvented this problem in two ways. First, the authors attempted to operationally define ISO 9001 principles using QMS requirements stipulated in ISO 9001 (this was critiqued by the researcher in section 2.5.3 of Chapter 02). Second, they confined their data collection to ISO 9001 certified organisations. In this regard, the theorisation of Lin and Jang stands analogous to that of the researcher.

For the above-mentioned reasons associated with extant literature, the researcher argues that her theoretical model and empirical test results makes a theoretical contribution to the field of quality management by attempting to enhance the theoretical underpinnings of ISO 9001.

Table 5.14: Tests Conducted on the Measurement model and the Structural Model

Tests Conducted on the Measurement Model	**Tests Conducted on the Structural Model**
• Content validity review of each construct • Collinearity testing of measures forming the constructs • The statistical significance of weights of the measures	• Collinearity testing of predictor constructs • The size and statistical significance of path coefficients • The R^2 values of regression models that explain endogenous constructs • The statistical significance of total effects
• The overall GoF fit of the model to data (in terms of SRMR) was also found to be quite satisfactory.	

5.6 CONCLUSION

This chapter presented the results and discussion on the theoretical model that was posited to address the first research question (RQ1). This research question contained three sub-questions. The first sub-question is "what does PDCA for the entire QMS really mean"?

RQ1a: What does "PDCA for the entire QMS" really mean?

RQ1b: How can the key clauses of ISO 9001:2015 be best aligned to PDCA theoretically?

RQ1c: What is the relationship between the key clauses of ISO 9001:2015, PDCA, and QMS Results?

Having explored the theory underlining the ISO 9001:2015 process model, first by hypothesising the theoretical relationships between the theoretical constructs — LDQMSP (Plan), Do, Check, Act, and QMS Results — and the hypothesised theoretical relationships between these constructs (barring QMS Results) and the key clauses of ISO 9001:2015 (Chapter 03) and testing these relationships empirically (this chapter) the three sub-questions of RQ1 are answered as follows.

PDCA for the entire QMS (RQ1a) really means *planning* (Plan), *implementing* (Do), *monitoring* (Check), and *controlling* (Act) activities related to the QMS, in order to achieve planned results on the QMS. Of the four steps planning is front loaded with many activities driven by the leadership. These activities as well as activities involved in the other three steps (i.e. Do, Check, and Act) are mentioned in Figure 5.8. PDCA for the entire QMS (the researcher refers to this as big PDCA) stands somewhat analogous to application of the PDCA approach to improve quality performance of an identified product (the researcher refers to this as small PDCA).

Above said, big PDCA can be reliably distinguished from small PDCA at least on two counts. Firstly, unlike small PDCA, big PDCA is a strategic management activity as indicated in Figure 5.8. Secondly, because big PDCA is a strategic management activity, it is likely that PDCA would not usually run several iterative cycles as in small PDCA. This is because planning in big PDCA involves many activities that need not and should not be changed frequently. Looking at the planning activities in the big PDCA, clearly, almost all the planning activities — setting strategic quality objectives from the quality policy, establishing processes required to meet the objectives, determining activities required for each process, establishing measurement criteria to examine the effectiveness of the processes, acquiring and developing resources for the processes — are relatively stable activities, especially if things are done right the first time. Changes are needed in certain occasions such as new product development or when major changes are needed to existing processes in the case of improving the quality of existing products to maintain completeness in the marketplace. Within big PDCA several different iterative small PDCA cycles can operate to achieve QMS Results.

The testing of the theoretical model showed that the key clauses of ISO 9001:2015 can be best aligned to big PDCA (RQ1b) as follows. Clauses 04 through to 07 indicate Plan (LDQMSP), clause 08 indicates Do, clause 09 indicates Check, and clause 10 indicates clause 10. Since each clause covers several compliance areas, the study treated Plan, Do, Check, and Act as latent variables. While the key clauses of ISO 9001:2015 are related to the constructs (latent variables) Plan, Do, Check, and Act (big PDCA) as indicators of these constructs, the study showed that these constructs do not follow a linear flow of Plan → Do → Check → Act → QMS Results. The study showed that while the above-mentioned direct relationships exist, there are several mediating relationships resulting from other direct and indirect relationships. In many instances, other direct and indirect effects via the mediation paths were stronger than the direct effects in the direct relationships in the Plan → Do → Check → Act → QMS Results path (see Table 5.12). For example, while Check was found to have a direct effect of only 0.254 on Act, Plan (LDQMSP) was found to have a total effect of 0.712 on Act (direct effect = 0.362 and indirect effect = 0.350 via mediation paths). Thus, the study clearly indicated that PDCA is not a basic linear process. These findings comprehensively answer RQ1c.

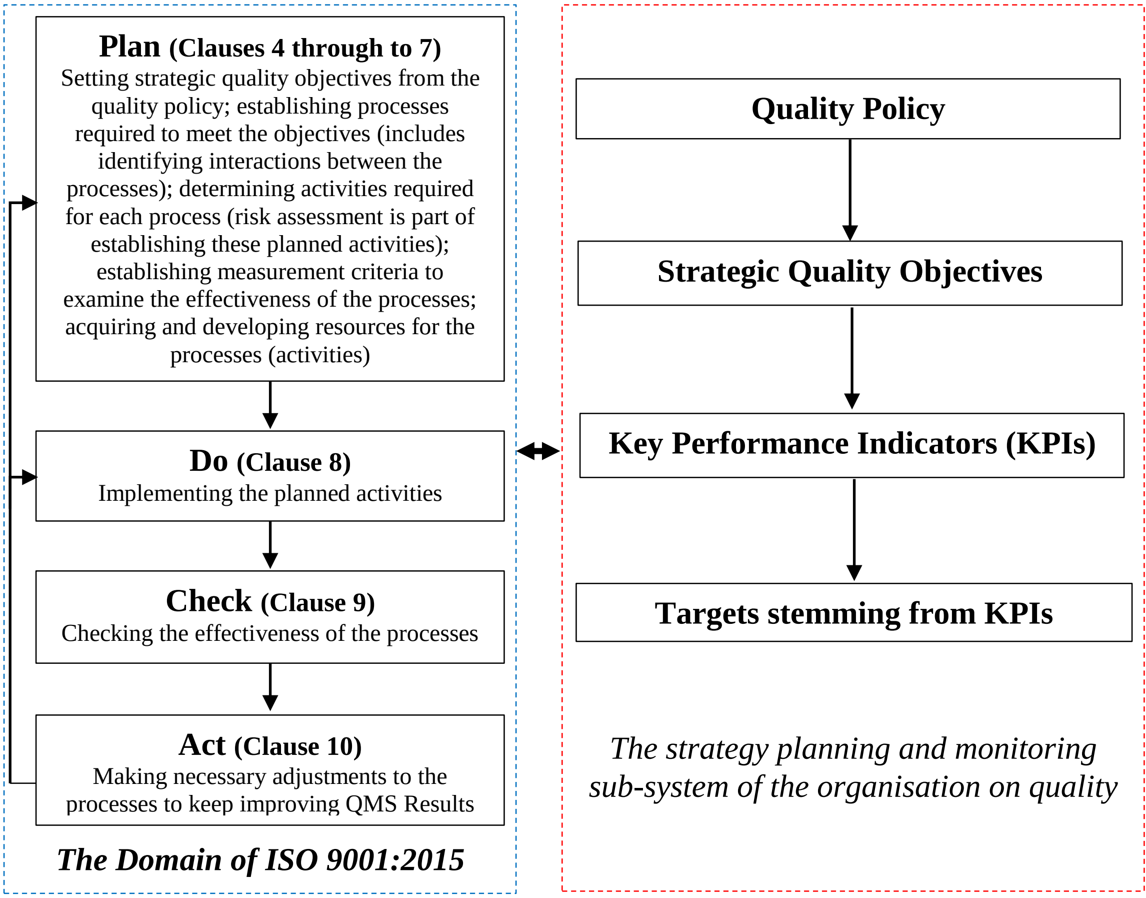

Figure 5.8: The PDCA as applied to the entire QMS as part of organisational strategy

The next chapter empirically examines the relationship between national culture dimensions and PDCA elements of the system (the entire QMS) as well as regions and PDCA elements of the system to answer RQ2: *"does ISO 9001:2015 have the same acceptance across cultures and regions"?*

CHAPTER 6

RESULTS AND DISCUSSION PART II: THE ACCEPTANCE OF ISO 9001:2015 ACROSS CULTURES AND REGIONS AS A FRAMEWORK FOR IMPROVEMENT OF A QMS

6.1 INTRODUCTION

This chapter presents the results and the accompanying discussion on *the influence of cross-cultural differences* on CI, as well as QMS Results. More technically precisely, here CI means the four elements/phases of the PDCA cycle, operationalised via the key clauses of ISO 9001:2015. As mentioned in Chapter 04, Hofstede's national culture dimensions considered in this study are Power Distance (PDI), Individualism (IDV), and Uncertainty Avoidance (UAI). The related research questions and the research objective this chapter addresses are RQ2, RQ3 and OBJ3 respectively:

RQ2: *Does ISO 9001:2015 have the same acceptance across cultures and regions?*

OBJ3: *To examine cultural and regional differences in the degree of acceptance levels of the requirements stipulated in ISO 9001:2015, when these clauses are aligned to constructs that explain QMS Results.*

In order to examine the extent to which national culture is related to the core components of ISO 9001:2015 (RQ2), a raft of hypotheses was developed in Chapter 03 (section 3.3) as the starting point; these hypotheses posit Hofstede's national culture dimensions as explanatory variables of the four elements of PDCA as well as QMS Results (the four elements of PDCA and QMS Results are the core components of ISO 9001:2015 as a theory on achieving QMS Results).

In order to examine the extent to which national culture is related to the core components of ISO 9001:2015 (RQ2), a raft of hypotheses was developed in Chapter 03 (section 3.3) as the starting point; these hypotheses posit Hofstede's national culture dimensions as explanatory variables of the four elements of PDCA as well as QMS Results (the four elements of PDCA

and QMS Results are the core components of ISO 9001:2015 as a theory on achieving QMS Results).

Section 6.2 shows the bivariate associations, particularly those between the three Hofstede's national culture dimensions under review and the four elements of PDCA as well as QMS Results, based on the 240 observations (questionnaire responses) at hand. Section 6.3 shows the multivariate associations between Hofstede's national culture dimensions (explanatory variables) of the four elements of PDCA as well as QMS Results. Here, the three Hofstede's national culture dimensions under consideration were treated as continuous variables that predict the four elements of PDCA as well as QMS Results via multiple regression models. The statistical significance of the explanatory variables (PDI, IDV, and UAI) and their size (standardised regression coefficients) are presented as part of hypothesis test results. Section 6.4 provides a discussion on hypothesis test results to answer RQ2, taking cultural dimensions as independent variables. Section 6.5 provides test results and an accompanying discussion to answer RQ2 taking a geographic region as the independent variable (factor). Finally, section 6.6 provides a summary of the key findings.

6.2 BIVARIATE CORRELATIONAL ANALYSES INVOLVING HOFSTEDE'S NATIONAL CULTURE DIMENSIONS

Before the bivariate correlations between Hofstede's national culture dimensions and PCDA elements (also QMS Results) are presented and discussed (section 6.2.2), it is necessary to understand how the Hofstede's national culture dimensions seem to be associated with one another (section 6.2.1).

6.2.1 PDI, IDV, and UAI Scores and Collinearity Among Them

Figure 6.1 depicts the scores of the three Hofstede's culture dimensions under consideration for the 5 countries in the study. As one expects, there is some parity between Australia and New Zealand (Tasman neighbours) as well as India and Sri Lanka (South Asian neighbours separated by an 18 nautical mile sea strip) in the scores. Greece is different to the other four countries, particularly in UAI.

Table 6.1 depicts the associations among the three Hofstede's culture dimensions themselves. PDI and IDV show a strong negative correlation and consequently, both PDI and IDV form a strong collinear relationship (VIF > 4.0), which act as a bane in traditional linear multiple regression, when these dimensions act as explanatory variables (predictors) of another variable, as in this study (technical details are given in Appendix 07).

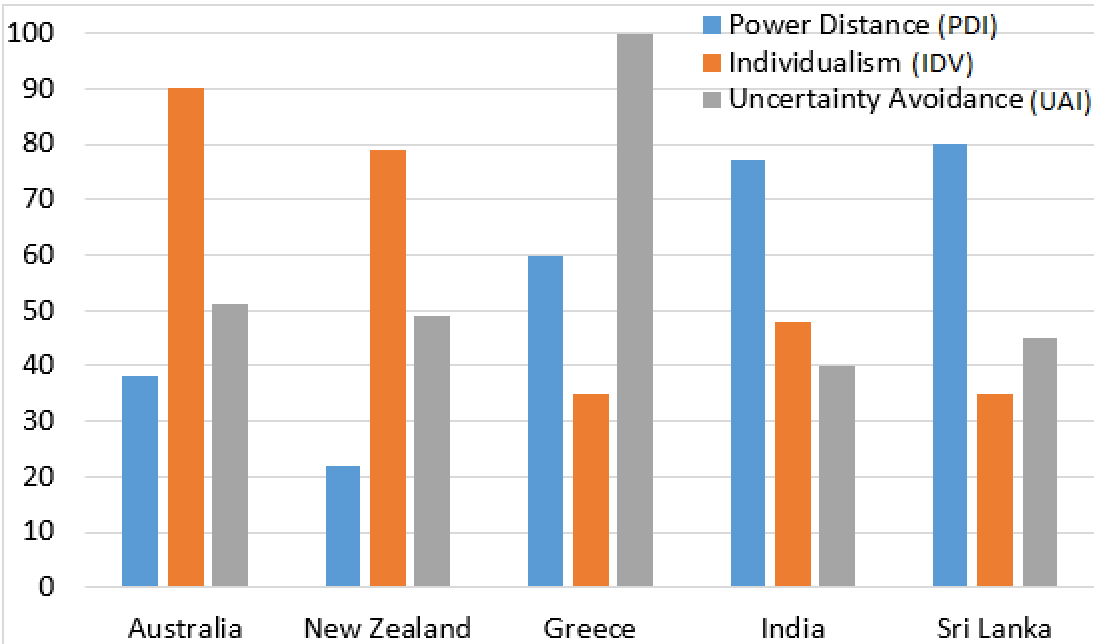

Figure 6.1: Hofstede's PDI, IDV, and UAI scores for the countries covered in the study

Table 6.1: Correlations Between PDI, IDV, and UAI for the Data Collected

	PDI	**IDV**	**UAI**
Power Distance (PDI) (VIF = 6.70)			
Individualism (IDV) (VIF = 8.33)	-0.840***		
Uncertainty Avoidance (UAI) (VIF = 2.46)	0.031	-0.444***	
*** $p < 0.001$; VIF > 4.0 is deemed very problematic (Hair et al., 2019). For a definition of VIF, see Appendix 6.			

6.2.2 The Correlations Between Hofstede's National Culture Dimensions and PDCA Elements as well as QMS Results

Table 6.2 depicts the bivariate correlations between Hofstede's national culture dimensions and each element of PDCA. The results suggest that some bivariate correlations between national culture dimensions and the elements of PDCA are statistically significant (albeit weak), and some bivariate correlations are nonsignificant even at 0.10 significance level. More specifically, UAI does not seem to relate to any of the four PDCA elements, and none of the three national culture dimensions seem to be related to DO phase of the PDCA.

Table 6.2: The Bivariate Correlations between National Culture Dimensions and the Four PDCA Elements

National Culture Dimension	**PDCA Element**			
	PLAN	DO	CHECK	ACT
Power Distance (PDI)	0.141*	0.062	0.216**	0.145*
Individualism (IDV)	-0.113	-0.065	-0.177**	-0.155*
Uncertainty Avoidance (UAI)	-0.026	-0.050	-0.019	0.078
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$				

Table 6.3 depicts the bivariate correlations between Hofstede's national culture dimensions and QMS Results, both as a whole as well as individually. Weak correlation patterns as in the previous case (Table 6.2) show up, and again, UAI appears as the nonsignificant predictor. However, when the three sub-elements of QMS Results are taken individually, UAI is showing up a statistically significant correlation with Product Quality Improvement. The results in Table 6.3 also suggest that national culture dimensions are not significantly related to Customer Satisfaction at 0.05 significance level.

All the above said, very low correlations between national culture dimensions and quality management related constructs have been reported in prior empirical studies (e.g. Flynn & Saladin, 2006; Lagrosen, 2003; Pagell et al., 2005). Thus, the results shown in Tables 6.2 and 6.3 do not come as a surprise.

Table 6.3: The Bivariate Correlations Between Culture Dimensions and QMS Results

National Culture Dimension	Results and its Sub-elements			
	Customer Satisfaction	Product Quality Improvement	Nonconformity Reduction	QMS Results
Power Distance (PDI)	0.127 (p = 0.055)	0.231***	0.200**	0.214**
Individualism (IDV)	-0.097	-0.263***	-0.202**	-0.217**
Uncertainty Avoidance (UAI)	0.047	0.137*	0.077	0.101
* p < 0.05, ** p < 0.01, *** p < 0.001				

6.3 HYPOTHESIS TEST RESULTS RELATED TO RQ2

In order to generate results to answer RQ2, eight multiple regression models[51] of the form $Y = \sum_{i=1}^{3} \beta i X i$ were fitted within a single optimisation (model fitting) algorithm via partial least squares regression (PLSR) technique. In these models, X_1 is PDI, X_2 is IDV, and X_3 is UAI (explanatory variables), and the four PDCA elements — PLAN, DO, CHECK, and ACT — as well as QMS Results are the explained variables (the Y variables).

As explained in Appendix 07, the PLSR technique was used in favour of linear multiple regression (LMR) modelling, because of the collinear predictors being present (Table 7.1). More specifically, PLSR algorithm was run in PLSR II mode, because of highly correlated response variables (see section 7.5.2 of Appendix 07). The software used to conduct PLSR was Unscrambler®X (CAMO Analytics, 2018). This software was selected in favour of more commercially widespread software such as IBM SPSS and Minitab, because unlike the latter, Unscrambler®X provides statistical significance information (e.g. confidence intervals and the p values) of the predictors being considered, based on the user defined cross-validation

[51] The first regression model would treat PLAN as the explained variable (response variable) and the three Hofstede's dimensions as explanatory variables (predictors). The second regression model would treat DO as the explained variable and the three Hofstede's dimensions as explanatory variables, and so on. There are eight separate regression models because there are eight explanatory variables: PLAN, DO, CHECK, ACT, QMS Results (as a composite variable formed from three sub-elements), Customer Satisfaction (the first sub-element of QMS Results), product quality improvement (the second sub-element of QMS Results), and reduction of nonconformities (the third sub-element of QMS Results).

method. In this study, the researcher used leave-one-out approach, which is named as full cross-validation in Unscrambler®X.

6.3.1 Selecting the Optimum Number of Components to Calculate Regression Coefficients and Other Statistical Parameters

As mentioned in Appendix 07 (section 7.5.2), one of the first tasks in model fitting in PLSR is selecting the optimal number of components (in Unscrambler®X the components are referred to as factors) to provide the highest predicted R^2 (or predicted error mean sum squares). Since there are three predictors (i.e. PDI, IDV, and UAI), in theory, as many as three factors can be used to represent the *X* variable space, but selecting too many factors could result in an overfitted model, while selecting too fewer factors could result in an underfitted model, when predictor collinearity is present (Wold, Sjöström, & Eriksson, 2001; Yeniay & Göktaş, 2002). Cross-validation is the strategy used in PLSR to select the optimum number of factors that neither underfit nor overfit a model to data (Wold et al., 2001; Yeniay & Göktaş, 2002).

Figure 7.2 depicts the explained variation of "Overall QMS Results", based on a single factor solution through to a three-factor solution, with and without cross-validation. Figure 7.2 clearly indicates that a three-factor solution overfits a model to data significantly (cross-validation results show zero explained variation, meaning zero predicted R^2, as against a raw R^2 of approximately 2.8%) and that the single factor solution is the best (optimal). This applied to other response variables (i.e. PLAN, DO, CHECK, and ACT and the sub-components of Overall QMS Results) also. An important observation regarding R^2 is that national culture dimensions have a "small effect" on all the response variables. Here, the researcher uses the "small", "medium", and "large" effect analogy prescribed by Cohen (1992). According to Cohen, a multiple regression model returning a Cohen's f^2 of 0.02 (R^2 = 1.96%) implies a small effect of predictors on the response variable (Cohen, 1992, p. 157).

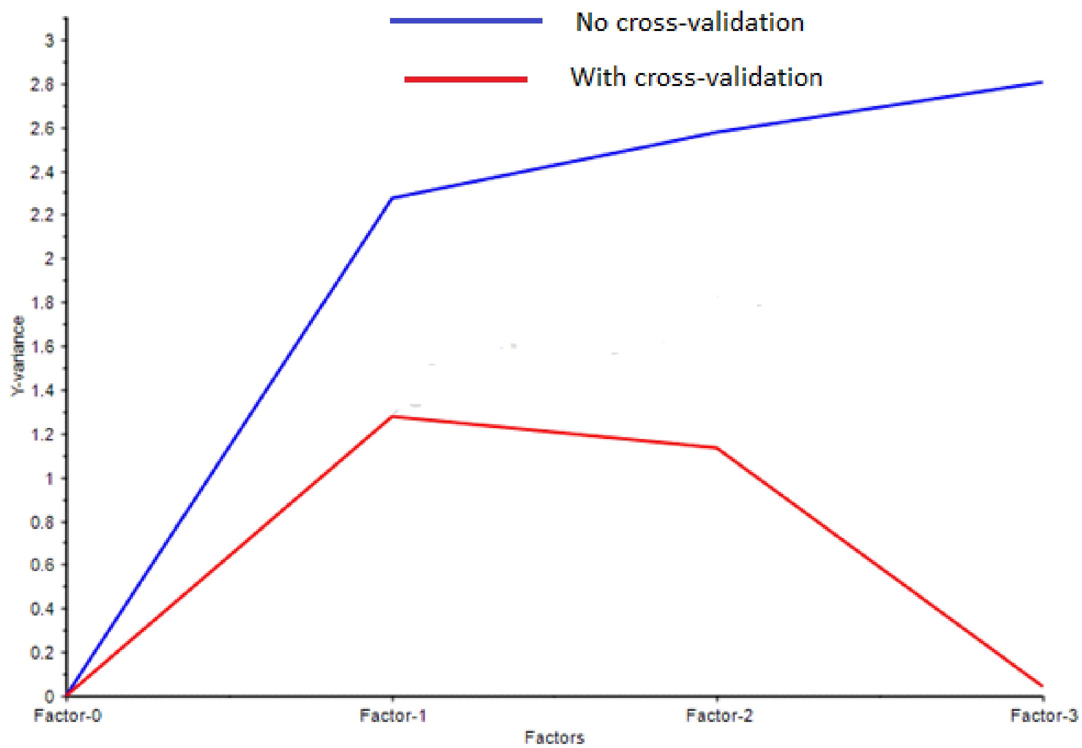

Figure 6.2: Explained variation of Overall QMS Results with and without cross-validation:

6.3.2 Standardised Regression Coefficients and Their Size

Table 6.4 depicts the standardised regression coefficients of national culture dimensions[52] that predict the individual elements of PDCA (i.e. PLAN, DO, CHECK, and ACT). In addition, Table 6.4 shows which predictors are significant, based on the *p* values reported by Unscrambler®X. This coupled with the sign of the regression coefficients become important in testing the hypotheses related to RQ2. For example, the statistically significant regression coefficient of -0.054 of IDV on PLAN (response) imply that the IDV score is negatively related to PLAN, in the sense, there is a greater acceptance for PLAN (in a PDCA context) in collectivistic cultures than in individualistic cultures. Stated alternatively, this result suggests that individualism has a negative effect on PLAN. As in the bivariate case, the results fail to suggest that UAI influences any of the four elements of PDCA.

[52] These standardised regression coefficients are analogous to the correlation coefficients shown in Table 6.2.

Table 6.4: The Standardised Regression Coefficients of the National Culture Dimensions When These Predict PDCA Elements

Predictor (National Culture Dimension)	Response			
	PLAN	DO	CHECK	ACT
Power Distance (PDI)	0.071*	0.037	0.110**	0.086**
Individualism (IDV)	-0.063*	-0.033	-0.098**	-0.076**
Uncertainty Avoidance (UAI)	0.007	0.003	0.010	0.008
* $p < 0.10$; ** $p < 0.05$				

Table 6.5 depicts the standardised regression coefficients of national culture dimensions that predict QMS Results. In addition, Table 6.5 shows which predictors are significant, based on the p value. Again, as in the bivariate case, the results fail to suggest that UAI influences QMS Results, or its three sub-elements. In addition, PDI and IDV fail to show a statistically significant relationship with Customer Satisfaction ($p = 0.120$ for both predictors). As in the bivariate case, the results (Table 6.5) suggest that national culture dimensions are not significantly related to Customer Satisfaction, at 0.05 significance level.

Table 6.5: The Standardised Regression Coefficients of the National Culture Dimensions When These Predict QMS Results

Predictor (National Cultural Dimension)	Response			
	Customer Satisfaction	Product Quality Improvement	Nonconformity Reduction	QMS Results
Power Distance (PDI)	0.055	0.126***	0.098***	0.108***
Individualism (IDV)	-0.057	-0.131***	-0.102***	-0.112***
Uncertainty Avoidance (UAI)	0.027	0.061	0.048	0.052
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$				

Having examined the standardised regression coefficients of the national culture dimensions (Tables 6.4 and 6.5), the researcher reports the hypothesis test results associated with each national culture dimension, from next subsection onwards.

6.3.3 Test Results on the Hypotheses Involving Power Distance

As evidenced from Table 6.6, the sub hypotheses of H_{22} have been supported by data, except H_{22b} (for H_{22b}, $p = 0.151$). One possible reason for PDI showing insufficient evidence of a positive relationship with DO could be the sample size. Another possible reason could be that Do is such basic a concept (Do means Do literally) in a PDCA context (for the entire QMS) that cultures and regions are indifferent to it. In the main, H_{22} has been supported through its sub-hypotheses. A discussion on these findings is provided in section 6.4.

Table 6.6: Significance of the Hypotheses on the Relationship Between Power Distance and the Elements of PDCA

Hypothesis	**Finding/Outcome**
H_{22}: There is a greater acceptance for CI (in a PDCA context) in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on CI.*	*See below (the results on the sub-hypotheses)*
H_{22a}: There is a greater acceptance for PLAN (in a PDCA context) in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on PLAN.*	**Weakly supported** *The regression coefficient is positive as desired and p = 0.081*
H_{22b}: There is a greater acceptance for DO (in a PDCA context) in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on DO*.	Not supported *The regression coefficient is positive as desired but p = 0.151*
H_{22c}: There is a greater acceptance for CHECK (in a PDCA context) in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on CHECK.*	**Supported** *The regression coefficient is positive as desired and p = 0.013*
H_{22d}: There is a greater acceptance for ACT (in a PDCA context) in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on ACT.*	**Supported** *The regression coefficient is positive as desired and p =0.023*

As evidenced from Table 6.7, H_{25} has been supported by data. Among the sub-hypotheses, all but H_{25a} have been supported by data. Again, a possible reason for PDI showing insufficient evidence of a positive relationship with Customer Satisfaction could be the sample size. A discussion on these findings is provided in section 6.4.

Table 6.7: Significance of the Hypotheses on the Relationship Between Power Distance and QMS Results

Hypothesis	Finding/Outcome
H_{25}: There is a greater acceptance for QMS Results in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on QMS Results.*	**Supported** *The regression coefficient is positive as desired and p = 0.002*
H_{25a}: There is a greater acceptance for customer satisfaction in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on Customer Satisfaction.*	Not supported *The regression coefficient is positive as desired but p = 0.120*
H_{25b}: There is a greater acceptance for product quality improvements in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on Product Quality Improvement.*	**Supported** *The regression coefficient is positive as desired and p = 0.001*
H_{25c}: There is a greater acceptance for reduction of nonconformities in high PDI cultures than in low PDI cultures. *In a regression modelling sense, the above hypothesis means that PDI has a positive effect on Reduction of Nonconformity.*	**Supported** *The regression coefficient is positive as desired and p = 0.001*

6.3.4 Test Results on the Hypotheses Involving Individualism

As evidenced from Table 6.8, the sub-hypotheses of H_{23} are supported by data, except H_{23b}. A possible reason for IDV showing insufficient evidence of a negative relationship with DO could be the sample size. In the main, H_{23} was supported through its sub-hypotheses. A discussion on these findings is provided in section 6.4.

Table 6.8: Significance of the Hypotheses on the Relationship Between Individualism and the Elements of PDCA

Hypothesis	Finding/Outcome
H_{23}: There is a greater acceptance for CI (in a PDCA context) in collectivistic cultures than in individualistic cultures. *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on CI.*[53]	*See below (the results on the sub-hypotheses)*
H_{23a}: There is a greater acceptance for PLAN (in a PDCA context) in collectivistic cultures than in individualistic cultures. *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on PLAN.*	**Weakly supported** *The regression coefficient is negative as desired and p = 0.096*

[53] Individualism is the exact opposite of collectivism.

Hypothesis	Finding/Outcome
H_{23b}: There is a greater acceptance for DO (in a PDCA context) i collectivist cultures than in individualistic cultures. *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on DO.*	Not supported *The regression coefficient is negative as desired but p =0.176*
H_{23c}: There is a greater acceptance for CHECK (in a PDCA context) in collectivistic cultures than in individualistic cultures. *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on CHECK.*	**Supported** *The regression coefficient is negative as desired and p = 0.013*
H_{23d}: There is a greater acceptance for ACT (in a PDCA context) in collectivistic cultures than in individualistic cultures. *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on ACT.*	**Supported** *The regression coefficient is negative as desired and p* = 0.050

As evidenced from Table 6.9, H_{26} is supported by data. Among the sub-hypotheses, all but H_{26a} are supported by data. A possible reason for IDV showing insufficient evidence of a negative relationship with Customer Satisfaction could be the sample size. A discussion on these findings is provided in section 6.4.

Table 6.9: Significance of the Hypotheses on the Relationship Between Individualism and QMS Results

Hypothesis	Finding/Outcome
H_{26}: There is a greater acceptance for QMS Results in collectivistic cultures than in individualistic cultures. *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on QMS Results.*	**Supported** *The regression coefficient is negative as desired and p = 0.007*
H_{26}a: There is a greater acceptance for customer satisfaction in collectivistic cultures than in individualistic cultures**.** *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on Customer Satisfaction.*	Not supported *The regression coefficient is negative as desired but p = 0.120*
H_{26}b: There is a greater acceptance for product quality improvements in collectivistic cultures than in individualistic cultures. *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on Product Quality Improvement*	**Supported** *The regression coefficient is negative as desired and p = 0.001*
H_{26}c: There is a greater acceptance for reduction of nonconformities in collectivistic cultures than in individualistic cultures**.** *In a regression modelling sense, the above hypothesis means that IDV has a negative effect on Reduction of Nonconformities*	**Supported** *The regression coefficient is negative as desired and p = 0.001*

6.3.5 Test Results on the Hypotheses Involving Uncertainty Avoidance

As mentioned earlier, UAI does not appear as a statistically significant predictor of the elements of PDCA, as well as overall QMS Results and its sub-components. Consequently, data fails to support all the hypotheses that involve UAI as a predictor (i.e. H_{24} and its sub-hypotheses as well as H_{27} and its sub-hypotheses). Tables 6.10 and 6.11 depict the *p* values associated with UAI. A discussion on these findings is provided in section 6.4.

Table 6.10: Significance of the Hypotheses on the Relationship between Uncertainty Avoidance and the Elements of PDCA

Hypothesis		Finding/Outcome
H_{23}:	There is a greater acceptance for CI (in a PDCA context) in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on CI.*	*See below (the results on the sub-hypotheses)*
H_{23a}:	There is a greater acceptance for PLAN (in a PDCA context) in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on PLAN.*	Not Supported $p = 0.581$
H_{23b}:	There is a greater acceptance for DO (in a PDCA context) in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on DO.*	Not Supported $p = 0.605$
H_{23c}:	There is a greater acceptance for CHECK (in a PDCA context) in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on CHECK.*	Not Supported $p = 0.575$
H_{23d}:	There is a greater acceptance for ACT (in a PDCA context) in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on ACT.*	Not Supported $p = 0.609$

Table 6.11: Significance of the Hypotheses on the Relationship Between Uncertainty Avoidance and QMS Results

Hypothesis	Finding/Outcome
H_{27}: There is a greater acceptance for QMS Results in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on QMS Results.*	Not Supported $p = 0.598$
H_{27a}: There is a greater acceptance for customer satisfaction in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on Customer Satisfaction.*	Not Supported $p = 0.363$
H_{27b}: There is a greater acceptance for product quality improvements in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on Product Quality Improvement.*	Not Supported $p = 0.322$
H_{27c}: There is a greater acceptance for reduction of nonconformities in high UAI cultures than in low UAI cultures. *In a regression modelling sense, the above hypothesis means that UAI has a positive effect on Reduction of Nonconformities.*	Not Supported $p = 0.326$

6.4 DISCUSSION OF RESULTS ON RQ2

Three key findings highlighted in sections 6.2 and 6.3 warrant a detailed discussion. The first is that national culture dimensions PDI and IDV have a statistically significant yet a "small effect" on PDCA-based CI, as well as QMS Results. As mentioned earlier, the researcher uses the phrase "small effect" to mean a Cohen f^2 of 0.02 (R^2 = 1.96%), as defined by Cohen (1992). Figures 6.3 and 6.4 summarise the effects of national culture on PDCA elements as well as QMS Results discussed in this section, in the form of standardised regression coefficients and their confidence intervals.

The three culture dimensions considered (PDI, IDV, and UAI) were causally linked to the responses Plan, Do, Check, Act (the constituents of CI) as well as QMS Results as per the hypotheses. It is important to note that the standardised regression coefficients shown in the two figures are the absolute values and the sign of the regression coefficients associated with the IDV is negative. The absolute values are shown for ease of comparing the size of the contribution of each predictor, through vertical height. The error bars shown are the confidence interval estimates that have been calculated by the software (Uncrambler®X) taking 1.96 and 1.64 standard deviations to be equivalent to 95% confidence interval and 90% confidence interval respectively, assuming a standard normal distribution. One thing that becomes very apparent from Figures 6.3 and 6.4 is that the parameter estimates are associated with sizable standard errors. These result in very wide confidence intervals. This makes effect size comparisons (e.g. contribution of each predictor on a response) of *true regression coefficients* (i.e. regression coefficients for the population) next to impossible.

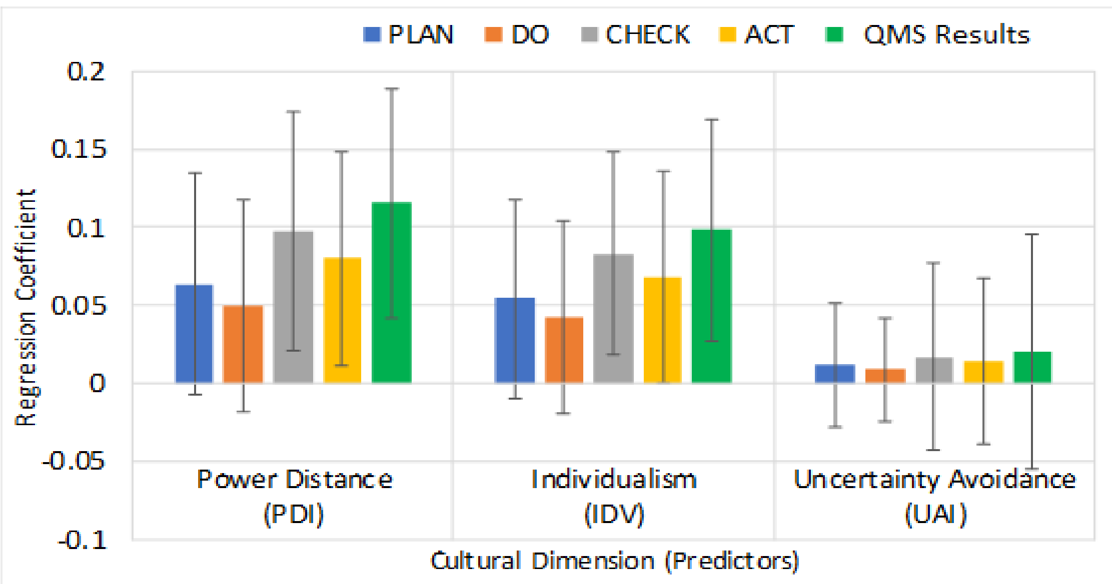

Figure 6.3: The estimates of the absolute values of standardised regression coefficients of culture dimensions along with 95% confidence intervals

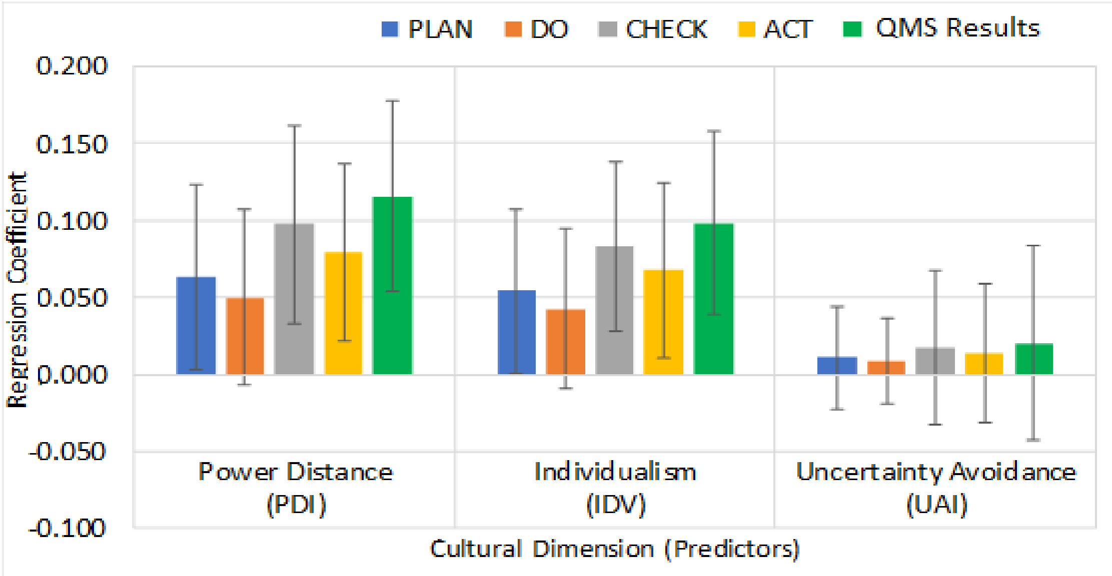

Figure 6.4: Figure 6.4: The estimates of the absolute values of standardised regression coefficients of culture dimensions along with 90% confidence intervals

The most important finding relevant to RQ2, which has implications to management practices is that, although being statistically significant, PDI and IDV explain only a miniscule portion of CI as well as QMS Results. The R^2 and Predicted R^2 values shown in the previous section stand testimony to this. Four possible reasons are suggested for the weak relationships (section 6.4.1).

6.4.1 Possible Reasons for the Weak Association Between National Culture and PDCA-based CI and as well as QMS Results

The *first possible reason* for the weak associations could be that it is what it is. As already mentioned earlier (section 6.2), prior studies have also reported weak associations between national culture dimensions and CI and QMS Results, as well as other comparable forms of outcomes such as operational performance, quality performance, business results. The *second possible reason* could be that PDCA is such an elegant and basic task, countries across the globe may be using it almost the same way. The *third possible reason,* the one that is most compelling, is that factors other than national culture (i.e. unaccounted factors) are likely to be mediating the national culture versus Plan, Do, Check, Act, (and QMS Results) relationship. The first, second and third possible reasons are discussed in the next section.

6.4.2 Discussion of Possible Reasons Suggested for the Low Correlations Between National Culture Dimensions and PDCA Elements, plus QMS Results

6.4.2.1 Possible Reason 1: Low Correlations are Normal and are Consistent with Prior Research

The bivariate correlations reported by Jung et al. (2008), Flynn and Saladin (2006), and Lagrosen (2003) on relationship between national culture dimensions and total quality management (TQM) elements and equivalent constructs are reported in Table 7.12 along with the corresponding correlations found in this study. It needs to be mentioned that TQM constructs being used in the studies found in the extant literature are broader in scope than the ones used by the researcher. For example, CI is a much broader concept than PDCA. Likewise, strategic planning is a top-level planning activity while "PLAN" in a PDCA context (this study) is an operational activity. However, it is important to note that PLAN (plus the other elements of the PDCA cycle) in this study covers the entire QMS, and hence not a rudimentary shop floor activity.

As evidenced from the correlations reported in Table 7.12, the size of the correlations that the researcher found (these correlations were reported earlier in Tables 7.2 and 7.3) are comparable with the correlations reported in the above three studies.

As mentioned elsewhere (see Chapter 03), one of the competing viewpoints on the effects of national culture on management practices — the convergence viewpoint — argues that organisations are not culture bound (i.e. practices are not affected by the culture and economy of a nation), but whether this viewpoint is true or the opposing viewpoint (the divergence viewpoint) is true can only be inquired through a moderation analysis, which is beyond the scope of this study.

Table 6.12: Table 6.12: Correlation Comparison Table

Author (Year), Sample Size, Quality Management Model	Relevant National Culture Dimensions (Predictors)	Relevant Quality Related Variable(s) (Response)	Bivariate Correlations
Jung et al. (2008) (*n* = 186) Baldrige Excellence Framework	PDI IDV UAI	Strategic Planning (PLN) Process Management (PRM) Business Results (RES)	PDI: PLN = 0.161 PDI: PRM = 0.178 PDI:RES = 0.111 IDV: PLN = - 0.001ns IDV: PRM = 0.110 IDV:RES = 0.114 UAI: PLN = 0.023 ns UAI: PRM = 0.065 ns UAI: RES = 0.019 ns
Flynn and Saladin (2006) (*n* = 4264) Baldrige Excellence Framework	PDI IDV UAI	Strategic Planning (PLN) Process Management (PRM) Business Results (RES)	PDI: PLN = 0.008 ns PDI: PRM = 0.309 PDI: RES = 0.184 IDV: PLN = - 0.250 IDV: PRM = - 0.398 IDV: RES = - 0.212 UAI: PLN = 0.114 ns UAI: PRM = 0.379 UAI: RES = 0.196
Lagrosen (2003) (*n* = 50) Generic TQM	UAI only	CI Process Focus (PF) Measurement Focus (MF)	UAI: CI = - 0.280 ns UAI: PF = 0.323 UAI: MF = - 0.084 ns
This Researcher's Study (*n* = 229) PDCA Embedded in ISO 9001:2015	PDI IDV UAI	PLAN (PN) DO CHECK (CK) ACT (AT) QMS Results (RS)	PDI: PN = 0.141 PDI: DO = 0.062 ns PDI: CK = 0.216 PDI: AT = 0.145 PDI: RS = 0.214 IDV: PN = - 0.113ns IDV: DO = - 0.065 ns IDV: CK = - 0.177 IDV: AT = - 0.155 IDV: RS = - 0.219 UAI: PN = - 0.026 ns UAI: DO = 0.050 ns UAI: CK = - 0.019 ns UAI: AT = 0.078 ns UAI: RS = 0.101 ns

6.4.2.2 Possible Reason # 2: PDCA is Such an Elegant and Basic Task, Countries Across the Globe May be Using it the Same Way

It could be argued that all ISO 9001 certified organisations are TQM organisations and therefore national culture as an explanatory (predictor) variable may explain very little variation of the Plan, Do, Check and Act. Stated alternatively, a task such as Plan, Do, Check and Act (at QMS level) is likely to be implemented the same way across the globe. Of course, the depth of implementation of PDCA will vary within any given country and this variation will probably be the same across countries. In terms of analysis of variance, this boil downs to small between group (between countries) variation, relative to a large within-group (within country) variation. The Box Plot shown in Figure 6.5 clearly illustrates this.

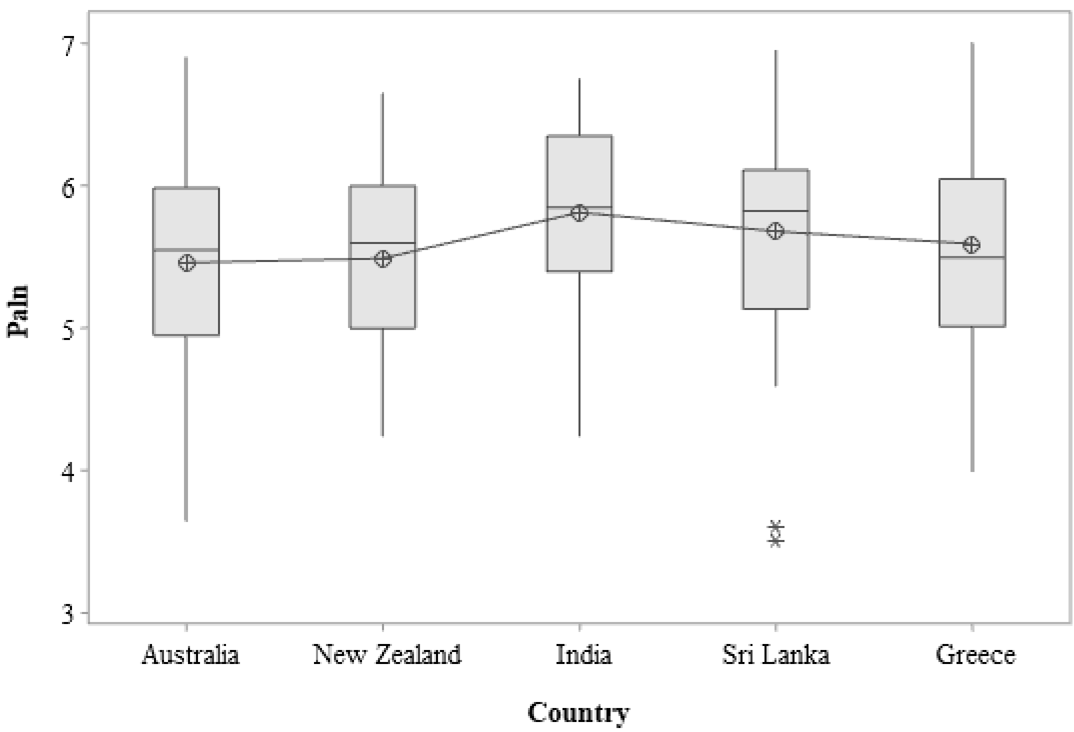

Figure 6.5: The Box Plot for Plan6.4.2.3 Possible Reason # 3: Unaccounted Mediating Variables

It is suggested that national culture transmits through to management practices such as CI through several layers of an organisation, and hence the association between national culture and management practice (in the researcher's study PDCA) as well as QMS Results ought to be weak. To explain this further, the researcher uses the following causal path (Figure 7.6) posited by Kanji and Yui (1997):

r_1 r_2 r_3 r_4

National Culture → Leadership Ic Organisational Culture → TQM Quality Performance

Figure 6.6: The path model adopted from Kanji and Yui (1997)

In Figure 6.6, the parameters r_i (i = 1, 2, 3, 4) refer to the strength (correlation) between the hypothesised causes and effects. Let us assume that $r_1= 0.5$, $r_2 = 0.7$, $r_3 = 0.5$, and $r_4 = 0.7$. Then, the association between national culture (say PDI) and TQM practice is only 0.175 (being 0.5*0.7*0.5), which is indeed a low correlation. The path model suggests that the association between national culture and quality performance is only 0.12. However, in fact, this may not be true because at least some constituents of quality performance (e.g. customer satisfaction, perceived quality) can be directly affected by national culture. Hence one could expect possibly a higher value than 0.12 between national culture and QMS Results.

What Figure 6.6 suggests is that *visionary leadership* and *organisational culture* are more adjacent (causally related) to TQM practices than national culture. Like in many other studies, these factors were not considered in this study due to practical difficulties in collecting data on these factors.

6.5 RESULTS AND DISCUSSION ON ACCEPTANCE OF PDCA AND QMS RESULTS ACROSS REGIONS

This section examines the means of the five constructs Plan (LDQMSP), Do, Check, Act and QMS Results across regions. Region is treated as a three-level factor, where the levels are: Australasia, South Asia, and Greece. Since Australasia (low power distance and individualist) is opposite to South Asia (high power distance and collectivist but similar in uncertainty avoidance to Australasia), the expectation is that mean scores of the five constructs would be higher for South Asia than Australasia. Greece being a highly uncertainty avoidant culture but lower power distance and higher individualism relative to South Asia, the expectation is that the mean scores of Greece should be at least higher than those for Australasia.

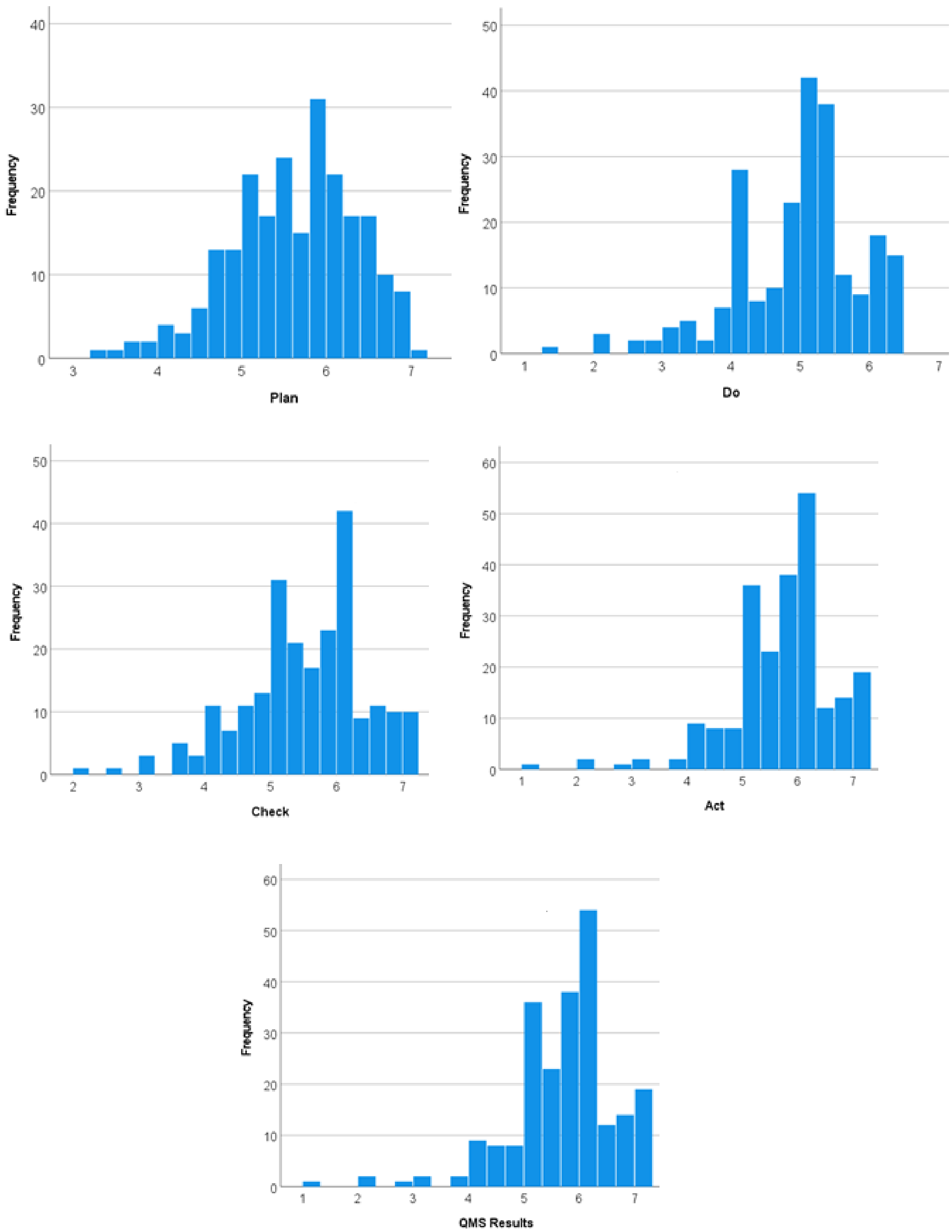

Figure 6.7: The distribution of construct scores

Since one-way analysis of variance (ANOVA) was used to test hypotheses on means (all means are the same versus all means are not the same), the distribution of the scores of the five constructs (response variables in ANOVA) were examined. Figure 6.7 shows these distributions. Since the distributions are not normal (Gaussian), the confidence intervals of the means and the statistical significance of the *F* test in ANOVA was conducted using the bootstrapping method available in IMB SPSS Version 27 software, by inputting the following *bootstrap specifications*:

- Sampling Method: Simple
- Number of Samples: 5000
- Confidence Interval Level: 95.0%
- Confidence Interval Type: Bias-corrected and accelerated (BCa)

The ANOVA test results shown in Table 6.13 clearly indicate that means scores are not the same for *Check*, *Act* and *QMS Results* at 0.05 significance level. LDQMSP returned a *p* value of 0.076, which could be interpreted as *weak significance*, but Do returned an exceedingly high *p* value. Table 6.14 depicts the mean estimates and their bootstrap 95% confidence intervals (CI). Figures 6.8 through to 6.12 depicts the 95% CI of means (error bars) of the scores five constructs for ease of interpretation (an alternative approach would have been Tukey's test on the confidence intervals of the differences of the means). In interpreting the error bars, the reader should note that while non-overlapping error bars shows statistically significant mean difference (at 0.05 significance level), overlapping error bars *do not necessarily imply* that the means are the same (Hair et al., 2010). Interpretation of ANOVA results (Table 6.13) in conjunction with the 95% CI of means of the scores of the five constructs lead to the following conclusions, based on the 0.05 significance level.

- The anticipated outcome of higher means scores for South Asia compared to Australasia was achieved for Check, Act and QMS Results.
- The score of Do is the same across all three regions. In fact, all three regions, the construct Do does not score as highly as the other four constructs.
- The expectation that the mean scores of Greece are higher those of Australasia is released only for QMS Results.

Table 6.13: One-Way Analysis of Variance Conducted to Study Mean Regional Differences

Construct	Variation Component	Sum of Squares	df	Mean Square	*F*	*p* value
Plan (LDQMSP)	Between Groups	2.848	2	1.424	2.608	0.076
	Within Groups	123.401	226	0.546		
	Total	126.249	228			
Do	Between Groups	1.139	2	0.570	0.675	0.510
	Within Groups	190.566	226	0.843		
	Total	191.705	228			
Check	Between Groups	9.331	2	4.665	5.844	0.003
	Within Groups	180.418	226	0.798		
	Total	189.749	228			
Act	Between Groups	6.280	2	3.140	3.584	0.029
	Within Groups	198.008	226	0.876		
	Total	204.288	228			
QMS Results	Between Groups	11.329	2	5.664	6.857	0.001
	Within Groups	186.699	226	0.826		
	Total	198.028	228			

Table 6.14: Mean Estimates of Regions and their 95% CI for the Constructs

Region	Construct				
	Plan (LDQMSP)	Do	Check	Act	QMS Results
Australasia (n = 89)	5.477 [5.314 ~ 5.639]	4.832 [4.632 ~ 5.021]	5.248 [5.056 ~ 5.437]	5.379 [5.149 ~ 5.606]	5.2879 [5.047 ~ 5.524]
South Asia (n = 79)	5.7376 [5.575 ~ 5.892]	4.941 [4.743 ~ 5.129]	5.719 [5.528 ~ 5.902]	5.6908 [5.498 ~ 5.877]	5.7219 [5.549 ~ 5.896]
Greece (n = 61)	5.594 [5.405 ~ 5.786]	5.003 [4.743 ~ 5.249]	5.494 [5.255 ~ 5.732]	5.7489 [5.524 ~ 5.969]	5.7692 [5.585 ~ 5.940]
Overall (n = 229)	5.598 [5.494 ~ 5.698]	4.915 [4.791 ~ 5.038]	5.476 [5.355 ~ 5.596]	5.585 [5.453 ~ 5.708]	5.566 [5.437 ~ 5.690]

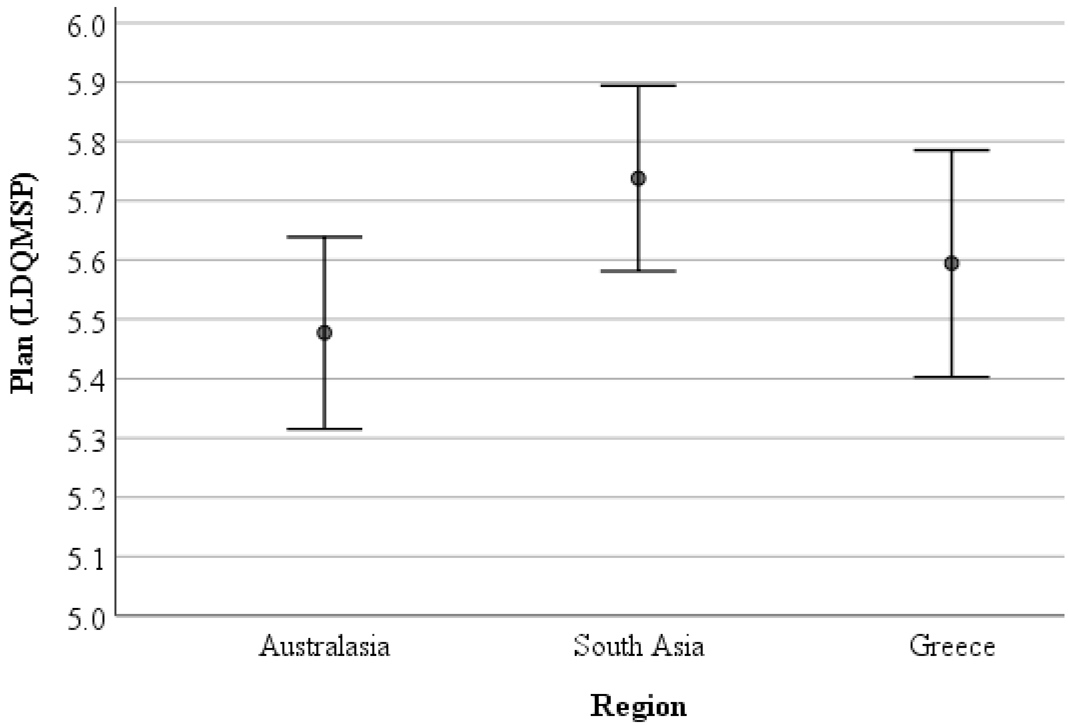

Figure 6.8: Figure 6.8: The 95% CI of means across regions for Plan (LDQMSP)

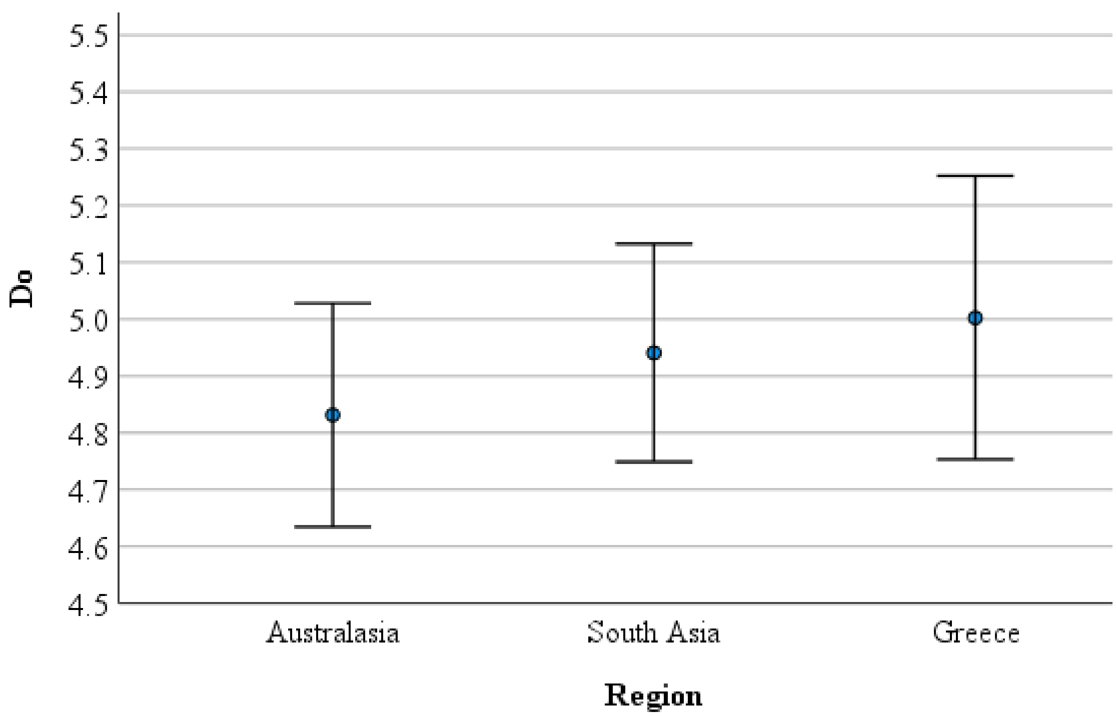

Figure 6.9: The 95% CI of means across regions for Do

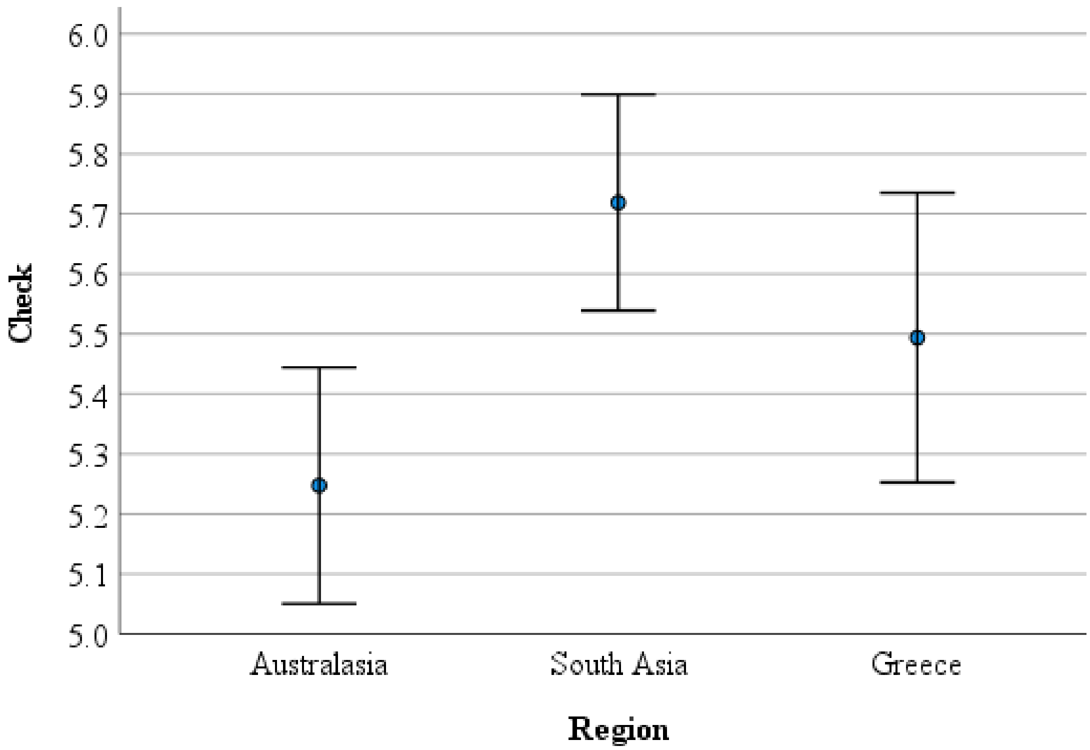

Figure 6.10: The 95% CI of means across regions for Check

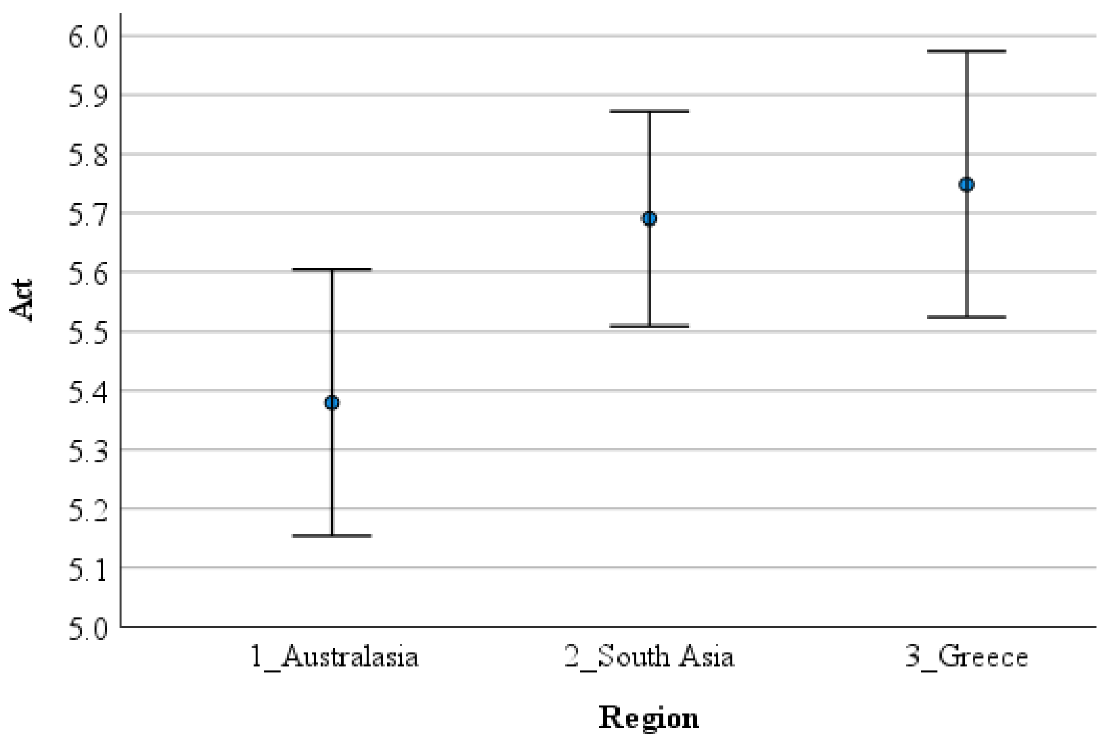

Figure 6.11: The 95% CI of means across regions for Act

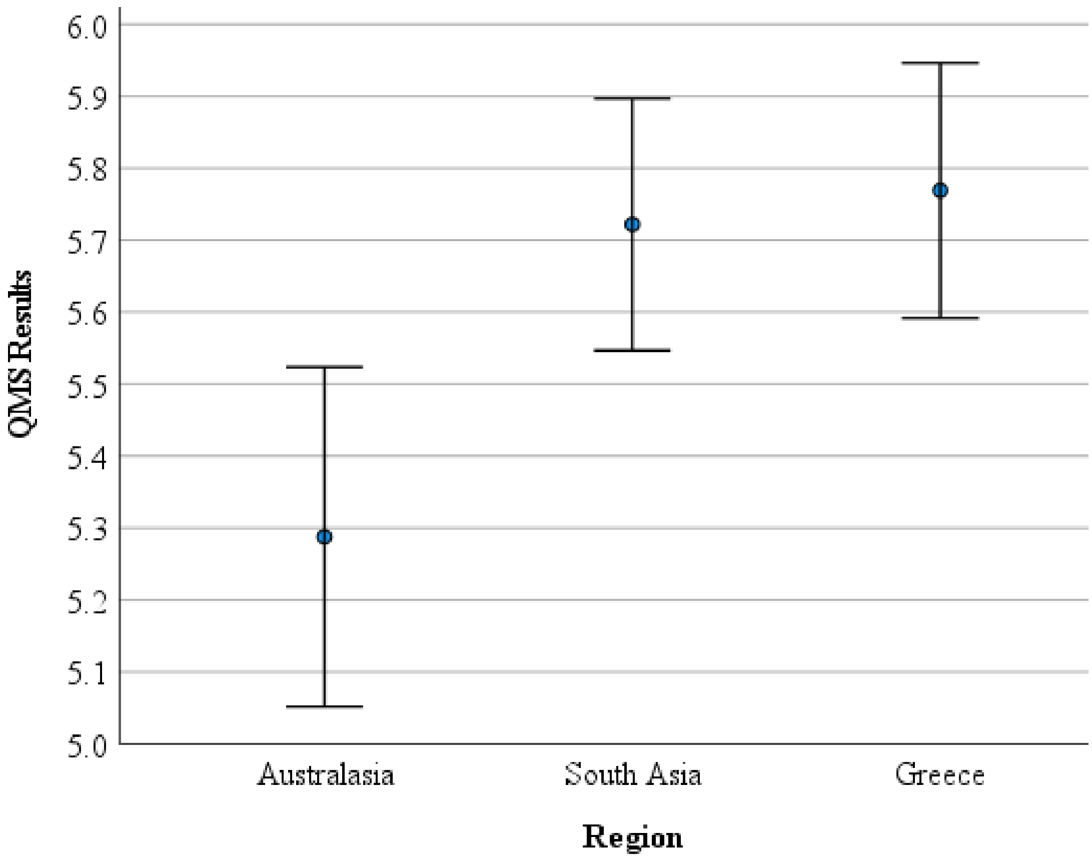

Figure 6.12: The 95% CI of means across regions for QMS Results

6.5.1 A Discussion on Regional Mean Scores

Australasia and South Asia are contrasting regions. The two regions represent two ends of a culture spectrum with Australasia having a low power distance individualistic culture and South Asia having a high-power distance collectivist culture. The two regions also differ from one another in factors other than culture. One such factor is access to capital in an aggregate sense (e.g. the per capital GDP of Australia is around 50,000 US$ but the per capita income of India is only around 2,000 US$). However, investigating how such factors affect ISO 9001 acceptance or implementation is beyond the scope of this study.

Comparing the scores of the theoretical constructs of ISO 9001:2015 (i.e. Plan/LDQMSP, Do, Check, Act in relation to the QMS and QMS Results) across regions as opposed to countries offset any under the assumption that certain chosen countries within a region are similar, which is one reason of justifying regional comparisons.

Table 6.15: Expectations of Mean Acceptance Scores of PDCA and QMS Results in Three Culture Profiles based on H_9 through to H_{14}

Construct	Culture Profile		
	Profile 1: low power distance and high individualism, but medium uncertainly avoidant **[Australasia]**	**Profile 2:** high power distance and high collectivism, but medium uncertainly avoidant **[South Asia]**	**Profile 3:** between profile 1 and profile 2 for power distance and individualism, but exceedingly high uncertainty avoidant **[Greece]**
Plan (LDQMSP)	A lower mean score than Profile 2 based on H_{9a} and H_{10a}	A higher mean score than Profile 1 based on H_{9a} and H_{10a}	A higher mean score than Profile 1 based on H_{11a}
Do	A lower mean score than Profile 2 based on H_{9b} and H_{10b}	A higher mean score than Profile 1 based on H_{9b} and H_{10b}	A higher mean score than Profile 1 based on H_{11b}
Check	A lower mean score than Profile 2 based on H_{9c} and H_{10c}	A higher mean score than Profile 1 based on H_{9c} and H_{10c}	A higher mean score than Profile 1 based on H_{11c}
Act	A lower mean score than Profile 2 based on H_{9d} and H_{10d}	A higher mean score than Profile 1 based on H_{9d} and H_{10d}	A higher mean score than Profile 1 based on H_{11d}
QMS Results	A lower mean score than Profile 2 based on H_{12} and H_{13}	A higher mean score than Profile 1 based on H_{12} and H_{13}	A higher mean score than Profile 1 based on H_{14}

Table 6.15 depicts the expectations of the means scores of the five theoretical constructs of interest for the three possible contrasting culture profiles based on PDI, IDV, and UAI. The PDI and IDV of Greece are not as extreme as Australasia or South Asia. Hence based on these two dimensions the mean scores of the five theoretical constructs of Greece should fall between the mean scores of Australasia (lower than South Asia) and South Asia (higher than South Asia). However, because Greece is associated with an exceedingly high UAI score, based on H_{12}, H_{13} and H_{14}, the mean scores of the five theoretical constructs of Greece are expected to close to — if not higher — the those of South Asia. It is this expectation is being examined in this section. These expectations are partially supported by the results. Clearly, the null hypothesis “means scores of Do are the same across all three regions” stays in contention (p = 0.510), which is something contrary to $H_{9b,}$ H_{10b}, and H_{11b}. However, these

hypotheses were not supported by data when they were tested. Thus, there is consistency in the results. For Act and QMS Results, the expected differences in the mean scores across regions were fully achieved ($p < 0.05$). For Check, the expected difference in the mean scores across Australasia and South Asia was achieved, but not that between Australasia and Greece ($p > 0.05$). For Plan (LDQMSP), none of the expected differences were achieved.

The important question is whether the statistically significant mean differences across regions are practically important (i.e., they are larger than small effects). This can be answered using Cohen's effect size (Cohen, 1988) guidelines for small effect, medium effect, and large effect based on η^2 (eta squared). According to Cohen (1988), $\eta^2 = 0.01$ indicates a small effect, $\eta^2 = 0.06$ indicates a medium effect, and $\eta^2 = 0.14$ indicates a large effect. Table 6.16 shows the η^2 point estimates and their 95% CI for the response variables Plan (LDQMSP), Do, Check, Act, and QMS Results. Based on the point estimates of η^2, only Check and QMS Results approach medium effect sizes (others are small). The consequence of small sample size is still evident due to wide 95% CI.

Table 6.16: The η^2 effect size Estimates and their 95% CI for the Theoretical Constructs

Construct	Point Estimate	95% CI	
		Lower	Upper
Plan (LDQMSP)	0.023	0.000	0.068
Do	0.006	0.000	0.034
Check	0.049	0.006	0.109
Act	0.031	0.000	0.081
QMS Results	0.057	0.010	0.120

Notes:
η^2 is estimated based on the fixed-effect model
Negative but less biased estimates are retained, not rounded to zero

6.6 CHAPTER CONCLUSION

This chapter provided results and an accompanying discussion to answerer the second research question (RQ2) of the study. The hypotheses surrounding RQ2 takes the position that national culture dimensions are related to Plan (LDQMSP), Do, Check, and Act (these stages are for the entire QMS), as well as QMS Results. Another way RQ2 was answered was by comparing the scores (mean values) of Plan (LDQMSP), Do, Check, Act and QMS Results across regions (see Figure 6.13).

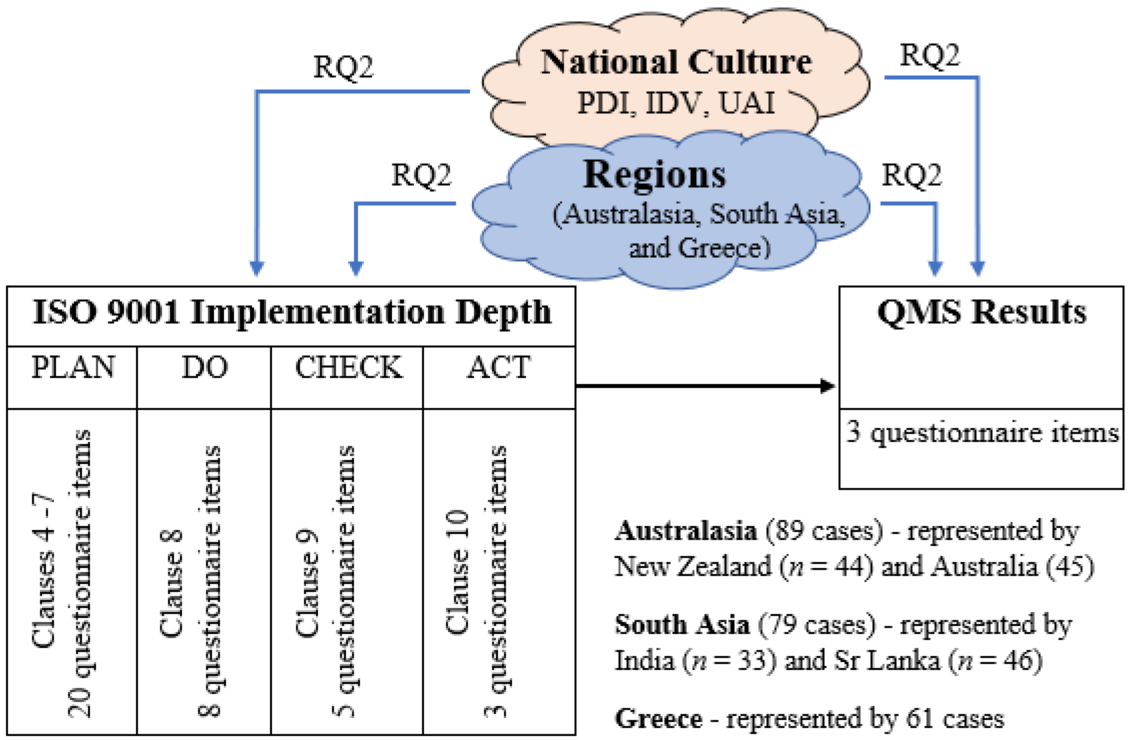

Figure 6.13: The Nexus between RQ2, the five theoretical constructs, and culture/regions

Data analysis revealed that in the main, PDI and IDV are related to Plan, Check, Act as well as QMS Results, as hypothesised (however PDI and IDV were found to have no effect on Do). Also, UAI was found to have no relationship with any of the four PDCA elements or QMS Results. Comparison of regional means also tallied with hypothesis test results.

In the cases were statistically significant results were found, they were found to be weak (the size of the bivariate correlations and the standardised regression coefficients were small). For example, the absolute values of statistically significant ($p < 0.05$) bi-variate correlations between national culture dimensions and PDCA elements (plus QMS Results) ranged from 0.141 (lowest statistically significant) and 0.219 (highest statistically significant). In terms of the *effect size definitions* of Cohen (1988) for bi-variate correlations, these correlations imply a small effect (according to Cohen, a population correlation coefficient of 0.1 is a small effect, a population correlation coefficient of 0.30 is a medium effect, and a population correlation coefficient of 0.50 is a large effect). Three possible reasons for weak relationships were proposed: consistency with prior studies that examined similar associations; PDCA being such an elegant and basic task, countries across the globe could be using it almost the same way; possibility of unaccounted mediating variables mediating the national culture → Plan, Do, Check, Act (and QMS Results) relationship. A detailed discussion was provided in section 6.4.2.

The next chapter (Chapter 07) concludes this thesis by reviewing the researcher's achievements against the objectives that were set out in planning this research, among other important things such as contributions of the study, and recommendations on future research directions.

CHAPTER 7
CONCLUSIONS

7.1 INTRODUCTION

This chapter, the final chapter of the thesis, is organised as follows. Section 7.2 reemphasises the basis of this research. This section provides a concise explanation of what drove the three objectives of the study. Section 7.3 highlights what was achieved against each objective of the study. Section 7.4 covers the contributions this study makes to academia (new knowledge). Section 7.5 covers the contributions this study makes to the practice of quality management. Section 7.6 briefly revisits the delimitations, limitations, and assumptions of the study, outlined earlier. Section 7.7 suggests future research directions, based on what was uncovered through this research.

7.2 RE-EMPHASISING THE BASIS OF THIS RESEARCH

Thousands of suppliers around the world implement the QMS certification standard ISO 9001 to improve their processes and to provide the assurance to the customer that they (supplier) possess the necessary elements (i.e. a QMS) to design, produce, deliver, and maintain what the customer wants. By default, ISO 9001 implementation translates to the supplier's QMS being audited by a third-party accreditation body for compliance against the standard, upon necessary improvements/adaptations required to meet the standard.[54] The current version of the standard is the year 2015 version, referred to as ISO 9001:2015. This version stipulates certain requirements a QMS ought to possess under seven key clauses: Context of the Organization (Clause 4), Leadership (Clause 5), Planning (Clause 6), Support (Clause 7), Operation (Clause 8), Performance Evaluation (Clause 9), and Improvement (Clause 10).

Relative to former versions, ISO 9001:2015 seems to have the following seemingly useful features:

[54] A supplier (first party) can also implement ISO 9001:2015 and self-declare that they are ISO 9001:2015 compliant by making necessary adaptations to meet the QMS requirements stipulated in ISO 9001:2015 via internal audits. A major purchasing customer (second party) can also audit the QMS of the supplier, leading the latter towards ISO 9001 implementation.

(i) **Plan-Do-Check-Act (PDCA):** The seven key clauses of the standard are somewhat clearly arranged (in a temporal fashion) to convince the user that the standard is based on the time-honoured continual improvement practice of PDCA, leading to QMS Results (e.g. Customer Satisfaction). This temporal arrangement of the key clauses of the standard is referred to as the ISO 9001:2015 process model (see Figure 1.2 of Chapter 01).

(ii) **The Process Approach:** Stemming from (i) above, the standard emphasises the "process approach". The process approach appreciates that converting inputs to outcomes through actions (processes) needs to take into account the interconnectedness of the processes and the relationship these have with the internal and external environment.

(iii) **Risk-based Thinking:** The standard emphasises *risk management* (risk-based thinking rather than reactionary thinking).

(iv) **Leadership Engagement and Commitment:** The standard requires the leadership to demonstrate their commitment to achieve the goals of the QMS, demonstrate customer focus, establish and implement quality policy, and assign authority and responsibility for people to ensure that the requirements of the standard and the intended outputs are met. Thus, the standard requires the organisational leadership to play a lead role in establishing processes, monitoring the effectiveness of these processes, and taking appropriate action to sustain QMS Results.

(v) **A High-level Generalisable Structure:** The standard follows a high-level generalisable structure (e.g. ten clauses and same titles for these ten clauses) common to other ISO based management systems standards.

The literature on ISO 9001 is proliferated with studies that examined different facets of implementation of the standard (Chapter 02). However, the literature lacks a study that directly tests the theoretical validity of the contents in the standard. The current standard provides a pathway to directly test the validity of the key assessment areas (clauses) of the standard, once the ISO 9001:2015 process model can be translated into a testable theoretical model that explains the PDCA phenomenon (in relation to the entire QMS), leading the QMS Results. This was one of the primary motivations of this research (Motivation 1).

ISO 9001:2015 is not a standard meant for a physical entity (e.g. a physical structure, a machine, computer hardware etc.). Standards for physical entities will have the same intent and meaning irrespective of who uses the standard, and where. ISO 9001:2015 is a standard meant for a social entity, namely, an organisation. Since it is reasonable to posit that organisations are influenced by the wider cultures in which they operate, it is reasonable to posit that the acceptance of PDCA (as promulgated in ISO 9001:2015) as well as achieving QMS Results would be influenced by the national culture in which an organisation operates. Stated alternatively, it is possible to propose that certain countries and regions of the world would have a higher-level of acceptance of PDCA and QMS results relative to countries and regions that have different/opposite culture characteristics. This proposition has not been rigorously tested empirically in prior research, in relation to ISO 9001. This was another key motivation for this research (Motivation 2). What is PDCA in relation to the entire QMS remains an important question that requires a comprehensive answer.

Given the above background, the researcher did set the following three objectives to achieve:

OBJ1: To develop and test a theoretical model that underpins the ISO 9001:2015 process model.

OBJ2: To develop a scientifically validated measurement instrument to operationalise the constructs underpinning the theoretical model.

OBJ3: To examine cultural and regional differences in the degree of acceptance levels of the requirements stipulated in ISO 9001:2015, when these clauses are aligned to constructs that explain QMS Results.

Based on literature synthesis, the following to research questions were advanced to achieve the three research objectives.

RQ1: How does meeting the requirements stipulated in the key clauses of ISO 9001:2015 (Clauses 4 through to 10) predict and explain the expected outcomes of ISO 9001 implementation (QMS Results) via the PDCA approach?

Subsequently (Chapter 03) RQ1 was partitioned into three sub-questions:

RQ1a: What does “PDCA for the entire QMS” really mean?

RQ1b: How can the key clauses of ISO 9001:2015 be best aligned to PDCA theoretically?

RQ1c: What is the relationship between the key clauses of ISO 9001:2015, PDCA, and QMS Results?

RQ2: Does ISO 9001:2015 have the same acceptance across cultures and regions?

Answering RQ1 (more specifically, the three subparts of RQ1) achieves OBJ1 and OBJ2 while answering RQ2 achieves OBJ3.

7.3 REVIEW OF ACHIEVEMENTS AGAINST RESEARCH OBJECTIVES

7.3.1 Achievements Against Objective 1

OBJ1: To develop and test a theoretical model that underpins the ISO 9001:2015 process model.

A testable theoretical model that underpins the ISO 9001:2015 process model was developed in Chapter 03 (see Figure 3.2). This model arranges the seven key clauses of ISO 9001 in a causal predictive fashion that follows a PDCA approach, leading to QMS Results. Figure 7.1 depicts the test results of this model (Figure 7.1 is essentially Figure 5.5 that was presented in Chapter 05 with cosmetic changes to construct labels and clarification points).

The study found that all the hypothesised structural relationships between the five constructs of the model (H1 through to H8) are statistically significant at 0.05 level; several paths returned p values much less than 0.05, with some returning $p < 0.001$ (details in Chapter 05; for example, see Table 5.11). The figures shown on the arrows leading from one construct to another are the standardised structural regression coefficients corresponding to the eight hypothesised relationships. These regression coefficients also represent the direct effect of the cause construct on the effect construct. The figures shown on the arrows leading from a construct to its indicators are the factor loadings (indicators loadings). All factor loadings were found to be significant ($p < 0.001$). In addition, the endogenous constructs well explained by their predictor constructs (high R^2 values). Finally, the overall goodness-of-fit of the model to data, based on the particular structural equation modelling that was used (partial least squares) was found to be satisfactory in terms of the standardised root mean square residual (SRMR)[55]; SRMR = 0.058.

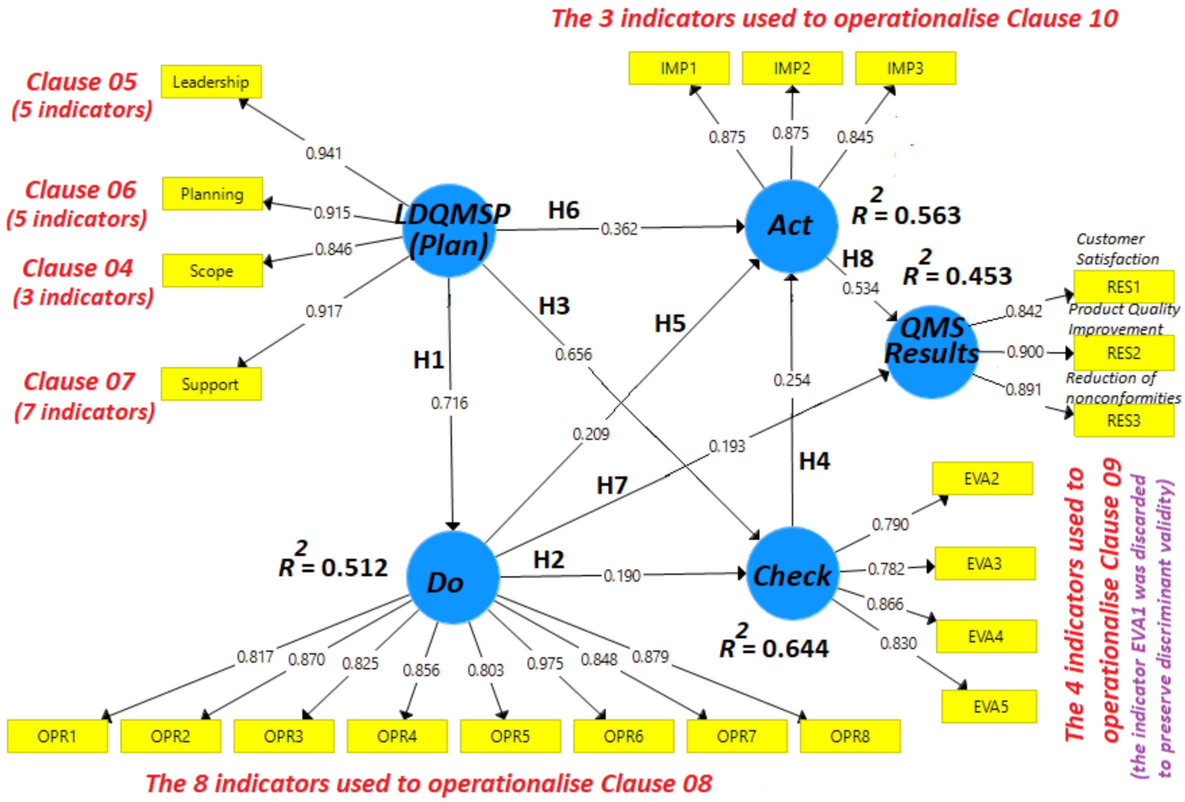

Figure 7.1: The hypothesised theoretical model to answer RQ1 with parameter estimates

The study found that PDCA for the entire QMS (RQ1a) means *planning* (Plan), *implementing* (Do), *monitoring* (Check), and *controlling* (Act) activities related to the QMS, to achieve planned results on the QMS. Of the four steps planning is front loaded with many activities, all being driven by the leadership. These activities are shown below:

- Setting strategic quality objectives from the quality policy
- Establishing processes required to meet the objectives (includes identifying interactions between the processes)
- Determining activities required for each process (risk assessment is part of establishing these planned activities)

[55] It is now an accepted practice to mention the overall goodness-of-fit of the model to data (an indicator that is traditionally used in the more established covariance structural equation modelling) in studies that involve partial least squares structural equation models; however, SRMR is the only overall goodness-of-fit indicator currently being recommend in the partial least squares structural equation modelling literature (details in Chapter 05).

- Establishing measurement criteria to examine the effectiveness of the processes
- Acquiring and developing resources required for the processes (activities)

Due to heavy involvement of the leadership in QMS planning, the study labels Plan (in the context of the entire QMS) as Leadership-driven QMS Planning (LDQMSP).

PDCA for the entire QMS (the researcher refers to this as big PDCA) stands somewhat analogous to application of the PDCA approach to improve quality performance of an identified product (the researcher refers to this as small PDCA). One similarity is that if Plan is taken as an exogenous construct, causal dependencies of Do, Check, Act and PDCA outcomes remain the same, whether one is referring to big PDCA or small PDCA.

Above said, the researcher argued that big PDCA can be reliably distinguished from small PDCA at least on two counts (Chapter 05). Firstly, unlike small PDCA, big PDCA is a strategic management activity. Secondly, because big PDCA is a strategic management activity, it is likely that PDCA would not usually run several iterative cycles as in small PDCA. This is because planning in big PDCA involves many activities that need not and should not be changed frequently. Looking at the planning activities in the big PDCA, clearly, almost all the planning activities — setting strategic quality objectives from the quality policy, establishing processes required to meet the objectives, determining activities required for each process, establishing measurement criteria to examine the effectiveness of the processes, acquiring and developing resources for the processes — are relatively stable activities, especially if things are done right the first time. Changes are needed in certain occasions such as new product development or when major changes are needed to existing processes in the case of improving the quality of existing products to maintain completeness in the marketplace. Within big PDCA several different iterative small PDCA cycles can operate to achieve QMS Results. The study found that QMS Results as a theoretical construct reflects *customer satisfaction* (RES 1), *product quality improvement* (RES 2), and *reduction of non-conformities* (RES 3).

The testing of the theoretical model showed that the key clauses of ISO 9001:2015 can be best aligned to big PDCA (RQ1b) as follows. Clauses 04 through to 07 indicate Plan (LDQMSP), clause 08 indicates Do, clause 09 indicates Check, and clause 10 indicates clause 10. Since each clause covers several compliance areas, the study treated Plan, Do, Check, and Act as latent variables. While the key clauses of ISO 9001:2015 are related to the constructs (latent variables) Plan, Do, Check, and Act (big PDCA) as indicators of these constructs, the model (Figure 7.1) that these constructs do not follow a linear flow of Plan → Do → Check → Act → QMS Results. The study showed that while the above-mentioned direct relationships exist, there are several mediating relationships resulting from other direct and indirect relationships. In many instances, other direct and indirect effects via the mediation paths were stronger than the direct effects in the direct relationships in the Plan → Do → Check → Act → QMS Results path (see Table 5.12). For example, while Check was found to have a direct effect of only 0.254 on Act, Plan (LDQMSP) was found to have a total effect of 0.712 on Act (direct effect = 0.362 and indirect effect = 0.350 via mediation paths). Thus, the study clearly indicated that PDCA is not a basic linear process. These findings comprehensively answer RQ1c.

Having addressed RQ1 comprehensively, it is concluded that the study achieved OBJ1 successfully.

7.3.2 Achievements Against Objective 2

OBJ2: To develop a scientifically validated measurement instrument to operationalise the concepts underpinning the theoretical model.

From a theoretical standpoint, OBJ2 is a corollary of OBJ1. This is because a valid measurement instrument is required to collect data to test the empirical model (Figure 7.1) mentioned in the previous section. However, OBJ2 appears as a standalone objective because of the practical importance associated with this objective, in that, a scientifically validated measurement instrument to assess the existing level of compliance to ISO 9001:2015 would be valuable to organisations contemplating on pursuing ISO 9001:2015.

A key requirement in developing the measurement instrument was to include sufficient number of measurement items, under each key clause of ISO 9001:2015. This is to capture what each clause is supposed to capture. Consequently, a survey instrument (a questionnaire) containing Likert-type “agreement seeking statements” on different facets of clauses 4 thorough to 10 was developed iteratively, using a panel of international experts[56] from New Zealand, Australia, UK, and Sri Lanka using a method that is similar to the *Delphi method*. The role of the researcher in the questionnaire development process was to act as the moderator, detailing what was found in the previous round, and what is expected in the current round (details in section 4.4 of Chapter 04). In round 1 of questionnaire development, the researcher provided examples of Likert type agreement seeking statements to educate the panel what style of statements are sought by the researcher in developing her questionnaire (see part II of Appendix 3). The questionnaire development task was completed in three rounds, resulting in a 39-item questionnaire (reduced from 72 items that was generated in round 1).

As mentioned earlier, the survey instrument (questionnaire) was administered among ISO 9001 certified manufacturing companies in five countries (i.e. New Zealand, Australia, Greece, India and Sri Lanka) resulting in 240 responses (one response per company); 11 responses were discarded due to the pattern of responding to the questionnaire (details in Chapter 04). The scientific validation of the survey instrument took place as part of empirical validation of the theoretical model, as is being done in partial least squares structural equation modelling (PLS-SEM) approaches, where the measurement model and the structural model are validated simultaneously (details in Chapters 05). Two pertinent concerns one might have in relation to questionnaire administration could be limiting the data collection to manufacturing and confining the study to ISO 9001 certified firms. Although these concerns have been addressed earlier, these are re-addressed in the next paragraph for the benefit of the reader.

The study was confined to manufacturing companies because some parts of the study (the part related to OBJ3) requires controlling for *between country variation* of technology and occupational culture (see section 1.7.1 of Chapter 01). By limiting the study to manufacturing, it was assumed that this control would be achieved to some degree through the case selection process. For example, a ceramic factory would function the same way, whether the factory is situated in Australia or India (people use the same jargon, and occupationally, they have similar orientations). The same cannot be said for most services

[56] The panel size was 7 in round 1, but the panel size was increased to 13 in the subsequent rounds to suit the objectives of each iteration.

(e.g. most schools and hospitals in Australia and New Zealand would function very differently to those in India and Sri Lanka). The study was confined to ISO 9001 certified companies because the study objectives require organisations that have implemented ISO 9001. Similar type of empirical research has been conducted by prior researchers. For example, Flynn and Saladin (2001, 2006) tested their theoretical models on performance excellence using data collected from World Class Manufacturing (WCM) companies around the world (WCM companies are expected to be excelling in strategic performance). Similarly, Jayamaha et al. (2014) tested their model on the Toyota Way using data collected from Toyota's logistics, sales and marketing facilities around the world outside Japan (data collected from Toyota facilities are expected to support any model on the Toyota Way). Therefore, the researcher maintains that response bias would not have crept in, when she tested her theoretical models on ISO 9001, using data collected from ISO 9001 certified firms. Besides, the questionnaire was designed and administered carefully.

For the above reasons, it is concluded that the study achieved OBJ2 successfully.

7.3.3 Achievements Against Objective 3

OBJ3: To examine cultural and regional differences in the degree of acceptance levels of the requirements stipulated in ISO 9001:2015, when these clauses are aligned to constructs that explain QMS Results.

RQ2 was formulated to achieve OBJ3. Figure 7.2 depicts the conceptual framework that was used to answer RQ2. This figure is a reproduction of Figure 6.13 of Chapter 06 with a different caption. RQ2 is based on the hypothesis that national culture dimensions are directly related to Plan (LDQMSP), Do, Check, and Act stages of CI (in relation to big PDCA), as well as QMS Results (see Chapter 03 for details). The study uses three of the four original national culture dimensions articulated by Hofstede (1980a). These are power distance (PDI), individualism (IDV) and uncertainty avoidance (UAI). The reasons for selecting Hofstede's national culture framework over its rival, the GLOBE framework, was given in Chapter 02. RQ2 is also answered in an alternatively analogous way by comparing the mean scores of Plan (LDQMSP), Do, Check, and Act and QMS Results across regions.

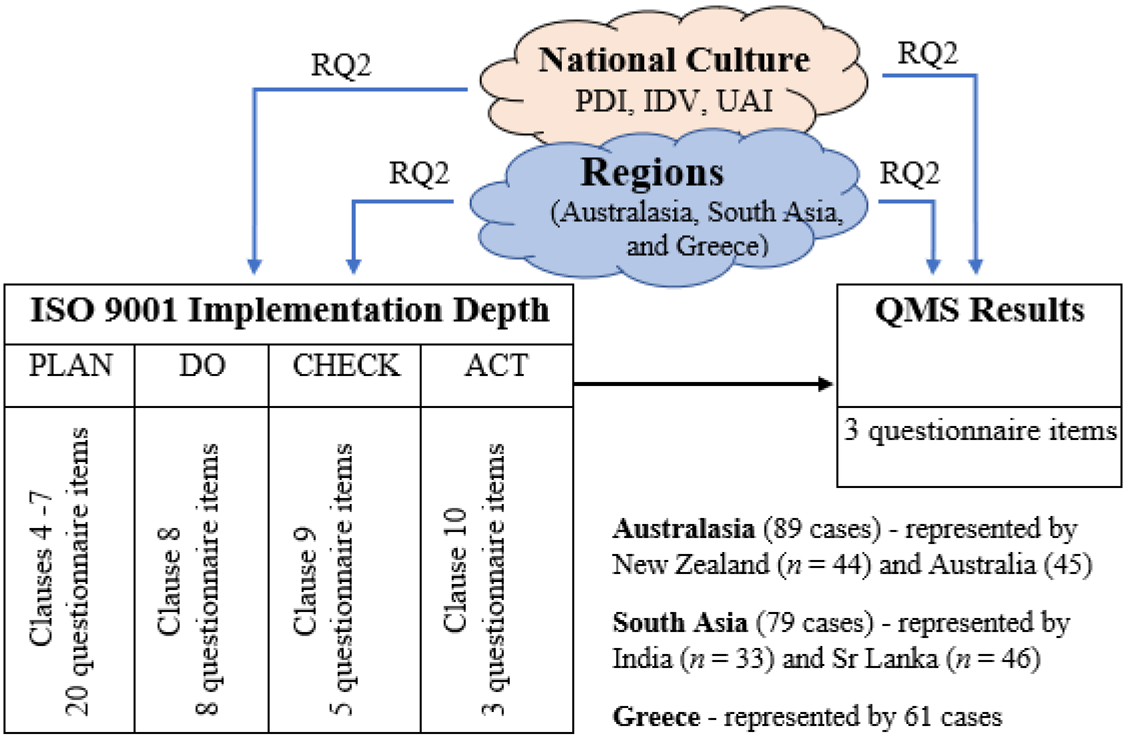

Figure 7.2: The conceptual framework that was used to answer RQ2 to achieve OBJ3

Related to RQ2, the study hypothesised that there is greater acceptance for PDCA elements and QMS Results in high PDI cultures (in this study South Asia) than in low PDI cultures (in this study Australasia). In the main, the hypothesis test results supported this overall hypothesis. Similarly, the study hypothesised that there is greater acceptance for PDCA elements and QMS Results in low IDV cultures (i.e. collectivistic cultures, which in this study is South Asia) than in high IDV cultures (i.e. individualistic cultures, which in this study is Australasia). In the main, the hypothesis test results supported this second overall hypothesis also. Finally, within RQ2, the study hypothesised that there is greater acceptance for PDCA elements and QMS Results in high UAI cultures (in this study Greece) than in low UAI cultures (in this study South Asia and Australasia). Hypothesis test results failed to support this third overall hypothesis.

An important finding that resulted in answering RQ2 was that even when culture (or region) was found to have a statistically significant effect on PDCA elements and QMS Results ($p < 0.05$), such effects were found to have a small effect (e.g. in terms of η^2, Cohen's f^2). Three possible reasons for this was proposed: consistency with prior studies that examined similar associations; PDCA being such an elegant and basic task, countries across the globe could be using it almost the same way, even in big PDCA; possibility of unaccounted mediating variables mediating the national culture → Plan, Do, Check, Act (and QMS Results) relationship (for details see section 6.4 of Chapter 06).

It is important to note that the underlying assumption on RQ2 is that greater the acceptance of ISO 9001:2015 clauses — the clauses representing the four elements of the PDCA cycle in relation to the overall QMS — by cultures, greater the outcome of implementing the standard. An equivalent assumption has been made in prior research in relation to TQM and performance excellence (e.g. Flynn & Saladin, 2006; Lagrosen, 2003). In TQM and performance excellence, the cultural differences come from management practices that are flexible. For example, some cultures will accept statistical process control more readily than others. The question is whether any flexibility in management practice can be afforded in ISO 9001:2015 as ISO 9001:2015 is a compliance standard. Although the key clauses of ISO 9001:2015 stipulates compliance requirements, the study showed that these clauses can be aligned with the Plan, Do, Check, Act (PDCA) steps in relation to the entire QMS (i.e. big PDCA).

It is true that ISO 9001:2015 is a *"pass/fail decision"* when it comes to QMS auditing and certification. In this regard, ISO 9001:2015 accreditation is no different to an accreditation of a high-level academic qualification (e.g. a PhD) or an accreditation of a high-level professional qualification to a person (e.g. chartered engineer, chartered quality professional, chartered accountant, lawyer etc.). Though not explicitly recognised in all these accreditations, there are candidates that pass an accreditation examination much better than the others. Likewise, not all ISO 9001:2015 certified organisations (or facilities within an organisation) would secure the same score against ISO 9001:2015 assessment criteria in an appropriately designed measurement scale (this study used 36 indicators of to cover the QMS certification requirements stipulated in clauses 04 through to 10 as shown in Figure 7.2). This is because the ISO 9001:2015 too affords the flexibility (within limits) in the practice of planning, implementation, monitoring and controlling activities (i.e. big PDCA) that are required to achieve QMS Results. Moreover, whether one is referring to big PDCA or small PDCA, the practice of PDCA is founded upon the "theory of knowledge" emphasised in pragmatism and organisational learning takes place in PDCA (see section 2.4.2).

Having answered RQ2 comprehensively, it is concluded that the study achieved OBJ3 successfully.

7.4 CONTRIBUTIONS TO ACADEMIA

It is claimed that this research makes the following contributions to new knowledge, via theory development and theory testing.

7.4.1 Discovering the Theoretical Basis of ISO 9001:2015 Through Model Building and Model Testing

A great deal of prior research has been conducted on different aspects of ISO 9001 implementation. Some relevant studies were mentioned in Chapter 02. Studying ISO 9001 implementation is important and in fact, researcher's RQ2 is also meant to investigate ISO 9001 implementation on an area that has not been explored earlier (section 7.4.2). Most of the prior studies on ISO 9001 have made the implicit assumption that the standard is theoretically valid. Review of prior research showed that only Lin and Jang (2008) have tested the theoretical validity of ISO 9001 directly (a detailed review on studies that tested the theoretical validity of ISO 9001 directly and indirectly is found in section 2.5.3 of Chapter 02). Lin and Jang used the year 2000 version of the standard to test their theoretical model,57 and a reflective critique on the said study was offered by the researcher. While the researcher critiqued the above study on several points, using the principles of ISO 9001 as constructs to build the theoretical model was the standout critique.[58] ISO 9001 principles are very broad, and it cuts across other theorisations of quality management.

To the credit of the developers of ISO 9001:2015, sufficient information has been provided in the standard to test its theoretical validity. The researcher exploited this opportunity. She identified the ISO 9001:2015 process model as the starting point to build the theoretical model. By building the theoretical model and testing it empirically to unearth the validity of the standard (using the protocols used in positivist research), it is argued that the researcher makes a theoretical contribution to the field of quality management. It is important to re-emphasise that the researcher did not test the validity of the PDCA approach as a theory

[57] This standard remained almost invariant up until the 2015 version came into force.

[58] Lin and Jang (2008) assigned the contents of the four key clauses of ISO 9001:2000 to their constructs (ISO 9001 principles). This resulted in an asymmetric allocation of questionnaire items, including a construct that received just one questionnaire item!

(arguably PDCA is the most venerated theory in quality management), rather, she tested the validity of the ISO 9001 clauses as a representation of the PDCA approach, leading to QMS Results, as implied in the ISO 9001:2015 process model.

The researcher claims that her study on the theoretical validity of ISO 9001 not only improves and updates the findings of the study conducted by Lin and Jang (2008), but it also adds the missing links to subsequent studies that attempted to establish the theoretical validity of ISO 9001 in some form.

7.4.2 Theorising the Relationship Between National Culture and Big PDCA Through Model Building and Model Testing

Although the literature is not too short of studies that examine the effect of national culture on the practice of operations management (some studies covered quality management) in a cross-cultural context, there were no prior cross-cultural studies that empirically examined the practice of PDCA in relation to the entire QMS (i.e. big PDCA). As explained earlier (sections 7.3.3), the researcher built and tested hypothesis to study how national culture seems to relate to PDCA emphasised in ISO 9001:2015. This required review of a vast body of literature on culture studies. Theorising and testing empirical models on the core of ISO 9001 in a multi-cultural context bring novelty to the field of quality management (not attempted before) and helps academia to widen their understanding on acceptance of ISO 9001 in different national cultural contexts (e.g. regional differences in the acceptance of PDCA). Thus, it is claimed that the researcher makes a theoretical contribution to the field of quality management.

7.5 CONTRIBUTIONS TO THE PRACTICE OF QUALITY MANAGEMENT

7.5.1 Designing a tool to Self-assess Compliance Against ISO 9001:2015

As mentioned earlier in this chapter, one of the direct and immediate benefits of the survey questionnaire developed by the researcher is that it provides a measurement system for organisations to quickly review where they stand, in relation to ISO 9001:2015 compliance, at any given point in time. The survey instrument is likely to be important for currently certified organisations as well as organisations who are considering ISO 9001 certification. At the time of conducting the survey, the researcher came across two instances where the researcher's permission was sought to use her questionnaire (along with the response choices the respondents made for each question) in management review meetings. This is a good sign that practitioners are trying to use the researcher's research outputs.

7.5.2 Creating a Pathway to Understand Causation of QMS Results via ISO 9001:2015 Implementation

Lewin (1952, p. 169) famously said "there's nothing more practical than a good theory" for a reason. A good theory explains why certain things happen. The researcher's theoretical model representing the ISO 9001:2015 process model (Figure 7.1) explains how compliance to requirements stipulated in each key clause of ISO 9001:2015 contributes towards quality-related outcomes, and what aspects of quality-related outcomes managers could realistically expect by implementing the standard. The model is simple and the ISO 9001:2015 clauses have been re-packaged to explain the achievement QMS Results via the PDCA approach.

All quality managers are well-versed with the PDCA approach (arguably the simplest, but the most elegant explanation of CI) and what they only need is strong evidence to suggest that ISO 9001:2015 is based on PDCA, and how strongly each stage of PDCA is linked to the preceding stages, in an ISO 9001 compliant QMS. The model and the estimated theoretical relationships show managers that PDCA does not follow the linear pathway of Plan leading to Do; Do leading to Check; Check leading to Act; and Act leading to QMS Results. The estimated theoretical relationships show that while the above direct relationships exist, there are many other significant indirect relationships (mediating relationships) associated with PDCA. For example, the Check stage not only depends on the Do (implementation of the processes) stage, but also on the Plan stage (what has been planned).

The researcher believes that the above practitioner-related outcome has been achieved successfully through this research.

7.6 REVISITING THE DELIMITATIONS, LIMITATIONS AND ASSUMPTIONS

Having arrived at the end of the thesis, in this section, the researcher looks back at the delimitations and limitations identified in setting out the research (see section 1.7 of Chapter 01) and the *a priori* assumptions that were made at the time of collecting the data (see section 4.5.8 of Chapter 04). This is to ascertain whether further comments need to be made (e.g. additional issues that cropped up as the research progressed). The delimitations mentioned earlier (only manufacturing, and only ISO 9001 certified organisations) remained intact and so were the limitations. However, an additional limitation cropped up when the researcher looked at her results critically. None of the researcher's models directly explain why ISO 9001 implementation efforts sometimes fail. Although covering this aspect does not fall under any of the research objectives directly, because researcher's models directly relate to ISO 9001 implementation and implementation outcomes (QMS Results), some critics may view exclusion of potential factors that affect ISO 9001 implementation success (e.g. motives of certification, management commitment) as a limitation of this research.

As regards the a priori assumptions, all of them remained intact and no further assumption was needed during data analysis. However, a special mention needs to be made on the third assumption, which concerns respondents from Australia and New Zealand, the new counties. Specifically, the third assumption (section 4.5.8) states that *"all the respondents in the new countries — Australia and New Zealand — that allow naturalisation of foreign immigrants respond to the questionnaire from the point of view of the values of their adopted countries"*. The study assumes that in the main, Australian and New Zealand respondents share *Anglo values* on power distance and individualism. In Australia (and perhaps to a lesser extent in New Zealand), a sizable portion of middle managers (e.g. quality managers and process owners who acted as respondents in this study) could hail from non-Anglo countries, including India and Sri Lanka — countries that were distinguished from Australia and New Zealand in answering RQ2. One can argue that "naturalisation" is a statutory process, rather than a behavioural transformation process. As such, the third assumption of the study could also be a potential weakness (limitation) of the study.

7.7 SUGGESTIONS FOR FURTHER RESEARCH

7.7.1 Including the Service Sector to Test the Researcher's Theoretical Model on Big PDCA leading to QMS Results

Further research may involve testing the researcher's theoretical model derived from the ISO 9001:2015 process model (see Figures 3.2 and 7.1) in a variety of industries, representing both the manufacturing sector and the service sector. Extending the study to two sectors enhances the external validity of the model, and possibly by deduction, the generalisability of the ISO 9001:2015 process model. In addition, a study covering both manufacturing and service sectors may reveal that the model fits to one sector better than the other, and if this becomes the case, further research may be conducted to ascertain the cause for this.

7.7.2 Augmenting the Model to Cover Constraining Factors on the Hypothesised Paths

The researcher's theoretical model was developed by capitalising on the ISO 9001:2015 process model. As mentioned earlier, in testing this model, no attempt was made to incorporate potential constraining factors (in some instances these factors can be viewed as moderators), which may explain why ISO 9001:2015 implementations sometimes fail to deliver expected outcomes. A relevant question in an ISO 9001:2015 compliant QMS in a PDCA context, may be "what constrains the linkages between each stage of the PDCA cycle?" (i.e. what might moderate the eight hypothesised paths shown in Figure 7.1?). Future research may attempt to answer this question.

7.7.3 Repeating the Cross-National Study via More Aggressive Case Selection

To make more precise estimates of cross-national/cross-cultural effects of ISO 9001 implementation, it is necessary to match cases across cultures (countries) carefully. One way to do this is to confine the study to just one type or few types of industries. It may also be necessary to cherry-pick countries to reduce collinearity (correlations) among culture dimensions to allow standard model fitting approaches that allow inclusion of control variables. Although PLSR tackled the collinearity issue very well, it undermined the ability to incorporate control variables well. Hofstede's culture dimensions PDI and IDV are notorious for strong negative correlations, but careful selection of countries may reduce the collinearity issue to a manageable level to introduce control variables. PLSR works best in situations where most (if not all) variables are collinear, to make dimension reduction effective. Inclusion of control variables make PLSR an unsuitable technique to conduct regression analysis.

Selection of the countries can be done using computer simulation to minimise collinearity (minimising VIF can be the criterion). Another approach to avoid the collinearity issue may be to use the GLOBE framework. Also, the GLOBE framework uses more culture dimensions, which may enable to shed more light on the cross-cultural phenomenon on ISO 9001 implementation.

Future research may focus on the above modifications suggested: matching respondents across cultures aggressively, selecting countries more carefully to avoid predictor collinearity, including sufficient number of control variables when matching companies across countries is difficult (still country selection needs to be done carefully to avoid predictor collinearity), and using the GLOBE framework as an alternative national culture framework.

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APPENDIX 1 EVOLUTION OF ISO 9000 QUALITY MANAGEMENT SYSTEM STANDARDS UP TO CURRENT STANDARDS: ISO 9000:2015, ISO 9001:2015, AND ISO 9004:2018

1.1 THE HISTORY OF QMS

The recorded history of 'quality' dates back to the early dynasty of the Babylonian emperors in the seventeenth century BC (Ross, 2009). Bibilon remained a small state until Emperor Hammurabi (1792-1750 B.C.) ascended the throne to build his dynasty. Canals and massive fortresses were built, codes of conduct were established. Time management, resource utilisation and quality, which are the cornerstones of modern-day project management, were the key facets of Emperor Hammurabi's governance of the Kingdom of Babylon. However, control of quality seems to have originated in the military industry, which also dates back to early 1450 BC. Quality assurance methods were said to have been used for manufacturing swords by the Egyptians for their worriers (Lucius, 2002). Although 'quality assurance' has this long history, formal QA emerged during the World War I, as the United Kingdom (UK) confronted the problem of non–exploding shells in the battlefield (Corinna, 2010). Far worse problems occurred during the World War II, as bombs started to explode in the factories, during the manufacturing process! Meanwhile, the United States (US) army also faced quality issues of the same kind, which could not be fully resolved through supplier-generated documented procedures and government-appointed inspectors. This was the triggering point of quality management system standards (Corinna, 2010). The evolution of quality standards since World War I is depicted in Figure 1.1.

The credit of formulating and implementing a comprehensive quality standard for military purchases goes to the Department of Defence of the US, who published the first quality standard in 1959, abbreviated MIL-Q-9858. This standard stipulated a set of requirements that suppliers to the US military need to comply with (Corinna, 2010; Seddon, 2000; Singhal & Singhal, 2012). In 1968, the North Atlantic Treaty Organisation (NATO) developed publications on QA to facilitate trading activities between NATO member countries.

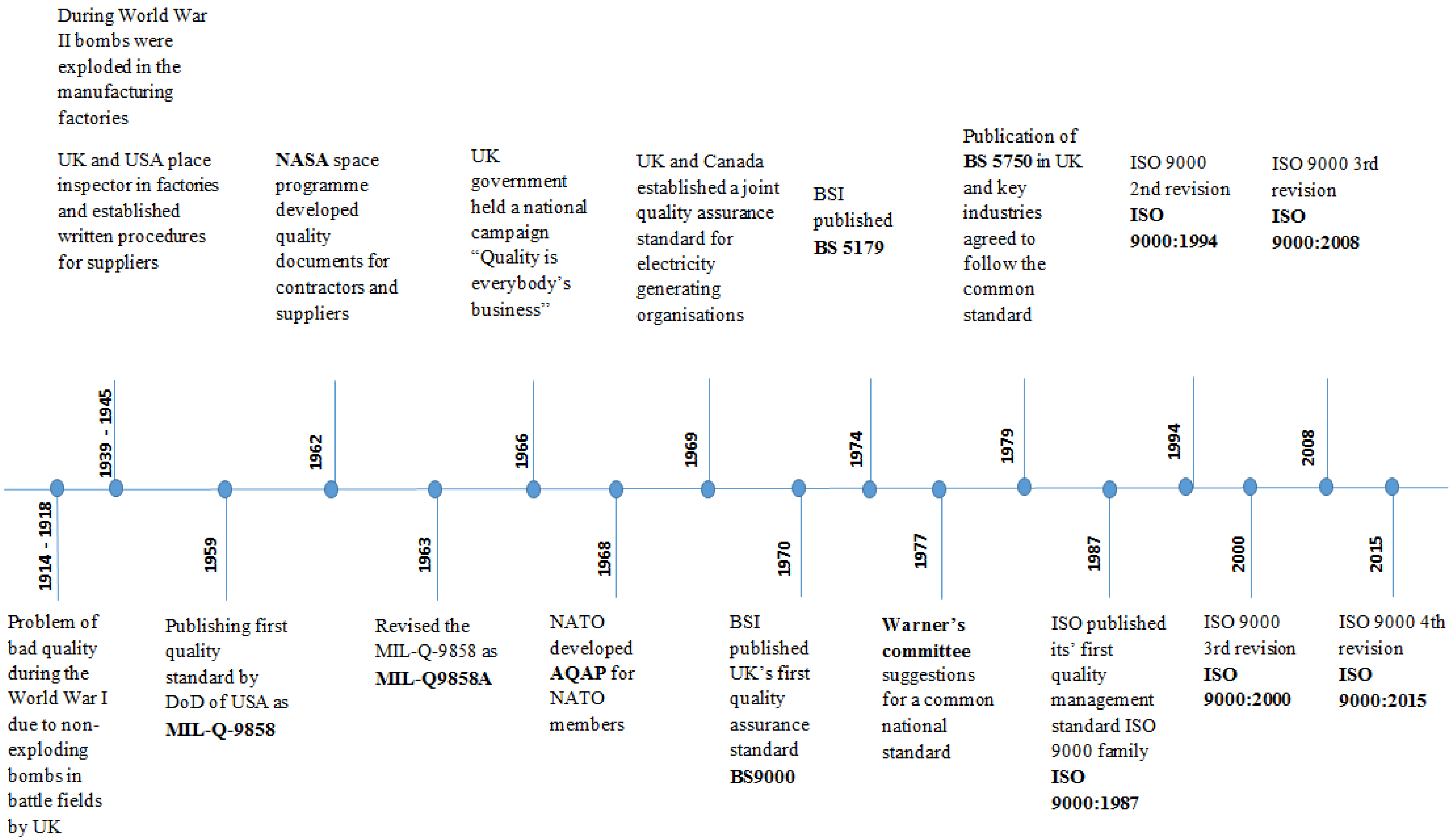

Figure 1.1: Evalustion of QMS standards since World War I

Although QMS standards were imposed in different jurisdictions, incompatibility between them created a need of a common platform on QA in international trading. The British Standards Institute (BSI) played a leading role in initiating the formation of an international standard, through a committee, which was referred to as the ISO/TC/176 committee. This triggered the formation ISO 9000 series of QMS standards in 1987 (Dale, 1999).

1.2 HISTORY OF ISO AND ISO 9000 SERIES OF STANDARD

The origin of the International Organisation of Standardization (ISO), the premier body of international standards59, dates back to 1926, which at the time, was known as the International Federation of the National Standardizing Associations (ISA). However, the ISA became redundant in 1942 due to the World War II; ISA was reorganised in 1947 by joining hands with the United Nations Standards Coordinating Committee (UNSCC) to form a global body of international standards (Martincic, 1997; Secretariat, 1997). The upshot of this union was the formation of the International Organisation for Standardization (ISO), with the blessings of 25 nations. The ISO began its operations in 1947. The International Organisation for Standardization is abbreviated as ISO (rather than IOS) to highlight the meaning of the Greek word isos — which means the equal (ISO ; Martincic, 1997).

Even though ISO started publishing standards from 1951, it did not become a household name among international trading circles up until ISO published its first quality management standard in 1987, as ISO 9000. ISO 9000 has always remained a family (series) of standards, some being certification standards and some being accessories to the certification standards.

1.2.1 The Inaugural ISO Standard (1987)

The inaugural QMS standard published in 1987 consisted of five separate standards: ISO 9000, ISO 9001, ISO 9002, ISO 9003 and ISO 9004. ISO 9000 served only as a guidance document (it still is) containing concepts, definitions, vocabulary and summary guidelines for the remaining standards in the ISO 9000 series. ISO 9001 (QMS requirements for the entire production system including product design and development), ISO 9002 (QMS requirements for the entire production system, less product design and development) and ISO 9003 (QMS requirements for testing and inspection of the final product) were three separate hierarchical QMS standards an organisation could certify against (Rao, 1996).

[59] However, the ISO does not cover electrical and electronic engineering standards; these standards are covered by the International Electrotechnical Commission (IEC). The ISO also does not cover telecommunication standards; these are covered by the International Telegraph Union (ITU). Finally, the ISO does not cover information technology standards; these are covered by JTC 1 a joint committee between ISO and IEC (JTC1)

1.2.2 First Revision (1994)

The first revision of the ISO 9000 series came into force in March 1994. The major change in this revision was the “streamlining of the numbering system” (Tricker, 2005, p. 32) followed by some other important changes such as requiring to implement job profiles for every member of the organisation defining the responsibilities and authorities, requiring to conduct a compulsory design review and expansion of documentation control scope to ensure up-to-date information. In addition, there were about 250 minor changes such as clarification to distinguish corrective action and preventive action (Drechsel, 2017; Tricker, 2005). However, the format of having five standards, including three certification standards (ISO 9001, ISO 9002 and ISO 9003) survived during the 1994 revision.

1.2.3 Second Revision (2000)

The second revision which came into force in the new millennium marked a turning point for ISO 9000 (Tricker, 2005). The year 2000 revision addressed the following shortcomings of the previous (1994) certification standards: (a) lack of alignment to total quality management (TQM), including lack of alignment to continuous improvement (CI) and customer focus; (b) absence of a framework to explain how CI and customer focus are caused, in the process of achieving product results; (c) documentation burden (mandatory documentation requirements were substantially reduced to make the standard more relevant to a wide variety of industries); and (d) the language (e.g. the previous versions were not service-friendly) (West, 2002).

In the second revision ISO 9002 and ISO 9003 were disbanded and consolidated under ISO 9001 to form a single certification standard (ISO 9001: 2000). The revision also saw a new structure — the structure represented a framework known as the process model — for the standard that contained 20 elements (subclauses) categorised into four major sections (clauses). The year 2000 standard focused on a “process approach” as opposed to a “procedural approach” prescribed in the previous standard (West, 2002). The process model explained how customer satisfaction and product results are caused through continual improvement, by conformance to the requirements stipulated in the four major clauses of the standard (Tricker, 2005).

1.2.4 Third Revision (2008)

The third revision of the certification standard (ISO 9001) came into force in 2008 as ISO 9001:2008, with minimal changes. There were no changes to the clauses and subclasses of the year 2000 standard; for academic purposes, the two standards ISO 9001:2000 and ISO 9001:2008 remain the same (Tricker, 2014).

1.2.5 Fourth and Final Revision (2015)

The fourth and final revision of ISO 9001 came to effect in September 2015 as ISO 9001:2015. The important changes in the new standard are summarised in Table 1.1. New version of ISO 9001 adopted Annex L – a generic ten-clause structure which ISO identifies as a universal high-level structure that captures the common terms, definitions and core text that can be generalised across different management system standards.

Although ISO 9001:2015 follows a new structure (Annex L) containing ten clauses, it is possible to match the contents of this standard with the 2008 standard (eight clauses) at subclause level (see Table 1.2). However, the new standard is purported to be a better representation of the "process approach" (Rybski, Jochem, & Homma, 2017; Tricker, 2016).

Table 1.1: Main Changes in ISO 9001:2015 (Source:Tricker, 2016, p. 10)

Inclusions and Exclusions	**Description**
Inclusions (or Emphasis)	The new high-level structure (Annex L)
	Explicit focus on risk-based thinking
	Emphasis on preventive action
	Emphasis on leadership commitment
	Emphasis on communication and customer focus
Exclusions (or De-emphasis)	The requirement of a management representative
	The requirement of a quality manual
	Corrective action (de-emphasis)

Table 1.2: Tallying ISO 9001:2015 Subclauses with Those of ISO 9001:2008 for the First Three Main Clauses of ISO 9001:2015 (Source: Secretariat, 2015)

ISO 9001:2015	**ISO 9001:2008**
4 Context of the Organization	**4 Quality Management System**
4.1 Understanding the organization and its context	4 Quality management system 5.6 Management review
4.2 Understanding the needs and expectations of interested parties	4 Quality management system 5.6 Management review
4.3 Determining the scope of the quality management system	1.2 Application 4.2.2 Quality manual

4.4 Quality management system and its processes	4 Quality management system 4.1 General requirements
5 Leadership	**5 Management Responsibility**
5.1 Leadership and commitment	5.1 Management commitment
5.1.1 General	5.1 Management commitment
5.1.2 Customer focus	5.2 Customer focus
5.2 Policy	5.3 Quality policy
5.2.1 Establishing the Quality Policy	5.3 Quality policy
5.2.2 Communicating the Quality Policy	5.3 Quality policy
5.3 Organizational roles, responsibilities and authorities	5.5.1 Responsibility and authority 5.5.2 Management representative 5.4.2 Quality management system planning
6 Planning	5.4.2 Quality management system planning
6.1 Actions to address risks and opportunities	5.4.2 Quality management system planning 8.5.3 Preventive action
6.2 Quality objectives and planning to achieve	5.4.1 Quality objectives
6.3 Planning of changes	5.4.2 Quality management system planning

1.2.6 Hierarchy of ISO 9001 Certification Flow

The International Organisation for Standardization (ISO) is recognized as the worlds' largest standards setting body (Muse, 2008), and at present, ISO has developed over 22000 standards and sells them through their stores and authorised members (ISO). However, ISO does not issue the certificates for particular organisations confirming that the certification seeking party meets the requirements stipulated by a particular standard developed by ISO. Hence for organisations, companies or any other interested parties who are seeking for ISO certification for particular standard (example ISO 9001:2015) cannot obtain the certification from ISO itself. Therefore, aforesaid parties/persons should certify their product, management system, person and etc. through an independent third party who is accredited by another authority: Accreditation Body (AB). The hierarchy of this process depicted in Figure 1.2.

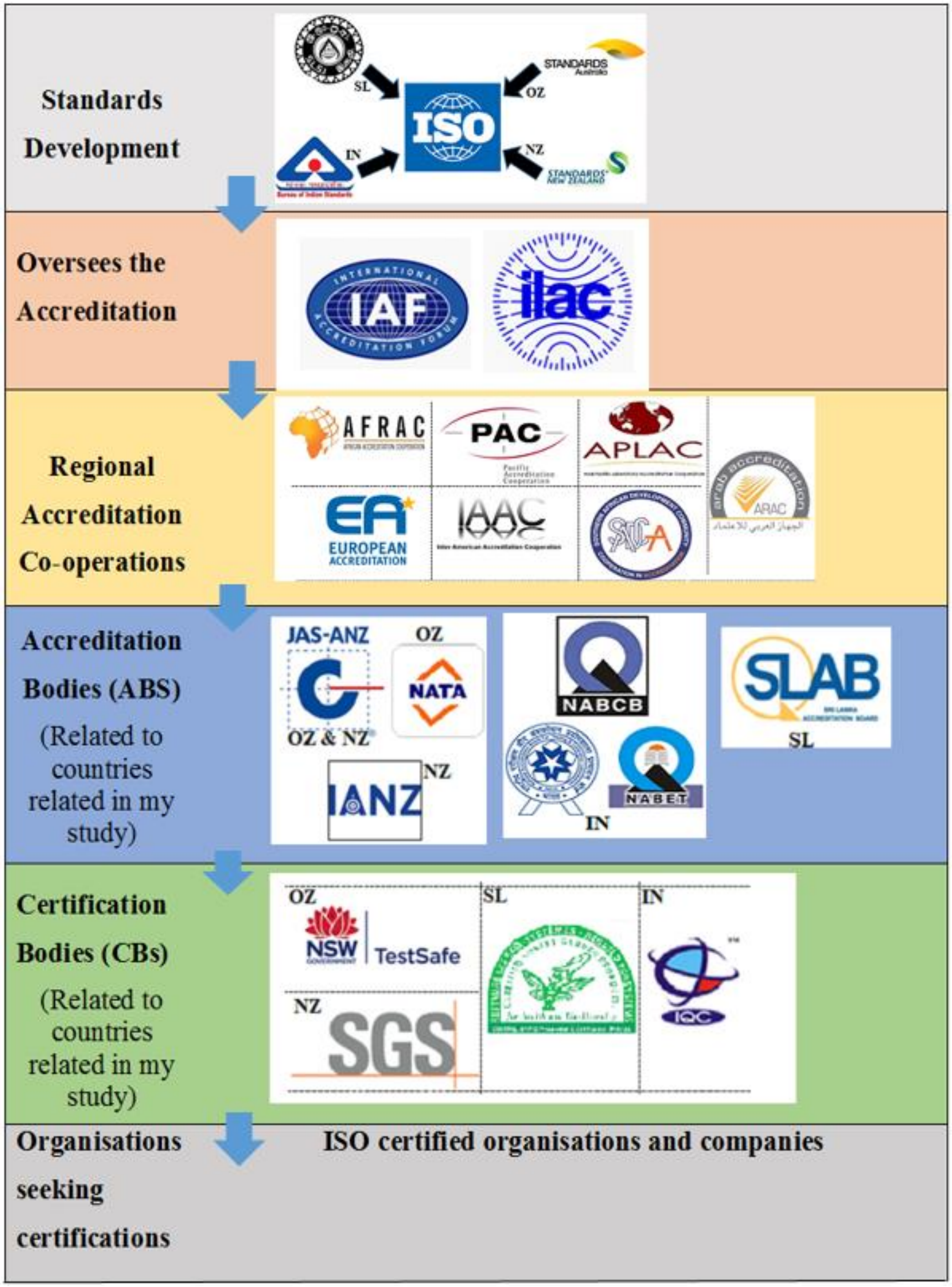

Figure 1.2: Hierarchy of ISO standards certification flow

1.3 THE STRUCTURE OF ISO 9001

In early stages, ISO 9000 compliance standards consist with three separate standards – ISO 9001, ISO 9002 and ISO 9003. However, ISO 9000 compliance standards were not aligned to a holistic structure representing a management model that explains the interrelationships of the core elements of the standard. For example, ISO 9001:1994 consists with 20 elements called "system elements" implying the requirements that comprised the structure of the standard which was latter aligned under four main clauses in ISO 9001:2000 (Karapetrovic & Willborn, 2001; Pheng & Fong, 2002). More importantly, from year 2000 onwards, ISO 9001 compliance standard was aligned to a holistic management model that represents, what is famously known as the "process approach". The model remained unchanged through its third revision in year 2008 up until year 2015 in its fourth and latest revision ISO 9001:2015. The model is referred as "process model" that represent the underline structure of the ISO 9001 compliance standard.

Both process models — ISO 9001:2000/2008 and ISO 9001:2015 — provide the interconnectedness of the key clauses of the standard representing how the process approach is embedded to the requirements of the standards and the model promotes the PDCA approach. However, ISO 9001:2000/2008 process model provides only a basic reasoning on the interconnectedness of the key clauses and PDCA cycle implication is not really explicit. Since the release of the ISO 9001:2015 standard this situation has changed as the standard now makes the substantially revised ISO 9001:2015 process model to better explain how quality improvement and customer satisfaction are caused via compliance to the standard (Pallawala, Jayamaha, & Grigg, 2019). Figure 1.3 below represents the both process models.

Continual Improvement Vs Continuous Improvement

The terms continual improvement and continuous improvement have sufficient distinctions to have their own identities. Continual improvement refers to relatively big improvements in segments, while continuous improvement refers to small increments, although two words are used interchangeably (ASQ, 2017). ISO 9001 uses the term continual improvement, specifically from year 2000 onwards. According to Russell (2003), the term continual improvement was chosen to enable the enforcement of ongoing improvement.

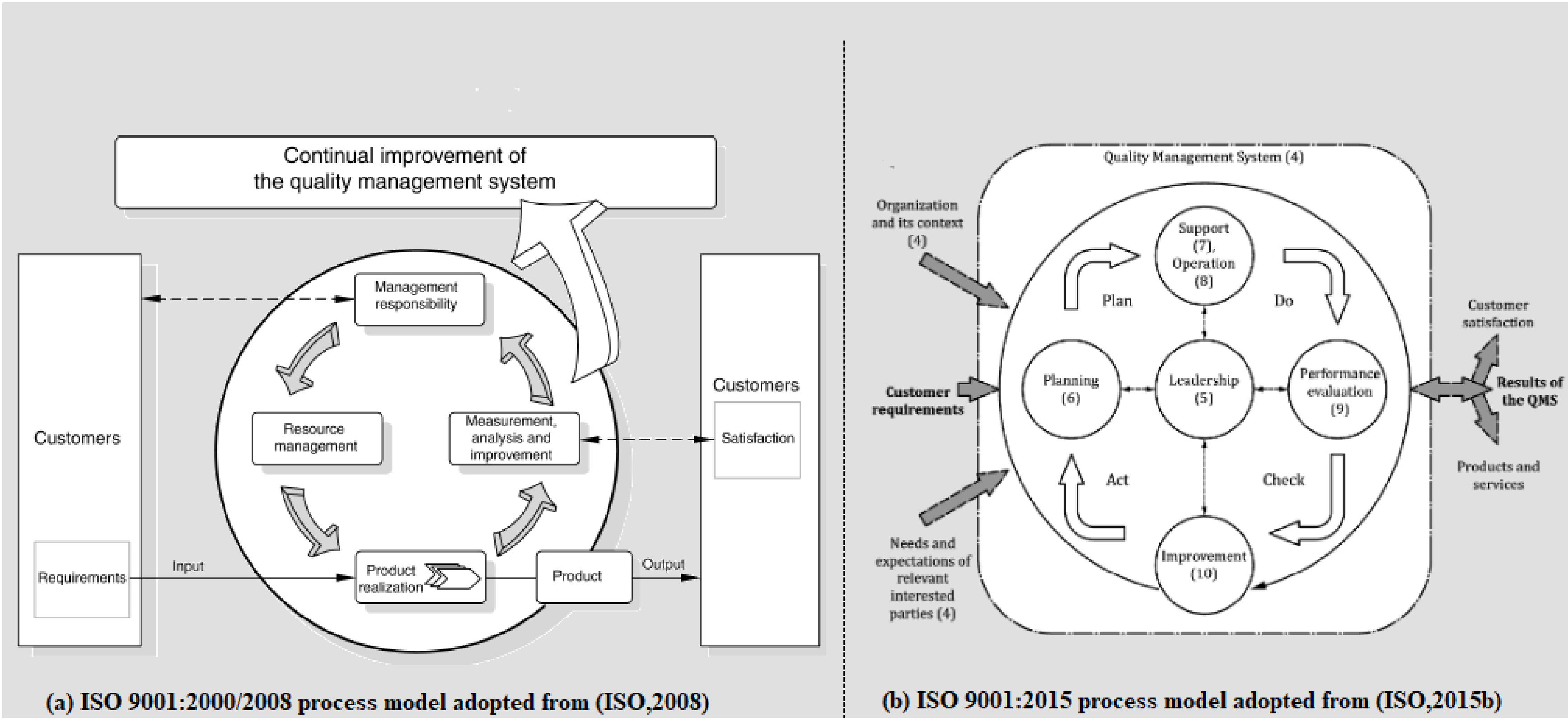

Figure 1.3: Process models of ISO 9001:2000/2008 and ISO 9001:2015 standards

Definition is not distinguishable for either word. This is apparent in ISO 9001 as it takes common continual improvement related approaches such as innovation and breakthrough change separately saying – "organization might find it necessary to adopt various forms of improvement in addition to correction and continual improvement, such as breakthrough change, innovation and re-organization" (ISO, 2015b, p. vi) and "Examples of improvement can include correction, corrective action, continual improvement, breakthrough change, innovation and re-organization" (ISO, 2015b, p. 19). In addition, other related quality management philosophies such as TQM, Six Sigma are promoting the continuous improvement (Russell, 2003) while PDCA is a well-known tool for continuous improvement (Sokovic, Pavletic, & Pipan, 2010) which was incorporated into the ISO 9001 structure (See figure 2.3).

1.4 THE STRUCTURE OF ISO 9001:2015

The current format of all management systems certification standards published by the ISO follows a so-called common high-level structure known as the Annex L, formally known as the Annex SL structure (ISO/IEC, 2019). A management system standard that conforms to the Annex L structure would have the exact same captions for the clauses stipulated in the standard. While there are ten clauses in the Annex L format, only clauses four through to 10 contain the actual requirements for certification. Figure 1.4 depicts the structure of ISO 9001:2015 in the PDCA cycle; the numbers whiten parenthesis refer to the seven key clauses of the standard, although clause 4 has been labelled as Scope by the researcher in her theoretical models. 60 From an academic standpoint, Figure 1.4, often referred to as the ISO 9001:2015 process model, is an attempt on the part of ISO to suggest how results of the QMS are caused through CI (via PDCA) by conforming to the requirements stipulated under the seven key clauses of ISO 9001:2015.

[60] The reader will note that Clause 4 has been named under three headings in Figure 1.2. These headings represents the three focus areas of Clause 4. The actual label given by the ISO for clause 4 is "Context of the organization".

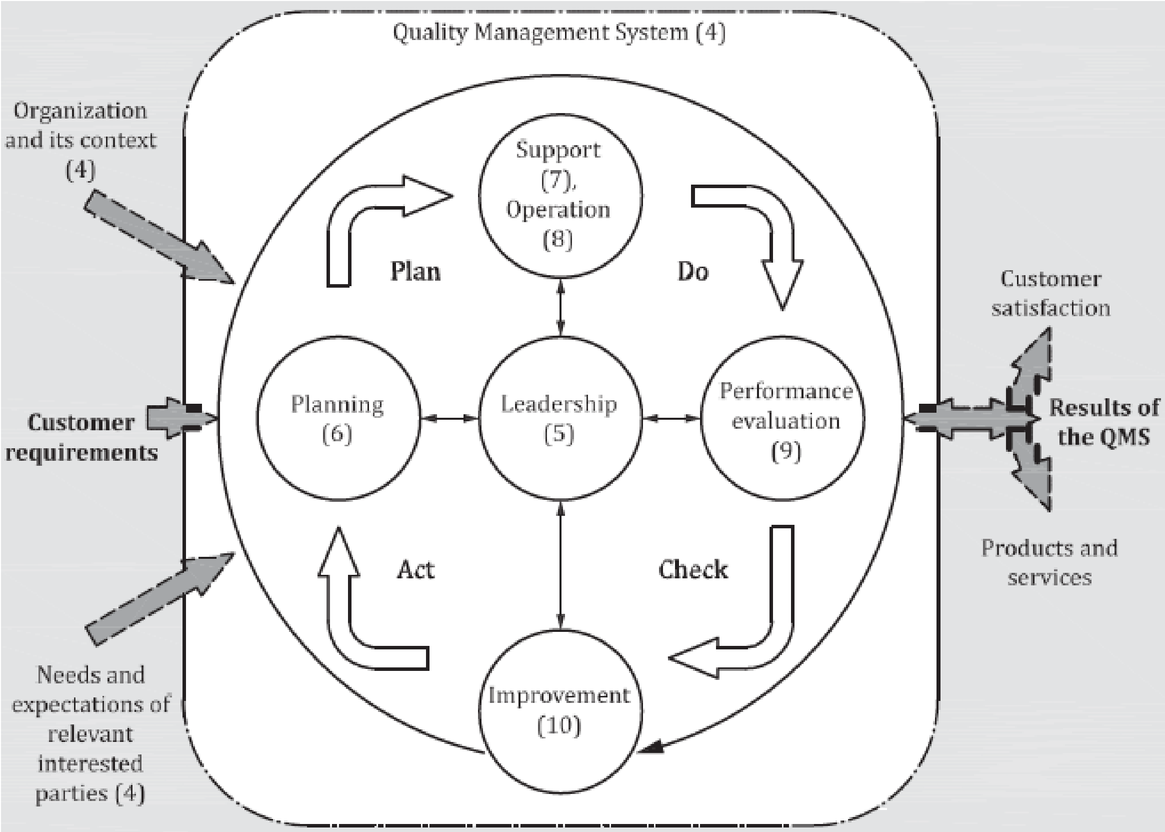

Figure 1.4: Representation of the structure of ISO 9001:2015 in the PDCA cycle (Source: ISO, 2015b)

1.4.1 Summarising the Key Assessment Areas of IS0 9001:2015

The ISO 9001:2015 standard consists of ten clauses (Clause 1 through Clause 10). Barring the first three clauses, which are generic in nature, the remaining clauses of the standard stipulates certain requirements that organisations need to fulfil to accredit their QMS against the standard. By being compliant with these requirements, it is expected that an organisation could assure their customers that they contain the necessary ingredients need to consistently meet customer requirements for provision of products and services, at the same time being able to comply with the rules and regulations imposed by the government and relevant authorities. Requirements stipulated in the standard (through phrases including the word "shall") are reasonably flexible, to be context dependent. In addition, organisations have to fulfil all the requirements stipulated in the standard unless certain requirements are justifiably inapplicable to the scope of a particular QMS. In following section, for the general understanding of the reader, the assessment areas under each key clause are summarised.

Clause 4: Context of the organisation

Clause 4 requires the auditee organisation to identify all issues that arise within and outside the organisation that can affect the stability of the organisation's QMS and its processes. In addition, the organisation is required to identify the relevant stakeholders (e.g. customers, employees, suppliers and legal authorities) and understand the requirements of each stakeholder category for planning effective QMS processes. The standard goes on to state that it is important to understand the context of the organisation and its boundaries to determine the scope of the QMS, in order to understand what organisation can deliver and what it cannot. Finally, Clause 4 requires all the processes, activities and their relationships to be determined by the auditee organisation, as these are needed to plan and implement the QMS.

Clause 5: Leadership

In Clause 5, the term "leadership" refers to top-management, which is defined as "the person or group of people who directs and controls the organisation at the highest level" (ISO, 2015a, p. 11). Clause 5 highlights the fact that the leadership is central to the QMS to maintain the consistency and stability of the QMS and its intended results. The clause stipulates that the top management (leadership) should ensure that customer and organisational needs have been identified, agreed upon and being constantly met by the organisation — whilst being compliant with legal requirements. The clause also stipulates top management should develop a quality policy that suits the purpose of the organisation; the clause goes on to state that this policy should be the foundation to establish quality objectives for the relevant QMS process and functions.

Finally, Clause 5 stipulates that it is the responsibility of the leadership to bring clarity to the roles played by each employee. Consequently, top management is required to ensure the provision of job descriptions and assign appropriate roles to employees; this requires including the position, duties, activities, the extent of power and its boundaries over the QMS activities, as well as the extent of obligations for consequences of results of QMS activities and actions to each corresponding role. More importantly, the clause states that top management shall assign "process owners" to each aspect of the QMS and that the process owners shall be responsible for maintaining consistency of conformity and provision of products and service results. In particular, top management should appoint relevant personnel to overlook the QMS to ensure that it conforms to ISO 9001:2015 requirements.

Clause 6: Planning

Clause 6 stipulates that the organisation needs to plan actions for the processes that were identified under organisational context (sub clause 4.4). Clause 6 states that issues and needs that were identified under Clause 4 (sub clauses 4.1 and 4.2) should be considered in planning; in addition Clause 6 requires the organisation to identify possible threats that can halt the consistency of the QMS processes and results, as well as deviations from the intended outcomes. Planning also requires the organisation to establish quality objectives for key functions and processes. Clause 6 highlights that the quality objectives should be measurable and be evaluated against the relevant requirements, at the same time being updated according to the needs of the QMS. Clause 6 goes on to state that planning quality objectives should include inputs, actions, outputs, roles and responsibilities, plus the time frames and criteria for conformity. Finally, Clause 6 stipulates that changes to the QMS and its processes should be planned in such a way that these changes do not result in adverse consequences.

Clause 7: Support

The support clause focuses mainly on providing necessary tangible and intangible resources such as material and human resources to facilitate the relevant QMS processes, actions and activities. It is observed that Support encompasses two broad activities: facilitating the implementation of planned actions and activities that go into QMS processes, and awareness of the roles being played by people (and accompanying people satisfaction element) to enhance QMS performance.

Clause 7 stipulates that organisations should identify the internal and external resources (more specifically inputs) needed for the operation of QMS processes such as material, knowledge, human resources, machinery and technology together with their availability and limitations. Consequently, the organisation is required to provide the necessary infrastructure to conduct the operations (Clause 8) together with inspection facilities to ensure conformity of outputs and process performance. In addition, Clause 7 stipulates that the organisation should provide the resources needed to create, update, maintain and control the records that are identified as being necessary for the operation of processes and activities in the QMS.

Human resource focus is considered as an important enabler for strategies that pursue CI such as TQM, BE, Toyota Way (Gómez, Martínez-Costa, & Martínez-Lorente, 2017; Jayamaha, Wagner, Grigg, Campbell-Allen, & Harvie, 2014; Keng, Arumugam, Safa, & Bakar, 2007). ISO 9001 emphasises the need of identifying knowledge, skills and training needs of employees who conduct QMS activities to enhance their competence. The organisation is required to create an environment that encourages positive engagement of employees to enable employees to self-realise the importance of their role towards contributing to QMS Results of the organisation. Equally importantly, the standard requires the organisation to establish a friendly work environment taking into account the social, physical and psychological aspects that contribute towards employee motivation.

Clause 8: Operation

Clause 8 is a substantial (it has 7 subclauses) clause, which is not surprising because process management is central to managing quality (Fonseca, 2015). The requirements stipulated under Operation ensures among other things that relevant requirements under all the other major clauses (Clause 4 onwards) are determined and met, to facilitate the implementation of processes and activities required to provide the goods and services that the customer needs. One of the most important actions required in connection with this is to determine what functional requirements and product features are expected in the final product. To accomplish this, organisations need to understand customer requirements, organisation requirements and relevant laws and rules imposed upon by the authorities applicable to all stages — from accepting the contract to delivery of the products/services as well as for post-delivery activities — relevant to products and services. Next, organisations need to determine processes needed to meet all the requirements determined above, actions needed for implementing and controlling these processes and finally, the resources needed for implementing the processes to provision of products and services. These requirements are covered under Clauses 4, 6 and 7 with integration of Clause 5 requirements discussed above which means that all of these clauses act as forerunners (causal antecedents) of Clause 8. Therefore, what is required under the Operation (Clause 8) is to implement criteria required to meet those identified in the preceding clauses. However, Clause 8 further expands on requirements identification covered in preceding clauses. For example, how customer communication should take place in determining their needs, the importance of determining capacity and capability of the organisation to fulfil the product and service requirement (e.g. quantity) before accepting the contract, and the need of reviewing the outputs to ensure that all the relevant requirements are met before and after providing the products and services as applicable.

Another important area Clause 8 focuses on, is referring the importance of design and development (DD) activities needed for products and services. The clause stipulates that firstly, organisations need to plan their DD process including identification of necessary phases for DD activities, necessary measures, reviews and controls needed in each phase, and interactions and incorporation among relevant parties (e.g. customers, suppliers, outsourced functions) during each phase of the DD process. The clause stipulates that secondly, DD activities should be done to obtain DD outputs and once the DD outputs have been created, the organisation should verify and validate the outputs which means that the organisations need to check for specifications are met (verification) and product/service should be created and tested by putting it to real use (validation) before commence actual provision of goods and services.

Clause 8 also stipulates that once actual provision of products and services have begun necessary controls should be implemented and controlled by the organisation. The clause further stipulates that the organisation should take necessary actions to implement appropriate identification methods to facilitate the traceability. Further, proper controls over conservation and safeguarding of outputs throughout the process and until the final delivery to the customers should be ensured while considering the requirements for post-delivery activities if relevant. Moreover, organisation should not proceed to release the products and services until that the conformity to all requirements (customer, organisation, legal and product/service features) is ensured. In addition, organisation should have an effective communication and control over external products, services and processes suppliers (such as outsourced functions).

Finally, Clause 8 stipulates that controls over nonconforming outputs should be carefully handled (e.g. applying suitable corrections or discarding nonconforming items while taking action to prevent unintended use of nonconforming items at any time).

Clause 9: Performance Evaluation

Performance Evaluation clause (Clause 9) mainly stipulates the requirement of conducting monitoring and measuring (M&M) activities as well as analysing and evaluating (A&E) activities of results. M&M is discussed a priory under the Clause 7.1.5, which focuses on resourcing the equipment, techniques and methods that are suitable for M&M for conformity of product and services, inputs and outputs.[61]

In general, what is expected through the requirements under the clause 9 is about M&M and A&E of overall QMS performance and effectiveness. For this purpose, the clause stipulates that the organisation needs to determine where M&M is needed, what methods and techniques are needed, when to conduct these activities, and when to analyse and evaluate the results. The clause stipulates that this should specifically include the extent and methods being used for monitoring customer satisfaction. Further, the clause stipulates that the organisation should monitor and measure the relevant results obtained for product and service conformity (Clause 7.1.5), performance and effectiveness of QMS processes and activities against the planed goals and objectives, in addition to monitoring and measuring the performance and conformity of suppliers and outsourced functions. The clause goes on to stipulate that once M&M has been conducted, the results obtained should be analysed and evaluated accordingly, as planned.

Next, the clause stipulates that the organisation should plan and conduct internal audits. The intent of conducting internal audit is to evaluate and understand if all relevant requirements stipulated under each clause in the standard are consistently met (in addition to the organisation's needs and expectations) and to demonstrate that the performance and effectiveness of overall QMS is in order. The clause stipulates that actions should be taken after internal audits to correct any deviations and again, the corrective actions taken should be audited and validated.

Finally, the clause stipulates that all M&M results obtained including audit results should be analysed and evaluated based on suitable methods and techniques, and that information should be produced to the management for review for decision making. The clause also stipulates that

[61] Clause 7 is focuses on this to a much lesser extent, as an enabler of effective Operation. However, the focus under the Clause 9 is not the same as the Clause 7; scope under Clause 9 is wide and comprehensive.

management reviews should cover evaluation of the effectiveness and performance of the overall QMS and its outcomes and any action taken for further improvements.

Clause 10: Improvement

Clause 10 stipulates that management reviews should result in taking suitable decisions and actions to improve the overall QMS (through planning and implementation) and its outcomes, such as customer satisfaction, product and service quality improvement and meeting possible future demands. Moreover, Clause 10 stipulates that any deviation of the QMS processes or outcomes should be corrected appropriately and that the organisation shall ensure the prevention of repetition of deviations by removing the root cause of the problem(s). Further, the clause stipulates that the organisation shall review/evaluate the suitability of the corrective actions taken. Finally, the clause stipulates that organisations should seek opportunities for continual improvement (CI) of the QMS to continually meet customer and market demands.

1.5 ISO 9000:2015

ISO 9000:2015 serves as a guidance manual that among other things contains the definitions for the terms used in ISO 9001:2015 and ISO 9004;2018 (see Table 1.3). In this regard, ISO 9000:2015 becomes indispensable.

Table 1.3: Terms for Which Definitions have been given in ISO 9000:2015 (Source: Praxiom Research Group Limited, 2017)

A - M	**N - Z**
Audit, Audit Criteria, Audit Evidence, Audit Findings, Audit Program, Characteristic, Competence, Complaint, Concession, Conformity, Context, Continual Improvement, Contract, Correction, Corrective Action, Customer, Customer Satisfaction, Data, Defect, Design and Development, Determination, Documented Information, Effectiveness, Feedback, Function, Improvement, Information, Information System, Infrastructure, Innovation, Interested Party, Involvement, Knowledge, Management, Management System, Measurement, Measuring Equipment, Monitoring	Nonconformity, Object, Objective, Objective Audit Evidence, Objective Evidence, Organization, Output, Outsource, Performance, Performance Indicator, Policy, Process, Process Approach, Process-based QMS, Product, Provider, Quality, Quality Management, Quality Management System, Quality Objective, Quality Policy, Regulatory Requirement, Release, Requirement, Review, Risk, Risk-based Thinking, Service, Statutory Requirement, Strategy, Supplier, System, Top Management, Traceability, Validation, Verification

In addition to above, the standard outlines QMS fundamentals of which the seven principles of quality management (Table 1.4) forms the basis of ISO 9000 lead quality improvement.

Table 1.4: ISO 9000 Quality Management Principles (extracted from ASQ, 2020)

Sr	Principle	Characteristics
1	Customer Focus	○ Understand the needs of existing and future customers ○ Align organizational objectives with customer needs and expectations ○ Meet customer requirements ○ Measure customer satisfaction ○ Manage customer relationships ○ Aim to exceed customer expectations ○ Learn more about the customer experience and customer satisfaction
2	Leadership	○ Establish a vision and direction for the organization ○ Set challenging goals ○ Model organizational values ○ Establish trust ○ Equip and empower employees ○ Recognize employee contributions ○ Learn more about leadership
3	Engagement of people	○ Ensure that people's abilities are used and valued ○ Make people accountable ○ Enable participation in continual improvement ○ Evaluate individual performance ○ Enable learning and knowledge sharing ○ Enable open discussion of problems and constraints ○ Learn more about employee involvement
4	Process approach	○ Manage activities as processes ○ Measure the capability of activities ○ Identify linkages between activities ○ Prioritize improvement opportunities ○ Deploy resources effectively ○ Learn more about a process view of work and see process analysis tools
5	Improvement	○ Improve organizational performance and capabilities ○ Align improvement activities ○ Empower people to make improvements ○ Measure improvement consistently ○ Celebrate improvements ○ Learn more about approaches to continual improvement
6	Evidence-based decision making	○ Ensure the accessibility of accurate and reliable data ○ Use appropriate methods to analyse data ○ Make decisions based on analysis ○ Balance data analysis with practical experience ○ See tools for decision making

Sr	Principle	Characteristics
7	Relationship management	o Identify and select suppliers to manage costs, optimize resources, and create value o Establish relationships considering both the short and long term o Share expertise, resources, information, and plans with partners o Collaborate on improvement and development activities o Recognize supplier successes o Learn more about supplier quality and see resources related to managing the supply chain

1.6 ISO 9004:2018

ISO 9004:2018 is not a certification standard. ISO 9004:2018 merely provides guidance for supplier organisations to achieve sustained success. Whereas the certification standard ISO 9001:2015 is supplied by an organisation, ISO 9004:2018 is meant to provide confidence to the supplier organisation itself that it is guided by the necessary aids to achieve sustained success. The standard consists of 11 clauses of which Clauses 5 through to 11 are the key clauses that provide the requisite guidance. Clause 4 is also important, in the sense, this is the clause that explains what is meant by “quality of an organization” and “sustained success”. Figure 1.5 depicts the structure of ISO 9004:2018 indicating how elements essential to achieve sustained success are connected to one another to achieve sustained success.

ISO 9004:2018 promotes self-assessment of performance. The standard provides a tool (a marking rubric) to enable an organisation to conduct self-assessment against each element of Clauses 5 though to 11. The self-assessment tool provides descriptors along 5 levels of achievement (Level 1 being basic and Level 5 being best practice) for each element of each clause (Clauses 5~11).

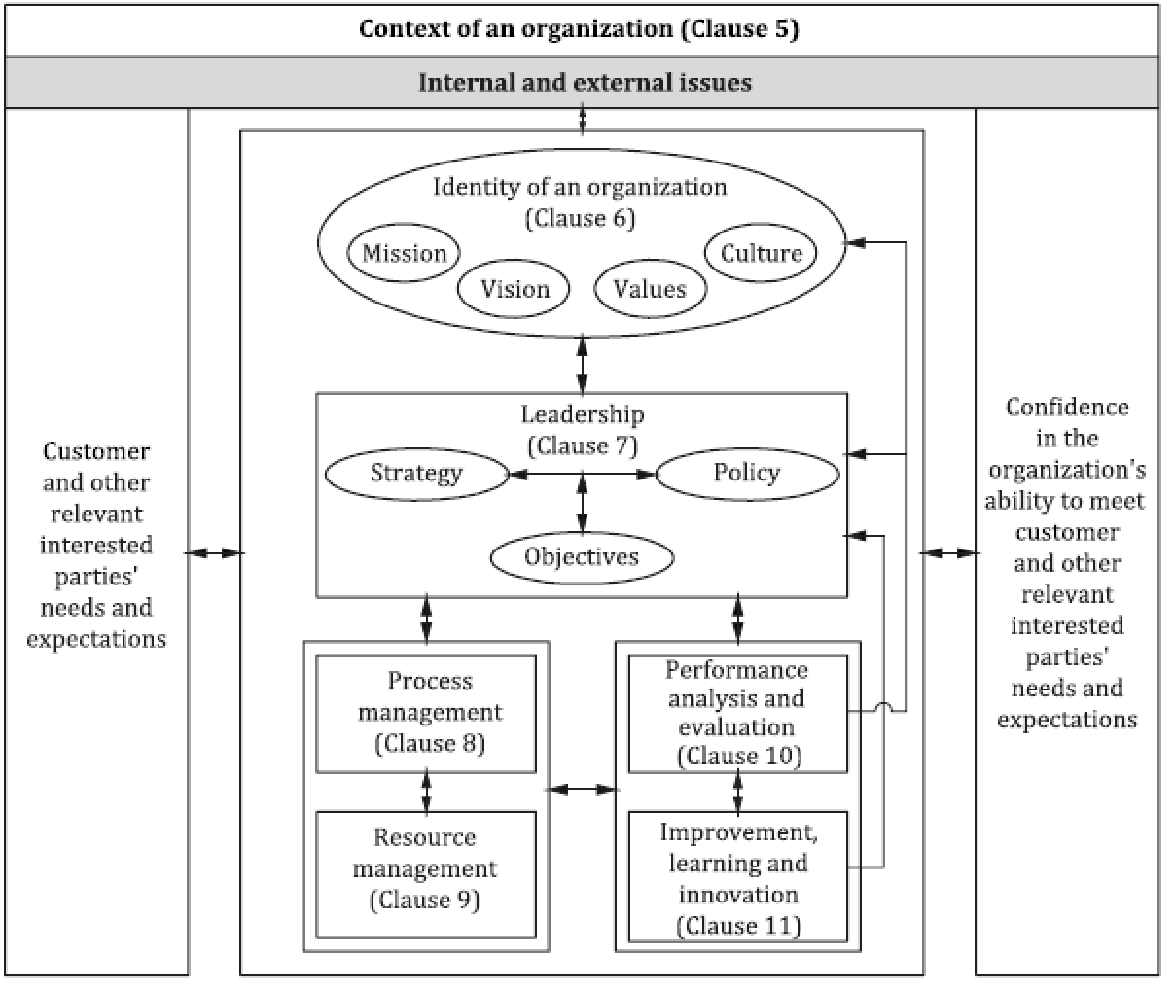

Figure 1.5: Representation of the structure of ISO 9004:2018 (Source: ISO, 2018)

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APPENDIX 2 PROOF OF ISO 9001 AUDIT TRAINING

Lead-Auditor Training Certificate

IQCS
Certification

CERTIFICATE
OF
ACHIEVEMENT

CQI IRCA

This is to certify that

P K B N M PALLAWALA

Attended and passed the Quality Management Systems (QMS)
Auditor/Lead Auditor (ISO 9001:2015) Training
Course No.: 18126 certified by CQI and IRCA

This course is certified by the Chartered Quality Institute and the International Register of Certificated Auditors and satisfies part of the formal training requirement for individuals seeking certification under the IRCA QMS 2015 Auditor Certification Scheme

Held in

SRI LANKA

on

07th – 11th August 2017

CQI IRCA APPROVED TRAINING PARTNER

Course Leader/Examiner:

CQI and IRCA UDN:

43198

Note: This Certificate is valid for 5 years for the purposes of IRCA Auditor Certification.

APPENDIX 3 THE INVITATION LETTER TO EXPERTS INTRODUCING THE QUESTIONNAIRE DEVELOPMENT PROJECT, ALONG WITH THE SPECIFICATION FOR ROUND 1 OF THE PROJECT

Part I - The Invitation Letter to Experts Introducing the Questionnaire Development Project

Dear (proper salute),

Seeking Help from International Experts on ISO 9001:2015 to Develop a Survey Questionnaire that Reflects the Requirements of the Key Clauses of ISO 9001:2015

I am Nisansala Pallawala, a PhD candidate attached to School of Engineering and Advanced Technology, Massey University. I am being supervised by Dr Nihal Jayamaha and Professor Nigel Grigg. My doctoral study is based on the hypothesis that different cultures *approach, deploy and integrate* the requirements of ISO 9001:2015 differently. In other words, I hypothesise that the level of acceptance on the requirements of ISO 9001:2015, as stipulated in the seven key clauses of this standard — Organizational Context (Clause 4), Leadership (Clause 5), Planning (Clause 6), Support (Clause 7), Operation (Clause 8), Performance Evaluation (Clause 9), and Improvement (Clause 10) — vary across nations. In addition, I hypothesise that the ISO 9001:2015 process model provides a better explanation of continual improvement and QMS Results than the ISO 9001:2008 process model. The questionnaire is required to collect data to test these hypotheses.

The questionnaire development project will take place in an iterative fashion (in three rounds) and the project brief is attached herewith for your kind consideration. I shall be most obliged if you could kindly review the project brief and let me know whether you are in a position to help me in developing the questionnaire.

I look forward to hearing from you at your earliest convenience.

Thanking You

Yours Faithfully

Nisansala Pallawala

PhD Candidate

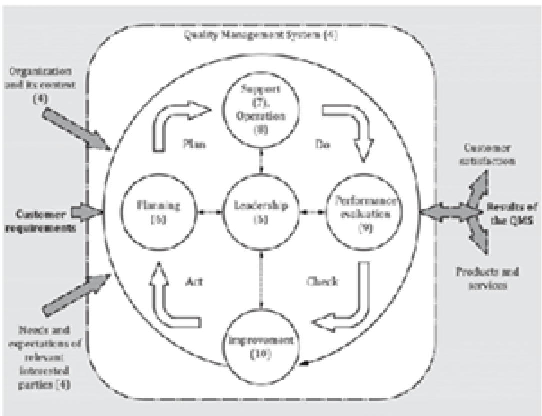
PROJECT BRIEF

Developing a Questionnaire to Measure the Acceptance of Managers on the Approach, Deployment and Integration of the Core Elements of ISO 9001:2015 in Their Organisation

1. Background

Although highly comparable to its predecessor ISO 9001:2008, the ISO 9001:2015 quality management system (QMS) standard is purported to be a better representation of contemporary QMS thinking (e.g. risk-based thinking, more alignment to total quality, derived from a common high-level structure representing managerial functions etc.). Many organisations around the world are transitioning from ISO 9001:2008 to ISO 9001:2015. In addition, organisations that will be certified for the first time will now be certified against this new standard. Thus ISO 9001:2015 will continue to have a profound impact on the industry across nations.

Because culture reflects the way in which activities are organised and done, it is hypothesised that different cultures *approach, deploy and integrate* the requirements of ISO 9001:2015 differently. In other words, it is hypothesised that the level of acceptance on the requirements of ISO 9001:2015, as stipulated in the seven key clauses of this standard — Organizational Context (Clause 4), Leadership (Clause 5), Planning (Clause 6), Support (Clause 7), Operation (Clause 8), Performance Evaluation (Clause 9), and Improvement (Clause 10) — vary across nations. In addition, the proposed study hypothesises that the ISO 9001:2015 process model is a better explanation of continual improvement and QMS Results than the ISO 9001:2008 process model (Figs. 1a and 1b).



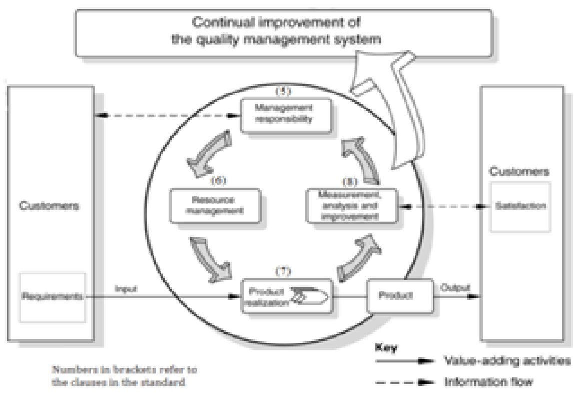


Fig. 1a: ISO 9001:2015 process model **Fig 1.b:** ISO 9001:2008 process model

A project has been launched to test the aforesaid propositions (and related sub-propositions) using survey data collected from ISO 9001:2008 certified manufacturing industries in five countries: Australia, New Zealand, Japan, India, and Sri Lanka (case studies will also be conducted). At the very outset, because of the applied nature of the subject (ISO 9001), the researchers have decided to seek the help of ten to twelve ISO 9001:2015 experts (e.g. very experienced lead auditors and lead auditor trainers) in developing the questionnaire. This project brief relates to the subproject of developing the survey questionnaire.

2. Requirements of the Questionnaire

The questionnaire will incorporate statements on the key clauses of ISO 9001:2015 (i.e. clauses included in the process model). Each statement (*three crude examples are given in Appendix-1*) seeks the acceptance of the respondent in the following seven-point scale: strongly disagree (1), disagree (2), somewhat disagree (3), neither disagree nor agree (4), somewhat agree (5), agree (6), strongly agree (7). The researchers have identified the need to limit the number of questionnaire items (statements) per clause to 6 (4 in the case of the Organizational Context). This is, in part, because another 12 survey items will be added to examine other areas such as QMS Results and company characteristics.

The most important requirement in developing the statements in the questionnaire is to *avoid ISO 9001 rich language* to minimise respondent bias. Ideally, we would like the panel to consist of 4-5 New Zealand experts (we have reached these numbers already), 3-4 from Australia (we only have one but if we have another expert, that would be sufficient), and 2 from Sri Lanka (we have reached these number already) to participate in the questionnaire development. The researchers aim to finalise the questionnaire in three iterations, using a Delphi-like approach.

The specific requirements in developing the questionnaire 30 items, with the help of the auditors are as follows:

- Each key clause of ISO 9001:2015 should be represented by no more than six survey items for Clauses 5, 6, 7, 8, 9, and 10 and four survey items for Clause4. In other words, the survey instrument should not include more than 40 survey items (6*6 + 1*4) on ISO 9001:2015 clauses.
- The questionnaire items should not be written in ISO 9001:2015 rich language. Ideally, the respondents should not perceive that the approach, deployment and integration of ISO 9001 is being measured in their organisation. However, this should be done without compromising the validity or intended meaning of each survey item.
- All or most survey items should be reconcilable with the key clauses of ISO 9001:2008.

3. Proposed Sequence of Activities In Each Round of Data Collection

Round 1: A questionnaire will be dispatched to the panel members, requesting each of them to identify no more than six different areas (aspects/facets) on clauses 5, 6, 7, 8, 9, and

10 and four different areas (aspects/facets) of clause 4 of ISO 9001:2015. The panel members will also be asked to write down a statement on each area. The basic structure of the questionnaire to be used in round 1 is shown in Appendix-1 *(please treat this appendix as a discussion document at this stage)*.

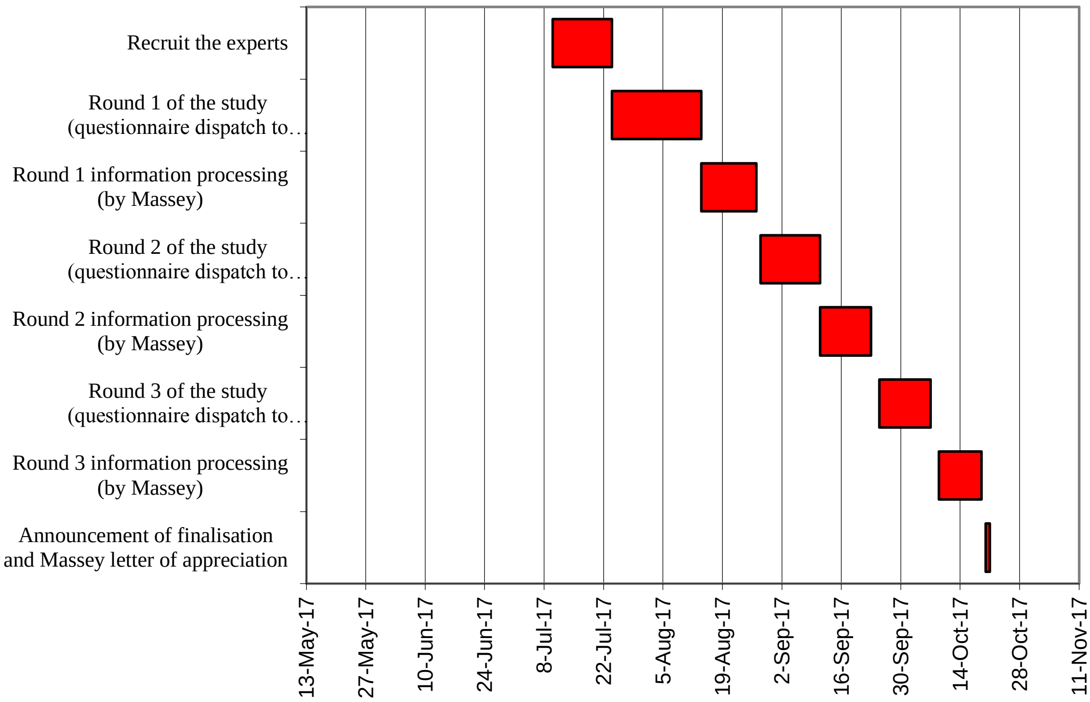
Round 2: The responses received from the panel members from Round 1 will be processed by the principal investigator (see section 4). This includes consolidating similar responses, isolating dissimilar responses, and framing the first draft of the questionnaire, with some instructions to the panel members. The processed information will be dispatched to the panel members advising each of them to amend the questionnaire, in the light of the information provided.

Round 3: The responses received from the panel members from Round 2 will be processed by the principal investigator with a view to finalise the questionnaire. The panel members will be asked to give their concurrence to this final version. Finally, each panel member will be asked to assign each survey item to one of the key clauses of ISO 9001:2008. The three choices will be given: first choice clause of ISO 9001:2008, second choice clause of ISO 9001:2008, not assigned to any of the clauses of ISO 9001:2008.

4. Key People

- The panel of 10-12 ISO 9001:2015 experts (for reliability and validity, anonymity will be preserved up until the questionnaire has been finalised)
- Nisansala Pallawala, PhD Researcher, Massey University (principal investigator)
- Nihal Jayamaha, Senior Lecturer, Massey University (advisor)
- Nigel Grigg, Professor, Massey University (advisor

5. Timeline



Nisansala Pallawala	Nihal Jayamaha	Nigel Grigg
Principal Investigator	Advisor	Advisor

Part II – The Specification for Round 1 of the Study

Dear (proper salute)

Developing a Questionnaire to Measure the Acceptance of Managers on the Approach, Deployment and Integration of the Core Elements of ISO 9001:2015 in their Organisation – Terms of Reference for Round 1

On behalf of Massey University, I would like to thank you for agreeing to participate in our project, as an expert on ISO 9001:2015. With your help, as mentioned in our project brief, we plan to develop the questionnaire in an iterative fashion (in three rounds). The questionnaire is to be administered on managers working in ISO 9001:2008 certified organisations in New Zealand, Australia, Japan, India, and Sri Lanka.

The questionnaire will contain a set of propositions (statements) on different areas (facets) examined by the key clauses of ISO 9001:2015. Each proposition is designed to elicit a response from the respondent on the following seven-point scale: strongly disagree (1), disagree (2), somewhat disagree (3), neither disagree nor agree (4), somewhat agree (5), agree (6), strongly agree (7).

To illustrate what we mean by the terms *areas* and *propositions*, supposing you view *quality policy* as an important facet of the 'Leadership' clause of ISO 9001:2015, then you would type the phrase *quality policy* in Table 1 under the heading 'sub-area'. Then, if you believe that the proposition *'we evaluate the appropriateness of the quality policies for our QMS in a timely manner'* is a proposition that most effectively captures the concept of quality policy, then you would type that above phrase against quality policy under 'corresponding proposition' (see Table 1). We have shown two other examples also in Table 1 (see the content in light grey font).

We have identified the need to limit the number of questionnaire items (propositions) per clause to 6 (4 in the case of the Clause 4 - on the Organisational Context). In this round, we are trying to identify what the key areas of each clause are, from a practitioner perspective and how each area can be translated into a succinct proposition. Therefore, we ask you to fill in the table (please type) shown at the end of this document, keeping in mind the following to key points.

Key Points:

1. In typing the subareas and propositions (Table 1) you <u>need not</u> have to think at subclause level. For example, in giving six subareas for the 'Leadership' clause (Clause 5) you do not have to use any of the captions the ISO have given to the three subclauses:

Leadership and commitment (5.1); Policy (5.2); Organizational roles, responsibilities and authorities (5.3). For a research point of view, what we need is the broad intent of the clause, rather than the detail.

2. Since English is not the native language in some countries, each propositions should be written in simple English (also, ISO 9001:2015 phrases should be avoided to the extent possible), limiting the word count (again, to the extent possible) to 20 — the more succinct the statement, the better.

To further illustrate the style of the propositions that you will be typing, a questionnaire that has been used by Massey researchers (my supervisors) on Toyota is attached herewith (Appendix - 1). Please be kind enough to provide your responses to our email (madhupallawala@gmail.com) on or before 12 August 2017.

In the next round, upon processing the information that we have received from you (there are 10 experts in our panel), we shall provide you a draft questionnaire accompanied by some discrepancies (points of divergences) that we need to resolve, with your help. Thus the focus in the next round is to improve the questionnaire for which the consensus is sought in the third and final round.

Table 1: Core Areas of the Key Clauses of ISO 9001:2015 and Corresponding Propositions That Need to be Included in the Questionnaire

Clause	Sub-Area *(please fill in the blanks; use extra space)*	The Corresponding Proposition *(please fill in the blanks; use extra space)*
4.Organisational Context *(please try to limit to four items)*	1.	1.
	2.	2.
	3.	3.
	4.	4.
5. Leadership	*e.g. Quality policy*	*e.g. We evaluate the appropriateness of the quality policies for our QMS in a timely manner.*
	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.
	6.	6.
6. Planning	*e.g. Planning for risk and opportunities*	e.g. *As part of planning, we anticipate risk/threats to our QMS and plan strategies in advance to overcome these risks/threats.*
	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.
	6.	6.
7. Support	1.	1.
	2.	2.
	3.	3.
	4.	4.

Clause	Sub-Area *(please fill in the blanks; use extra space)*	The Corresponding Proposition *(please fill in the blanks; use extra space)*
	5.	5.
	6.	6.
8. Operation	*e.g. Design and Developmen Planning*	*e.g. We ensure that we incorporate customer and design requirements at the product design stage.*
	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.
	6.	6.
9. Performance Evaluation	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.
	6.	6.
10. Improvement	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.
	6.	6.

Appendix 1 - Illustrating What we Mean by 'Propositions' via a Questionnaire Administered on Toyota Employees in 27 Countries (Source: Jayamaha et al., 2014)

1. The processes at my company are clearly standardized.
2. My company's processes are consistently applied.
3. My company treasures diverse opinions and ideas.
4. My company delights in making the best use of employees' backgrounds and talents.
5. My company encourages new ideas that defy conventional wisdom.
6. Leaders in my company help me see how changes made today will affect my company's future.
7. My team considers the widest range of opinions prior to developing a final solution.
8. The leadership of this company views errors as opportunities for learning.
9. Sharing knowledge is highly valued in my company.
10. Before making decisions, we strive to fully understand the facts.
11. When mistakes happen, we stop and learn from them.
12. My success is judged based on clear, objective metrics that I can impact directly.
13. My team always seeks consensus around common goals.
14. This company places customer interests ahead of all others.
15. Everyone at this company is treated fairly.
16. My company's processes support our strategic objectives.
17. In the last six months, my company has implemented a best practice idea.
18. Our planning process is based on facts and data.
19. My team always identifies problems at the root cause level.
20. In the last six months, I have grown in my ability to positively impact our customers.
21. We always provide the best available product or service to our customers.
22. The leadership of my company always treats me with respect.
23. Our management provides opportunities for my growth and development.
24. There is cooperation between my department and other departments with whom I work.
25. My company consistently uses the Toyota Way principles in our daily work.
26. My company demonstrates outstanding knowledge of the Toyota Way.
27. My company routinely discusses how to best implement the Toyota Way in our business.

Scale: *Strongly disagree (= 1), Disagree (= 2), Neither disagree nor agree (= 3), Agree (= 4), Strongly agree (= 5)*

Jayamaha, N. P., Wagner, J. P., Grigg, N. P., Campbell-Allen, N. M., & Harvie, W. (2014). Testing a theoretical model underlying the 'Toyota Way' - An empirical study involving a large global sample of Toyota facilities. *International Journal of Production Research*, *52*(14), 4332-4350. doi:10.1080/00207543.2014.883467

APPENDIX 4 A PRINTED COPY OF THE ONLINE QUESTIONNAIRE

Quality Management Systems (QMS): a Multi-country Study

Project Description and Invitation

Massey University, New Zealand is conducting a research study on Quality Management Systems (QMS) of organisations in several countries.

The aim of this research is to explain how core elements of a QMS relate to one another in contributing towards quality-related performance.

A practical outcome of the study is this questionnaire (measurement instrument) itself, which will be validated using your responses.

The measurement instrument will help managers to capture the current position of the QMS of their business in the key areas that lead to quality-related performance. This in turn helps managers to effect continuous improvement.

- **Survey Procedures**

The survey will ask you questions about the QMS of your company. The survey will take 15-20 minutes to complete.

- **Data Management**

All data collected will be treated with confidentiality and will be analysed and presented only in aggregated (collated) form so as to preserve your confidentiality.

- **Participants rights**

If you decide to participate, you have the right to:

- Ask any questions about the study at any time during participation
- Provide information on the understanding that your name will not be used
- Be given access to summary of the project findings when it is concluded

Project Contacts

If you have any questions, please feel free to contact me or my supervisors:

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Supervisors:
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Professor Nigel Grigg
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T: +6469516921

Ethical Concerns

This project has been evaluated by peer review and judged to be low risk. Consequently it has not been reviewed by one of the University's Human Ethics Committees.

The researcher(s) named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Dr. Brian Finch, Director (Research Ethics), email humanethics@massey.ac.nz.

Part I: General Information

1. To which sector does your company belong?

Choose an item.

2. Approximately how many permanent full-time employees does your facility employ? (Please type a number)

3. How long has your organisation (including any predecessor/s if applicable) been in operation? (Please type your answer in approximate number of years)

4. How long has your QMS been subjected to independent audits? (Please type your answer in number of years to the closest 1/2 year; e.g. 4.5)

5. What is your job title (e.g. CEO, quality manager, quality controller)?

Part II – Specific Information on Your Quality Management System (QMS)

Please indicate your level of agreement in a scale of 1 to 7 to the following statements.

Statements	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neither Agree or Disagree 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
Organisational Scope and Environment							
1. Our organisation has a clearly defined scope, stating the types of products and services it covers.							
2. Our organisation understands the expectations of all stakeholders.							
3. Our organisation has identified processes associated with its QMS and the interactions between them.							

Statements	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neither Agree or Disagree 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
Leadership							
4. Our organisation's top management understands and fulfils its leadership role for our QMS.							
5. In fulfilling customer needs, our top managers ensure that regulatory requirements are complied with							
6. Our top management has established a quality policy that is commensurate with the purpose of our							

Statements	Strongly Disagree *1*	Disagree *2*	Somewhat Disagree *3*	Neither Agree or Disagree *4*	Somewhat Agree *5*	Agree *6*	Strongly Agree *7*
7. Our top management ensures that everyone in our organisation understands the responsibilities and							
8. Our top management follows a systematic approach in managing risks in our QMS.							
Operational Strategy							
9. We assess the impact of possible operational risks and plan appropriate actions in our planning process.							
10. Our quality objectives are established so as to be in line with our quality policy and organisational goals.							

Statements	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neither Agree or Disagree 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
11. We make changes to our QMS in a planned and controlled manner.							
12. Our organisation puts in place action plans to achieve our quality objectives.							
13. We consider external and internal issues that affect our organisation in planning our QMS.							
Resources							

Statements	Strongly Disagree *1*	Disagree *2*	Somewhat Disagree *3*	Neither Agree or Disagree *4*	Somewhat Agree *5*	Agree *6*	Strongly Agree *7*
14. Our organisation ensures that sufficient resources are being made available to perform its QMS							
15. Our organisation considers competences when jobs/tasks are being assigned to its people.							
16. Our organisation provides staff training when necessary.							
17. Our organisation ensures that system and process documentation as well as records are appropriately							
18. We use calibrated, reliable and valid monitoring and measuring equipment.							
19. Our organisation maintains an effective communication system to communicate with staff and							

Statements	Strongly Disagree *1*	Disagree *2*	Somewhat Disagree *3*	Neither Agree or Disagree *4*	Somewhat Agree *5*	Agree *6*	Strongly Agree *7*
20. Our organisation maintains appropriate infrastructure to support our operations/processes as							
Operations and Processes							
21. Our design and development activities are planned and controlled to minimise design rework.							
22. Our QMS operations and processes are planned and controlled for efficient delivery of products and							

Statements	Strongly Disagree *1*	Disagree *2*	Somewhat Disagree *3*	Neither Agree or Disagree *4*	Somewhat Agree *5*	Agree *6*	Strongly Agree *7*
23. We have established criteria for selection, monitoring and control of our suppliers/outsourced							
24. We review our ability to meet customer requirements before we accept the orders.							
25. Our organisation puts in place effective processes to capture customer needs.							
26. Our organisation controls and verifies product/service related processes at suitable stages to							
27. We have a system in place to track all our products/services at different stages throughout the							

Statements	Strongly Disagree *1*	Disagree *2*	Somewhat Disagree *3*	Neither Agree or Disagree *4*	Somewhat Agree *5*	Agree *6*	Strongly Agree *7*
28. We have a system to identify nonconforming products/outputs.							
Evaluation							
29. We conduct regular independent internal audits to verify system integrity.							

Statements	Strongly Disagree *1*	Disagree *2*	Somewhat Disagree *3*	Neither Agree or Disagree *4*	Somewhat Agree *5*	Agree *6*	Strongly Agree *7*
30. Our organisation conducts management reviews to evaluate the effectiveness of our QMS.							
31. We measure and monitor customer satisfaction.							
32. Our organisation identifies what processes need to be monitored and measured to evaluate the							
33. Our organisation analyses data and information in decision making.							
Improvement							

Statements	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neither Agree or Disagree 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
34. Improvement is a fundamental component of our organisational culture.							
35. Our organisation has effective process to accommodate improvement suggestions made by staff							
36. Our organisation has an effective and responsive customer complaint handling procedure.							
Results							

Statements	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neither Agree or Disagree 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
37. We have been able to achieve expected customer satisfaction levels consistently over the past three							
38. We have been able to improve the quality of our products and services over the past three years.							
39. We have been able to reduce defect rates consistently over the past three years.							

APPENDIX 5 MASSEY UNIVERSITY HUMAN ETHICS CLEARANCE (LOW RISK)

Gmail Nisansala Pallawala <madhupallawala@gmail.com>

Human Ethics Notification - 4000017511
1 message

humanethics@massey.ac.nz <humanethics@massey.ac.nz> Fri, Apr 7, 2017 at 1:37 PM
To: A.Lindsay@massey.ac.nz, N.Pallawala.Kapurupastha.B.1@uni.massey.ac.nz, N.P.Jayamaha@massey.ac.nz
Cc: M.E.Thomas@massey.ac.nz

HoU Review Group

Ethics Notification Number: 4000017511
Title: Validating the Theoretical Underpinnings of the ISO 9001:2015 Quality Management System Standard: a Cross Cultural Perspective

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our system which is reported in the Annual Report of the Massey University Human Ethics Committee.

The low risk notification for this project is valid for a maximum of three years.

If situations subsequently occur which cause you to reconsider your ethical analysis, please log on to http://rims.massey.ac.nz and register the changes in order that they be assessed as safe to proceed.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"This project has been evaluated by peer review and judged to be low risk. Consequently it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.
If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director (Research Ethics), email humanethics@massey.ac.nz. "

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish require evidence of committee approval (with an approval number), you will have to complete the application form again answering yes to the publication question to provide more information to go before one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

You are reminded that staff researchers and supervisors are fully responsible for ensuring that the information in the low risk notification has met the requirements and guidelines for submission of a low risk notification.

If you wish to print an official copy of this letter, please login to the RIMS system, and under the Reporting section, View Reports you will find a link to run the LR Report.

Yours sincerely

Dr Brian Finch
Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)

APPENDIX 6 SUPPLEMENT TO CHAPTER 04 — EXPLAINING ADVANCED STATISTICAL TECHNIQUES THAT WERE CONSIDERED FOR THIS RESEARCH

7.1 INTRODUCTION

Statistics forms the key medium that positivists and post-positivists use to plan, design and discuss research, whether they are hard scientists or soft scientists, such as social scientists and behavioural scientists. As mentioned in Chapter 05, answering the researcher's first research question (RQ1) requires testing two alternative path models. Path models are nothing more than causally arranged variables, explaining a phenomenon of interest. Path models can be tested in three basic ways, and all these methods have their roots in ordinary least squares multiple linear regression (OLS-MLR), or just "multiple linear regression" (MLR) in shortened form. Of the three available path modelling techniques, choosing the optimal technique to test the hypotheses is an important decision any researcher must make.

Answering the researcher's second research question (RQ2) requires positing national culture dimensions as variables that explain and predict the individual elements of the Plan-Do-Check-Act phenomenon of continual improvement as well as results. On the surface this looks like a straightforward application of OLS-MLR. However, it is well-known that OLS-MLR fails miserably when one is confronted with highly correlated (collinear) predictors, which indeed happens to be the case in the researcher's study. The question then is what alternative form of regression modelling should the researcher choose?

Thus, this appendix describes and reviews alternative or competing statistical techniques that are relevant to the researcher's study in order to select the most suitable statistical techniques to answer RQ1 and RQ2. Section 7.2 covers path modelling. Here the researcher explains what path modelling is in relation models involving latent constructs — a topic that falls under a family of techniques known as *structural equation modelling* (SEM). Section 7.2 also covers key elements attached to SEM, such as different measurement perspectives to operationalise constructs and different SEM approaches used in path modelling. More specifically, section 7.2 covers the covariance approach to SEM and the variance approach (partial least squares approach) to SEM. Section 7.3 provides a full justification for selecting partial least squares SEM (PLS-SEM) for this study. Section 7.4 covers PSL-SEM in detail, including a full explanation on theory testing via PLS-SEM. Section 7.5 covers widely used statistical techniques that are designed to handle highly correlated (collinear) predictors; this section also justifies why partial least squares regression (PLSR) was selected in favour of the other two techniques available (ridge regression and principal components regression). Finally, section 7.6 outlines the key points of this appendix.

7.2 AN INTRODUCTION TO PATH MODELS AND STRUCTURAL EQUATION MODELLING

7.2.1 Introducing Second Generation Multiple Linear Regression-Type Statistical Models Used in Social Research

OLS-MLR[62] in its current form has been known to scientists since late 1890s thanks to the pioneering work done by Karl Pearson (Stanton, 2001). The objective of linear regression analysis is to fit a linear model/equation of the form $Y = b_0 + \sum_{i=1}^{i=N} b_i * X_i$ to data on the dependent variable *Y* and the independent variable(s) *Xi* (where $i = 1$ or 2 or up to *N*) to estimate the unknowns b_0 and b_i (known as model parameters) and thereafter, examine the quality of the model to determine the adequacy of the model (Hair, Black, Babin, & Anderson, 2010). The phrase "least squares" comes about due to the fact the regression model is fitted to data on the basis of least summed squared distance between observations (observed values of *Y*) and predictions (predicted values of *Y*, through the regression equation). Although OLS-MLR is still the most widely fitted model to available data, with the advancement of theoretical abstraction in the 20th century in disciplines such as psychology, analysts started to look beyond the first generation statistical modelling techniques such as OLS-MLR (Fornell, 1985; Hair Jr, Hult, Ringle, & Sarstedt, 2016).

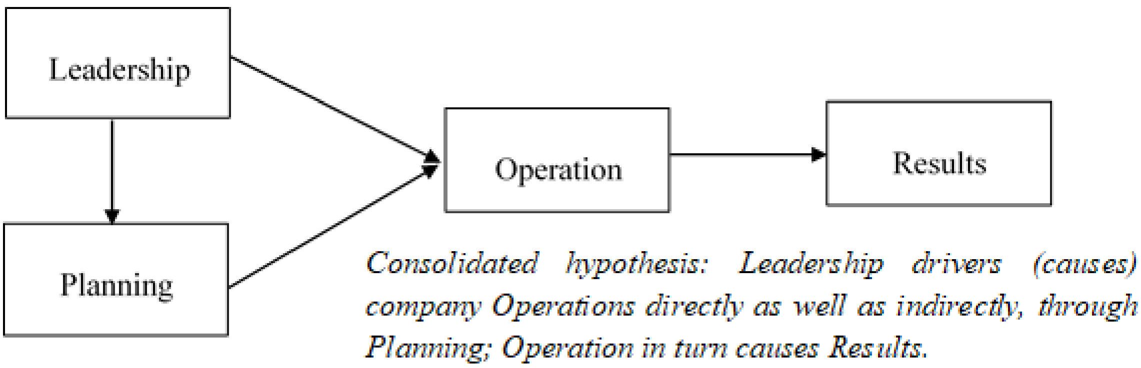

Figure 7.1: Illustration of a path model (imaginary)

To discuss theoretical abstraction, consider the imaginary theoretical model shown in Figure 7.1. As the reader could see, there are three separate regression models associated with the imaginary

[62] The first word "ordinary" is use to distinguish this method from other forms of regression such as weighted least squares regression and partial least squares regression.

theoretical model (Leadership predicting Planning; Leadership and Planning predicting Operation; and, Operation predicting Results). This means that assessment of the overall goodness-of-fit of the model to data (hence tenability of the theory represented by the model) becomes more sophisticated. This is one kind of sophistication (theoretical abstraction). The other kind of sophistication is with the variables in the path model. In Figure 7.1, at least some of the variable (e.g. Leadership, and may be even Planning) are latent (directly unobservable) and theorists had to develop separate measurement models to represent these variables, which means that the quality (goodness-of-fit) of the measurement models also come into reckoning in the assessment of the overall goodness-of-fit of the model to data. This saw the birth of path modelling.

By the phrase "path model" a scientist generally means a model that does not involve latent variables (Jayamaha, 2008; Lohmöller, 1989). If the path model involves one or more latent variables, scientists use a more specific phrase such as a "latent variable path model" (Lohmöller, 1989). The statistical analysis of a *latent variable path model* can take the form of an analysis of covariance of the measures underlying the variables in the path model (in Figure 7.1, there are four variables in the path model) or analysis of variances (Chin, 1998; Fornell & Larcker, 1981; Hair Jr et al., 2016). Path modelling, the two types of latent variable path modelling, and the third type of latent variable modelling technique known as confirmatory factor analysis (CFA) fall under the umbrella technique known as *structural equation modelling* (SEM). Figure 7.1 illustrates the four statistical methods falling under the SEM umbrella.

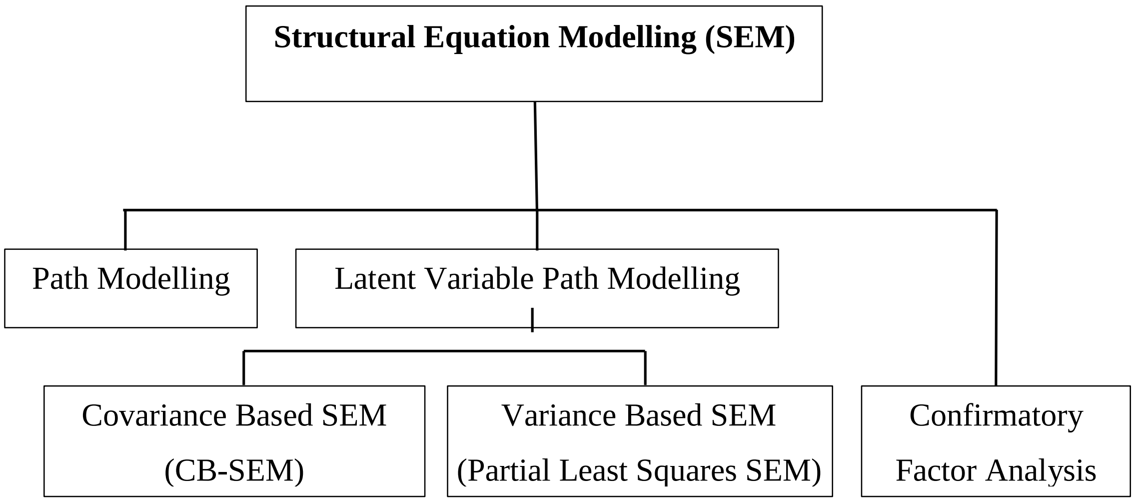

Figure 7.2: The family of techniques falling under the SEM umbrella (own work)

7.2.2 Introducing the Keywords

As in other statistics topics, there is a jargon associated with SEM. Definition of key terms relevant to this study follows.

A ***construct*** represents a concept that is used as a building block of a theory (e.g. Leadership and the remaining concepts in Figure 7.1). A construct may represent something that is directly observable (i.e. income) or, often something that is not directly observable (i.e. latent), in which case a construct could be called a *latent variable*, a *latent construct*, a *factor*, or a *theoretical variable*. Constructs are indicated as *circles* or *ovals* in a path model. Typically, a construct is represented by several so-called indicator variables (indicators) or measures or manifest variables (to distinguish from latent variables). A set of measures can relate to its assigned constructs in one of the two ways, which leads to two types of constructs: reflective constructs and formative constructs (see next para).

An ***indicator*** refers to a directly observable and a measurable proxy that a researcher uses to operationalise a construct (i.e. making the construct measurable). An indicator can be a statement that comprised an idea, which is believed to reflect an aspect of underlying construct (i.e. the statements in the researcher's survey questionnaire covered in Appendix 4). Since the positivistic ontology takes the stance that a concept exists irrespective of the observer, an indicator is not supposed to "*alter or influence*" the meaning of construct (Fayers & Hand, 2002, p. 236). For example, in an organisational setting, there is a thing called Leadership, whether one uses measures to operationalise Leadership or not. Thus conventionally, a measure is only supposed to reflect the variability of the construct through the variability of the measure (Diamantopoulos, Riefler, & Roth, 2008). As such, a conventional construct is sometimes known as *reflective construct*, and the measures assigned to it are known as *reflective measures* (Coltman, Devinney, Midgley, & Venaik, 2008; Diamantopoulos et al., 2008). However, there are instances where the meaning of the construct is formed by its measures. Such construct is known as *formative construct*, and the measures assigned it are known as *formative measures* (Coltman et al., 2008; Diamantopoulos et al., 2008; Roberts & Thatcher, 2009).

A ***measurement scale*** associated with a variable refers to a tool which consists with a set of possible responses/values that can be used to evaluate a given variable, question or statement (Hair Jr et al., 2016).[63] There are four types of measurement scales: nominal, ordinal, interval and ratio. A *nominal scale* refers to just a "label" or a "tag" being used to classify any attribute of an

[63] An example for a variable in a quality management context might be number of hours spent in inspection; an example of a question or statement might be "our leaders plan ahead to face uncertainly".

object (e.g. 0 means a female and 1 means a male), and the labelling/tagging is not meant to show any numerical difference between the labels/tags. An *ordinal scale* refers to a meaningfully orderable nominal scale, where numerical distance between each tag is equal (e.g. 1 means low, 2 means medium, and 3 means high). An *interval scale* is a numeric scale that is ordered in a finite number of equi-distance intervals; an interval scale does not have a meaningful absolute zero (e.g. the intelligence of a person). Finally, a *ratio scale* is the ultimate scale that has a meaningful zero that enables taking continuous measurements (e.g. weight). SEM is designed to work with interval or ratio scales.

The **Likert-scale** named after the American social psychologist Rensis Likert, is a type of a quasi-interval scale that is designed to seek a respondent's level of agreement (typical 5 points/tags or 7 points/tags) for a particular statement or a question on a given attitude or an aspect (as mentioned in Chapter 05, the researcher uses a Likert scale in Part II of her survey questionnaire). While in the strict scheme psychometrics a Likert-scale is an ordinal scale, many scientists including the researcher treat a Likert scale as being interval (Albaum, 1997; Weinberg & Abramowitz, 2008; Wu & Leung, 2017). This is because often a construct is represented via multiple measures and hence one can take the scale of the construct as a summed scale[64] (Albaum, 1997; Likert, 1932).

7.2.3 The Structural Model versus the Measurement Model

In structural equation modelling, there are two sets of statistical models in place: the structural model and the measurement model. Although there are several relationships/models within either of the said models, it becomes possible to combine all structural relationships (models) into a single structural model; likewise it becomes possible to combine all measurement relationships (models) into a single measurement model, using matrix algebra (Kline, 2011; Lohmöller, 1989).

7.2.3.1 The Structural Model

The structural model defines (both graphically and statistically) how constructs are related to each other (i.e. the relationships between constructs). Thus, the structural model represents the theory that a scientist is attempting to advance (Kline, 2011). In a path model (Figure 7.3 shows a parameterised path model), the direction of causal relations between constructs flow from left to right (cause at the left and the effect at the right). Mathematical equations on the relationships between the constructs are as follows ($\in_1$, $\in_2$, and $\in_3$ are error terms):

$$Y_2 = k_1 * Y_1 + \in_1 \tag{7.1}$$

[64] As an example, if a researcher uses five measures to represent a construct and each measure adopts a seven-point Likert scale (hence 6 ordered gaps), there are 30 ordered possibilities in a summed (or averaged) scale, thus approximating to equal distances across the gaps.

$$Y_3 = k_2 * Y_1 + k_3 * Y_2 + \epsilon_2 \quad (7.2)$$

$$Y_4 = k_4 * Y_3 + \epsilon_3 \quad (7.3)$$

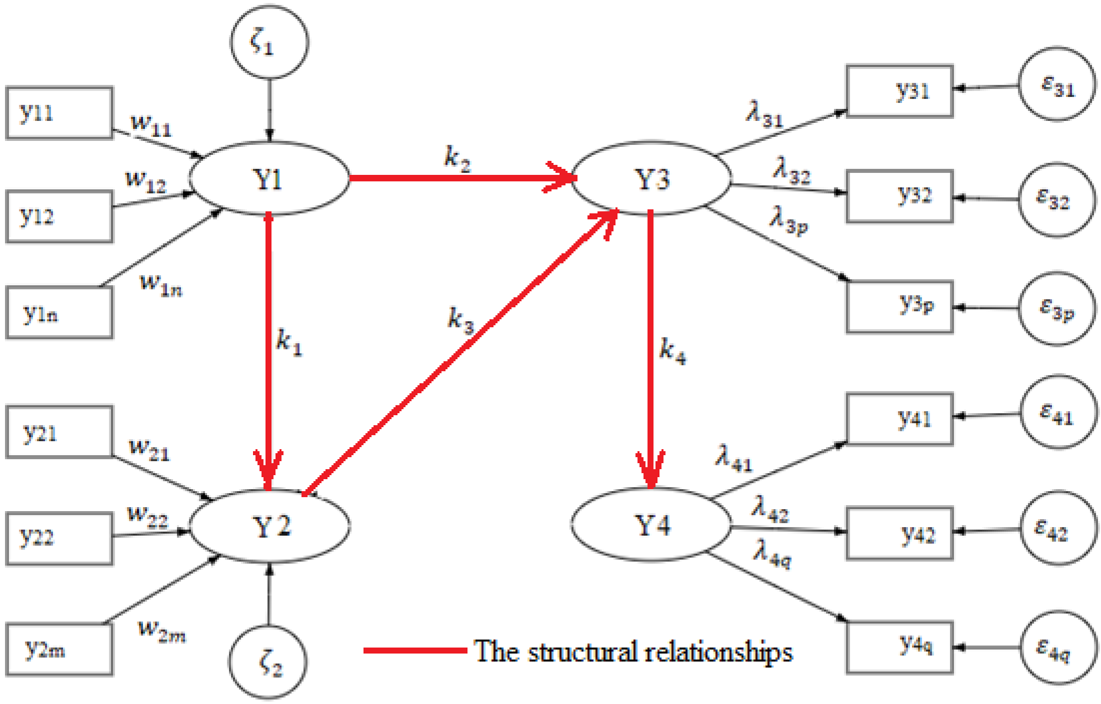

Figure 7.3: A parameterised latent variable path model (Source: Hair Jr et al., 2016)

In a path model, there will be at least one construct that is not explained by one or more remaining constructs (in a casual or regression sense). Such a construct(s) is known as an exogenous construct.[65] In the path model shown in Figure 7.3, there is one exogenous construct, which is Y_1. A construct that is explained by another construct (or constructs) is known as an endogenous construct. In the path model shown in Figure 7.3, there are three such constructs (Y_2, Y_3, and Y_4). In the path model shown in Figure 7.3, the parameters $k_{1,}$ k_2, k_3 and k_4 are referred to path coefficients (typically estimated using standardised scores). In SEM, the acceptance or failing to accept a research hypothesis depends on the statistical significance of the estimated parameter (the *p* value).

7.2.3.3 The Measurement Model

[65] Or an exogenous latent variable, if the construct is a latent variable.

While it is all well and good to examine the statistical significance of the path coefficients to test research hypotheses, the findings are of little value if the researcher's operationalisation of the constructs are found lack of validity — or more technically, construct validity (Diamantopoulos, Sarstedt, Fuchs, Wilczynski, & Kaiser, 2012; Hair Jr et al., 2016; Kline, 2011). This is where the measurement model comes into its own.

The measurement model defines how measures (indicators) are related to their assigned constructs in a predictor-response sense (Hair Jr et al., 2016). If the construct(s) under consideration is a formative construct (in Figure 7.3, Y1 andY2), the predictor-response relationships (graphically speaking, arrows) go from measures to the construct, because the construct does not exist without its measures (Diamantopoulos et al., 2008). On the other hand, if the construct(s) under consideration is a reflective construct (in Figure 7.3, Y3 and Y4), the relationships do reverse, because the existence of the construct does not depend on the measures, in true positivistic ontological spirit (Coltman et al., 2008; Roberts & Thatcher, 2009). With regard to Figure 7.3, equations 7.4 and 7.5 represent the mathematical relationships underlying the reflective measurement models. Here, the parameters $\lambda_{3i\,,i=1,\ldots p}$ and $\lambda_{2j,j=1,\ldots,q}$ are referred as factor loadings and $\varepsilon_{3i\;i=1,\ldots p}$ and ε_{4j} are referred as to measurement error terms associated with the indicator variables y3i, i=1,…,p and y2j, j=1,…,q, respectively (Hair Jr et al., 2016).

$$y_{3i} = \lambda_{3i} * Y_3 + \varepsilon_{3i} \; (i = 1,2,\cdots,p) \qquad (7.4)$$

$$y_{4i} = \lambda_{4j} * Y_4 + \varepsilon_{4i} \; (j = 1,2,\cdots,q) \qquad (7.5)$$

The mathematical equations for the formative measurement models cannot account for measurement error corresponding to individual measures (Diamantopoulos et al., 2008). Regarding Figure 7.3, the equations representing the formative measurement models are as follows:

$$Y_1 = w_{1i} * y_{1i} + \zeta_i \; (i = 1,2,\cdots,n) \qquad (7.6)$$

$$Y_2 = w_{2j} * y_{2j} + \zeta_2 \; (j = 1,2,\cdots,m) \qquad (7.7)$$

7.2.4 Parameter estimation in SEM

The particular algorithm used to estimate the parameters specified in a latent variable path model (both the measurement model parameters and the structural model parameters) depends on which of the two latent variable path modelling technique has been used by a researcher (see Figure 7.2).

7.2.4.1 Parameter Estimation in Covariance-Based SEM

In covariance based SEM (CB-SEM), which is also sometimes called **LI**near **S**tructural **REL**ations (LISREL), all model parameters are estimated simultaneously, using a discrepancy function (typically the maximum likelihood discrepancy function) that minimises the discrepancy between the *covariance matrix of the indicators as implied* by the model parameters θ and the *covariance matrix of the indicators* based on sample data. Thus in CB-SEM, the best fitting model is the model that minimises the right hand side of the following discrepancy function (see equation 7.8) for the unknowns θ, if the maximum likelihood function has been used (Kline, 2011; Olsson, Foss, & Breivik, 2004).

$$F(S, \Sigma(\theta)) = \log|\Sigma(\theta)| + tr(S\Sigma(\theta)^{-1}) - \log|S| - k \tag{7.8}$$

In equation 7.8, $\Sigma(\theta)$ is the implied covariance matrix; S is the sample covariance matrix; k is the number of indicators; tr means the trace; $|\quad|$ means the determinant. Since the parameters (unknowns) of both the structural and measurement model are determined based on a global optimisation function, assessment of the goodness-of-fit of the overall model — hence one's theory — to data[66] becomes quite straightforward (Byrne, 2010; Olsson et al., 2004). For this reason, CB-SEM is the method of choice for theory confirmation. However, CB-SEM has its own limitations, which are covered in section 7.3.

7.2.4.2 Parameter estimation in partial least squares-based SEM

Unlike CB-SEM, the alternative latent variable path modelling approach, *the partial least squares SEM (PLS-SEM)* is not associated with an overall (global) optimisation function (Chin, 1998; Hair Jr et al., 2016). Optimisation in PLS-SEM is local (hence partial). For example, the indicator loadings of a conventional construct are computed such that the construct extracts as much

[66] Here data means the population covariance matrix of the indicator data.

variance of the indicators as possible; this variance extraction hardly depends on how the structural model has been specified by a researcher (Chin, 1998; Hair Jr et al., 2016). Here, PLS-SEM handles the measurement model almost like how principal component analysis (PCA) handles variance, and the construct scores are quite identical to the scores of the first component extracted in PCA (Lohmöller, 1989; Pirouz, 2006). Coming back to the structural model, PLS-SEM works much like multiple regression based on component scores, in that the goal is to minimise error variances of each regression model within the structural model (Lohmöller, 1989; Pirouz, 2006). This basically means the theory confirmation via PLS-SEM becomes somewhat questionable. This is not to say that PLS-SEM is not suitable for theory testing; indeed, PLS-SEM is suitable for theory testing in an exploratory sense, such as evaluating alternative conceptualisations (Chin, 1998; Haenlein & Kaplan, 2004; Hair Jr et al., 2016; Henseler, Ringle, & Sinkovics, 2009). This is one of several reasons why the researcher selected PLS-SEM for her study (see section 7.3).

7.3 SELECTING PLS-SEM IN FAVOUR OF CB-SEM

Despite CB-SEM being the widely applied conventional approach, Hair Jr et al. (2016) stress that neither CB-SEM nor PLS-SEM is superior to one another, because each has its own advantages and disadvantages. Further, authors assert that simulation studies show that the differences in parameter estimates returned by the CB-SEM approach and the PLS-SEM approach in most cases is negligible. A researcher employs the PLS-SEM approach in favour of the CB-SEM approach under one or more of the following five reasons:

1) CB-SEM, PLS-SEM is suitable for testing evolving theorisations, whereas CB-SEM is more appropriate for confirming developed theories (Chin, 1998; Haenlein & Kaplan, 2004; Hair Jr et al., 2016; Henseler et al., 2009).

2) Unlike CB-SEM, PLS-SEM can be applied for measures that are not fully interval type or ratio type (Haenlein & Kaplan, 2004; Hair Jr et al., 2016; Ringle, Sarstedt, Mitchell, & Gudergan, 2018).

3) Unlike CB-SEM, the statistical significance of models parameters in PLS-SEM is computed using nonparametric methods, and these nonparametric methods do not rely on distributional assumptions such as the normal distribution (Chin, 1998; Kock, 2016; Lohmöller, 1989; Pirouz, 2006). Since researcher's target respondents were managers of ISO 9001 certified firms, and for the most part the questionnaire measured the respondent's acceptance on ISO 9001 implementation. For this reason, unsurprisingly the data were found to be negatively skewed (left skewed), departing from a normal distribution, to some extent (some construct scores not much but others somewhat). CB-SEM is sensitive to violation of normality (Byrne, 2010; Kline, 2011) and was not considered. The reader may

note that in PLS-SEM. the standard errors of model parameters and hence the T values are obtained through an appropriate resampling technique (Chin, 1998; Hair Jr et al., 2016). Most software packages incorporate *bootstrapping* (Efron, 1979) as the resampling method by default. For a detained deception of bootstrapping in PLS see (Streukens & Leroi-Werelds, 2016).

4) Inclusion of formative constructs (the researcher has quite a few) do not cause problems in PLS-SEM, whereas inclusion of such constructs in CB-SEM makes a model un-identifiable. This is because CB-SEM is a covariance-based approach, and the covariation of indicators is not explained by the model in any way (Byrne, 2010; Hair Jr et al., 2016; Kline, 2011).

5) Unlike CB-SEM, PLS-SEM allows estimation of more complex models with moderate sample sizes and yet, achieve higher statistical power (Hair Jr et al., 2016; Kock, 2016; Reinartz, Haenlein, & Henseler, 2009).

There is often a bad thing in any good thing! Until very recently, PLS-SEM was not associated with any valid global goodness-of-fit measure to test how well a model (theory) fits to data. As such, reporting the overall goodness-of-fit has always been cumbersome in PLS-SEM (Hair Jr et al., 2016; Henseler, Hubona, & Ray, 2016). However, proliferation of this approach into numerous subject disciplines and the exponential grown in the application of PLS-SEM has led the experts to come up with a reasonably settled list of results that need to be reported in theory testing studies (Hair, Risher, Sarstedt, & Ringle, 2019; Hair Jr et al., 2016; Henseler et al., 2016). Researcher followed these modern practices (see section 7.4) in presenting the results (see Chapter 06).

7.4 THEORY TESTING USING PLS-SEM

As mentioned in previous section, because PLS-SEM adopts a partial (piece-wise) optimisation procedure, testing one’s theory has always been cumbersome, compared to CB-SEM. However, now there are clear guidelines as to how researchers should go about in testing the goodness-of-fit of their overall PLS-SEM model to data (Hair Jr et al., 2016; Ringle et al., 2018). Due to the piece-wise nature of optimisation, one needs to demonstrate the quality of the measurement model and structural model separately, in order to conclude on the goodness-of-fit of a PLS-SEM model (Hair Jr et al., 2016). The specific statistical procedures one needs to apply in testing the quality of a measurement model depends on whether that measurement model represents a reflective construct or a formative construct.

7.4.1 Testing the Quality of Reflective Constructs

For a reflective measurement model, in keeping with psychometric theory, validity of the measurement scales has to be demonstrated through *scale reliability* analysis and *construct validity* (Carmines & Zeller, 1979; Nunnally & Bernstein, 1994; Straub, 1989). Reliability, more precisely the internal consistency reliability, estimates the consistency of the measures of a construct, whereas validity demonstrates the fact that the measures that operationalise constructs actually measure what they are supposed to measure (Carmines & Zeller, 1979; Nunnally & Bernstein, 1994; Straub, 1989). *Cronbach's alpha* and *composite reliability* estimates are used to demonstrate the internal consistency reliability of the measurement scales, while convergent *validity* and *discriminant validity* results are used to demonstrate construct validity when PLS-SEM is used in path analysis (Götz, Liehr-Gobbers, & Krafft, 2010; Hair Jr et al., 2016).

7.4.1.1 Testing Internal Consistency Reliability

Internal Consistency Reliability refers to the interrelatedness of measures underlying a construct, in a correlational sense (Nunnally & Bernstein, 1994). Thus, the theoretical maximum of internal consistency reliability as a coefficient is 1.0, while the theoretical minim is zero. In PLS-SEM estimation, most widely used reliability coefficient is Cronbach's alpha coefficient (Cronbach, 1947), despite its incompatibility with PLS-SEM (Bonett & Wright, 2015). Cronbach's alpha coefficient is sensitive to number of indicators being used to operationalise a construct, and still worse (from a PLS-SEM standpoint), Cronbach's alpha coefficient calculation assumes that all measures weigh equally in operationalising the construct. This goes against the PLS algorithm, because the PLS-SEM algorithm calculates optimal weights for each measure (Chin, 1998; Hair Jr et al., 2016). Consequently, PLS-SEM experts advocate that an alternative reliability coefficient known as composite reliability should be used alongside Cronbach's alpha (Hair Jr et al., 2016). The rule-of-thumb acceptable cut-off value for the Cronbach's alpha — and by default composite reliability — is 0.70, for a new scale, although values between 0.60 and 0.70 could be acceptable in an exploratory study (Hair Jr et al., 2016; Nunnally, 1978). If reliability coefficients return a value less than the threshold value the researcher could consider removing offending measures to improve reliability (see the next section for caveats).

7.4.1.2 Testing Construct Validity

Construct validity refers to the question of whether or not the measurement system that underlies the construct is measuring what it is supposed to measure (Nunnally & Bernstein, 1994). Establishing construct validity is of paramount importance because a reliable measurement scale can still be invalid (Hair Jr et al., 2016). In PLS-SEM, construct validity is assessed by assessing convergent validity and discriminant validity of the measurement system (Chin, 1998; Gefen & Straub, 2005; Hair Jr et al., 2016).

Convergent validity of a measurement system67 underlying a construct refers to extent to which the measures are correlated with one another (on average) in representing the contract (Gefen & Straub, 2005; Hair Jr et al., 2016). Stated alternatively, convergent validity refers to the extent to which measures underlying a contract converge in represent the construct. One way to demonstrate convergent validity is to show that on average, the measures do extract a substantial proportion (> 50%) of the variance of the construct (Gefen & Straub, 2005; Hair Jr et al., 2016). This measure of convergent validity is known as the average variance extracted (AVE) of the construct. Another way to establish convergent validity is to show that each measure representing the construct does correlate strongly (r > 0.70) with the construct (Hair Jr et al., 2016).

Discriminant validity of a measurement system underlying a construct refers to how well the measures assigned to a particular construct can be reliably isolated (discriminated) from measures assigned to other constructs, in a correlational sense (Gefen & Straub, 2005; Hair Jr et al., 2016). A basic way to establish discriminant validity is to show that measures assigned to a construct do not correlate strongly with other constructs (i.e. weaker cross-loadings) as they do with the construct the measures are assigned to (i.e. strong loadings) (Gefen & Straub, 2005; Hair Jr et al., 2016). A more elegant way to demonstrate discriminant validity is to show that a construct correlates less strongly with the other reflective constructs in the model than with its assigned measures, on average, as reflected by the square root of AVE of the construct68 (Chin, 1998; Gefen & Straub, 2005; Hair Jr et al., 2016). This criterion is known as the Fornell-Larcker criterion (Fornell & Larcker, 1981). Very recently, a new method of assessing discriminant validity, on the basis of heterotrait-monotrait (HTMT) ratio of correlations, was proposed by Henseler, Ringle, and Sarstedt (2015). Henseler et al. claim that their method is superior to the more established method prescribed by Fornell and Larker. As with all new methods, there is some debate over optimal cut-off value of the HTMT ratio that needs to be prescribed for acceptable level of discriminant validity (Voorhees, Brady, Calantone, & Ramirez, 2016).

As with reliability, if the discriminant validity is found to be unsatisfactory, a researcher may attempt to get a more favourable correlation pattern through rationalisation, including removing offending measures from its assigned construct (Hair Jr et al., 2016).69 While practice is deemed acceptable in true latent variable methods such as CBSEM (due to the principal of interchangeability of measures), in component-based methods such as PLS-SEM, removal of

[67] A measurement system representing a construct is indeed the measurement model representing that construct.
[68] Square root is taken to make a variance component comparable with a correlation coefficient.
[69] Another way of rationalising is moving a measure from its assigned construct to another.

measures (especially if the measures represent a formative construct) may lead to conceptual and/or statistical issues such as imprecise or unreliable path coefficients which may lead to false conclusions. This is a personal viewpoint of the researcher, based on scrutiny of the PLS-SEM algorithm.

7.4.2 Testing the Quality of Formative Constructs

It is argued that reliability and validity criteria meant for conventional constructs (i.e. for reflective constructs) are not applicable to formative constructs due to conceptual reasons (Diamantopoulos et al., 2008; Hair Jr et al., 2016; Jarvis, MacKenzie, & Podsakoff, 2003). As mentioned elsewhere, the positivistic ontology takes the position that a construct exists without its measures and measures are mere manifestations of the construct, and hence are required to co-vary (Hair Jr et al., 2016; Jarvis et al., 2003). This forms the conceptual basis of measures on internal consistency reliability (e.g. Cronbach alpha), convergent validity (e.g. AVE), and discriminant validity (e.g. Fornell-Larker criterion). Again, as mentioned elsewhere, the meaning of the construct is formed by its measures, which may or may not co-vary (correlate) (Diamantopoulos et al., 2008; Jarvis et al., 2003). This leads to an altogether different procedure of testing the quality of formative constructs. The procedure described in the next paragraph is based on the criteria described by Hair Jr et al. (2016).

In testing the validity of formative constructs, first one needs to establish the content validity of the measures underlying a construct. Content validity assesses if a set of indictors of corresponding construct sufficiently capture the essence of domain under consideration (Roberts & Thatcher, 2009). The next step in testing validity is to establish convergent validity by showing that the formative construct under review is correlated with some global measure the construct is supposed to predict (one may view this as establishing criterion-related validity or predictive validity). However, this approach requires collecting additional data on so-called global measures, and more the number of formative construct more the challenge becomes in collecting additional data (Hair Jr et al., 2016). However, it is generally agreed that establishing convergent validity of formative constructs through a global indicators is optional (Jarvis et al., 2003; Roberts & Thatcher, 2009). The third step70 in testing validity is to show that measures forming the construct are not strongly related to one another (i.e. collinearity) as this leads to stability problems in parameter estimates due to variance inflation (section 7.5 among other things describes how variance inflation is measured and what degree of variance inflation is acceptable in multiple linear regression). The final step of establishing validity is to demonstrate that the weights of the measures are statistically significant.

[70] Second step, if circumstances preclude convergent validity testing.

7.4.3 Testing the Quality of Single Item Constructs

Single item constructs are not unusual in path modelling. In fact, path modelling, as opposed to latent variable path modelling, always refer to models that contain single measure constructs (Lohmöller, 1989). With a single item construct, most test procedures described above (for either reflective constructs or for formative constructs) remain redundant, because concepts such as inter-correlations between measures of the construct do not simply exist (Diamantopoulos et al., 2012; Fuchs & Diamantopoulos, 2009). A construct is better operationalised through multiple measures because the measurement error gets negated in computing the construct score, because the construct score is the weighted average score of the measures (Diamantopoulos et al., 2012; Fuchs & Diamantopoulos, 2009). For example, in a survey research context, if a construct is represented by six survey items (hence six measures) the measurement error gets attenuated through the six-item measurement model in computing the construct score as some measures could have been over-scored and some measures could have been under-scored but the average (subject to the assumption that measurement error is random) should be close to the true score of the construct.

7.4.4 Testing the Quality of the Structural Model

In PLS-SEM, the parameters of the structural model (e.g. path coefficients) are estimated based on construct scores, using standard linear regression modelling techniques via a set of linear regression models corresponding to each endogenous construct (each endogenous variable is associated with one or more predictor constructs). In situations where an endogenous construct is associated with multiple predictor constructs, the collinearity among predictor constructs could lead to unstable parameter estimates due to variance inflation (Hair Jr et al., 2016). As such, the first step in testing the structural model is to ensure that there are no serious collinearity issues involving the predictor constructs (see section 7.5 for details on collinearity assessment).

The second step in testing the quality of the structural model is to test the statistical significance of the path coefficients and the effect sizes associated with the regression models — that is R^2 or Cohen's f^2 of all the regression models predicting/explaining endogenous constructs.71 One could use the "large effect", "medium effect", and "small effect" from values given by (Cohen, 1992) to examine whether or not the endogenous constructs are well-explained by their predictor constructs. In this regard, for substantive meaning of the structural relationships, examining the

[71] Cohen (1992) defined f^2 as applicable to multiple regression as $f^2 = R^2/(1 - R^2)$

sign and the size of the path coefficients (these are always reported as standardised regression coefficients in PLS-SEM) also becomes important (Hair Jr et al., 2016).

Another method that could be used to test the quality of the structural model and the corresponding measurement model (a) both is thorough cross-validated redundancy analysis. In this regard, the statistic cross-validated redundancy Q2 has been prescribed. This statistic indicates how well a value of an endogenous construct of a case (a row in the data set) is predicted by the measures belonging to the predictor constructs through the remaining data points in the data set (Chin, 1998; Hair Jr et al., 2016). Describing how the blindfolding/cross-validation works is beyond the scope of this thesis. For details see (Chin, 1998, p. 318). It is important to note that this statistic is only applicable for reflective constructs or single-item constructs in the path model (Hair Jr et al., 2016).

7.5 REVIEWING TECHNIQUES MEANT TO HANDLE HIGHLY COLLINEAR PREDICTORS IN REGRESSION MODELLING

Collinearity of predictors — one predictor being strongly linearly related to other predictors — has been a problem in multiple regression, more specifically in OLS-MLR (Hair, Anderson, Tatham, & Black, 1995). The key problems being inflation of the standard errors (variance inflation) of regression coefficients leading to unstable estimates and over-fitting of the model to data (Harrell, Lee, Matchar, & Reichert, 1985; Magidson, 2013).

Reducing the number of predictors and/or collecting more data has been suggested as a remedy to deal with variance inflation and overfitting, but there are many instances that prevent a researcher from doing this. In the case of the researcher's study, including the two offending predictors IDV or PDI but not both would have solved the problem (see section 7.5.1), but simultaneous consideration of both culture dimensions was important due to conceptual/theoretical reasons. As regards more data, it would have been possible for the researcher to reduce collinearity by cherry-picking additional countries having different patterns of culture dimensions scores (see Figure 7.5 for the pattern of culture dimensions scores for the five counters included in this study). However, in practice, collecting primary data from a large number of countries is virtually impossible in a medium-size project such as doctoral study. Consequently, the researcher looked for other remedies available to tackle the collinearity/overfitting problem. The researcher found from the literature that three statistical techniques — ridge regression, principle component regression, and partial least squares regression72 — standout as possible remedies (Abdi, 2010; Bhat & Vidya, 2018; Yeniay & Göktaş, 2002).

[72] Not to be confused with PLS-SEM.

Before, reviewing the potential remedial measures (section 7.5.2), the researcher highlights the collinearity problem faced by her in the next section (section 7.5.1).

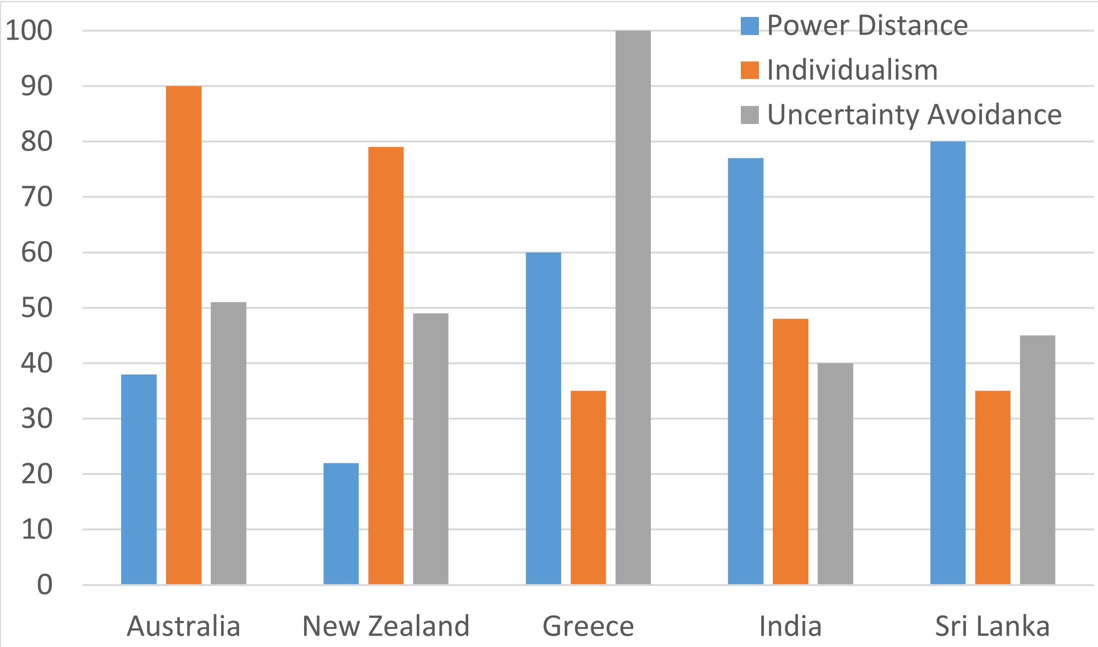

Figure 7.4: Hofstede's PDI, IDV, and UAI scores for five countries covered in this research study

7.5.1 Collinearity Diagnostics

The association (Pearson's correlation coefficient) of three culture dimensions (predictors in the statistical models used by the researcher to answer RQ2) are shown in Table 7.1, along with the values of variance inflation factor (VIF) of each predictor.

Table 7.1: Correlations between PDI, IDV, and UAI for the Data Collected

	PDI	IDV	UAI
Power Distance (PDI) (VIF = 6.60)			
Individualism (IDV) (VIF = 8.33)	-0.840***		
Uncertainty Avoidance (UAI)	-0.444***	-0.444***	

(VIF = 2.46)			
*** $p < 0.001$; VIF stands for "Variance Inflation Factor"			

Based on the information shown in Table 7.1, it becomes evident that the predictors PDI and IDV are highly (negatively) correlated, returning high variance inflation factor (VIF) values. The square root of VIF of a predictor indicates by what factor the standard error of a regression coefficient of that predictor has inflated due to the relation the predictor has with the other predictors (Hair et al., 1995). A VIF value of 4.0 indicates that the standard error of a regression coefficient has been inflated by a factor 2, which is often taken as the upper-bound limit to avoid collinearity problems in weak (low R^2) models (Hair et al., 2019). As in previous research (see Chapter 03), the researcher found that culture is weakly related to quality (e.g. TQM) as well as results73 (e.g. customer satisfaction), which means that the estimates of the regression coefficients of PDI, IDV as well as their statistical significance (p values) remain much to be desired, under OLE-MLR, thus warranting an alternative model-fitting technique.

7.5.2 Ridge Regression, Principal Component Regression, and Partial Least Squares Regression versus OLS-MLR

To explain the above techniques, the researcher uses a series of regression models (i.e. a set of predictors predicting several response variables simultaneously) written down in matrix algebra form with mean centred data74 as follows (equation 7.9):

$$Y = XB + E \qquad (7.9)$$

where,

Y is a n x q matrix of observations of q number of response variables y1 through to yq,

X is a n x p matrix containing n observations of p variables,

B is a p x q matrix of model parameters (regression coefficients),

E is a n x q matrix of error terms

In OLS-MLR, the estimates of model parameters will be calculated as follows:

$$\hat{B} = (XTX)\text{-}1XTY \qquad (7.10)$$

[73] For example, OLS-MLR returns a R^2 value of 2.75% when customer satisfaction is taken as the response and PDI, IDV, and UAI are taken as predictors.

[74] Mean centred value of a variable means, the observed value being deducted by the mean value of the variable.

where $\hat{B}$ is the matrix containing estimated model parameters and the XT denotes the transpose of a matrix X.

In OLS-MLR, under the condition of substantial multicollinearity, the matrix XTX becomes “ill-conditioned”, meaning the parameter estimates become extremely sensitive for a small chance in the response values, resulting in inflated standard errors of model parameters (Yeniay & Göktaş, 2002).

In ridge-regression (RR), the ill-conditioned matrix XTX will be rectified by adding a small positive bias θ to its diagonal elements to make the solution less sensitive to value changes. The challenge in ridge-regression is to select the optimal adjustment, and there are prescriptions in the literature on selecting the bias (Kibria & Banik, 2016; Yeniay & Göktaş, 2002).

In principal components regression (PCR), the problem of dimensionality (collinearity) in the X variable space is tackled by selecting the optimal c number of principal components — out of a possible p number of principle components75 — that extract the maximum variability of variables in the X variable space, and using only those c number of orthogonal components as predictors of Y in an OLS-MLR context (Bhat & Vidya, 2018; Yeniay & Göktaş, 2002). In PCR the optimal number of components are selected using an acceptable criterion used in principal components analysis (PCA) such as the Kaiser criterion or the scree plot. Thus, PCR can be viewed as a two-step process where the first step corresponds to a PCA while the second step corresponds to OLS-MLR.

In partial least squares regression (PLSR), the problem of dimensionality (collinearity) is tackled in a somewhat similar way to that adopted in PCR. The key difference is that in PLSR, in extracting the optimal c number of components, the PLSR algorithm, more specifically the PLSR II algorithm, looks not only at the X variable space but also the Y variable space (to account for possible collinearity among Y variables also) and the covariance between the X variable space and the Y variable space (Abdi, 2010; Geladi & Kowalski, 1986; Yeniay & Göktaş, 2002). PLSR I algorithm differs from PLSR II algorithm in that unlike in PLSR II, only one response variable (depended variable) is considered in optimising the variance-covariance extraction in PLSR I, in computing the model parameters (Abdi, 2010; Geladi & Kowalski, 1986; Yeniay & Göktaş, 2002). Thus, PLSR I is recommended only in situations where there is only one response variable or when the response variables show no significant collinearity among themselves (Abdi, 2010;

[75] p is the maximum because there are only *p* number of predictors in the X variable space.

Geladi & Kowalski, 1986; Wold, Sjöström, & Eriksson, 2001). In general, a PLSR solution (the regression estimates) is expected to be more robust than a PCR solution (Abdi, 2010; Geladi & Kowalski, 1986).

Unlike in PCR, in PLSR, the optimal number of principal components are typically selected by examining the predicted error mean sum squares of different solutions (i.e. the one component solution, 2 component solution, …., p component solution) and selecting the solution that returns the minimum predicted error mean sum squares; the software package the user uses allows the user to select a suitable cross-validation algorithm (e.g. full cross-validation) to compute the predicted error mean sum squares (Wold et al., 2001; Yeniay & Göktaş, 2002).

7.5.3 Justification of PLSR

Although all three methods adopt a strategy to overcome collinearity by introducing a bias, the way bias is being introduced in ridge regression is somewhat subjective. PCR and PLSR are grounded in more solid reasoning (e.g. PCA and OLS-MLR used in the two steps of PCR are well-accepted techniques), but because a PLSR solution is expected to be more robust than a PCR solution (Abdi, 2010; Geladi & Kowalski, 1986), the former was selected.

7.6 CONCLUSION

This appendix introduced and reviewed statistical techniques available to conduct the statistical analysis required to answer the first two research questions. Answering RQ 1 requires two latent variable path models be analysed. The researcher introduced two well-known latent variable path modelling techniques — the CB-SEM technique and the PLS-SEM technique — and argued why PLS-SEM is the right choice in this study. Answering RQ 2 requires several predictor-response type linear models be fitted to data, which on the surface, looks like a classical OLS-MLR model fitting application. However, the predictors in this study (for models related to RQ2) are national culture dimensions, which are highly correlated with one another (i.e. collinearity). Since collinearity makes OLS-MLR unsuitable, the researcher introduced three alternative techniques: RR, PCR, and PLSR. Of these PLSR was found to be the most suitable for this study.

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APPENDIX 7 COMPARING THE CHARACTERISTICS OF EARLY VS LATE GREEK RESPONDENTS

8.1 INTRODUCTION

The purpose of this appendix is to examine whether there is a response bias of Greek respondents, based on the characteristics of Early respondents and Late respondents. Given that the survey was launched on 01 May 2018 and the reminder was sent out on 13 May 2018, the late respondents were considered as companies that responded from 05/05/2018 through to 13/05/2018 (both days inclusive) and companies that responded after 20/05/2018, based on the response pattern (Figure 8.1). The two characteristics chosen for comparison were the QMS Maturity of the companies and the proportions of Small, Medium and Large companies belonging to Early versus Late respondents. The next section shows data analysis results conducted via Minitab 19 software.

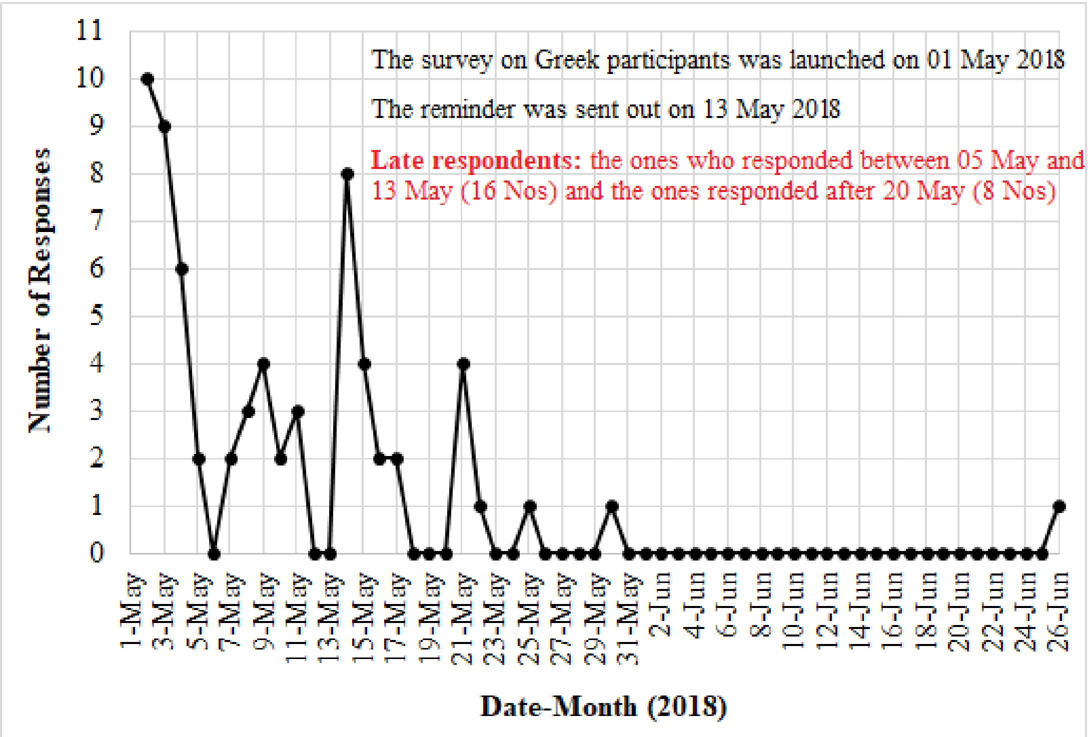

Figure 8.1: The number of responses received each day since the launch of the survey

8.2 RESULTS

Figure 8.2 depicts the box plots for QMS Maturity (in Yrs.) of the two groups: Early respondents (n = 40) and Late respondents (n = 23). The two respondents did not respond to the relevant questionnaire item that captures the QMS Maturity were not included in the analysis. Table 8.1 depicts the results of the two-sample T-test results for QMS Maturity (note that two samples are the Early respondents and late respondents). The two sample T-test results suggest that at 0.05 level of significance, there is no evidence to reject the null hypothesis “the mean QMS Maturity of the two categories of respondents are the same". The Box plot shows graphical comparisons of means and dispersions.

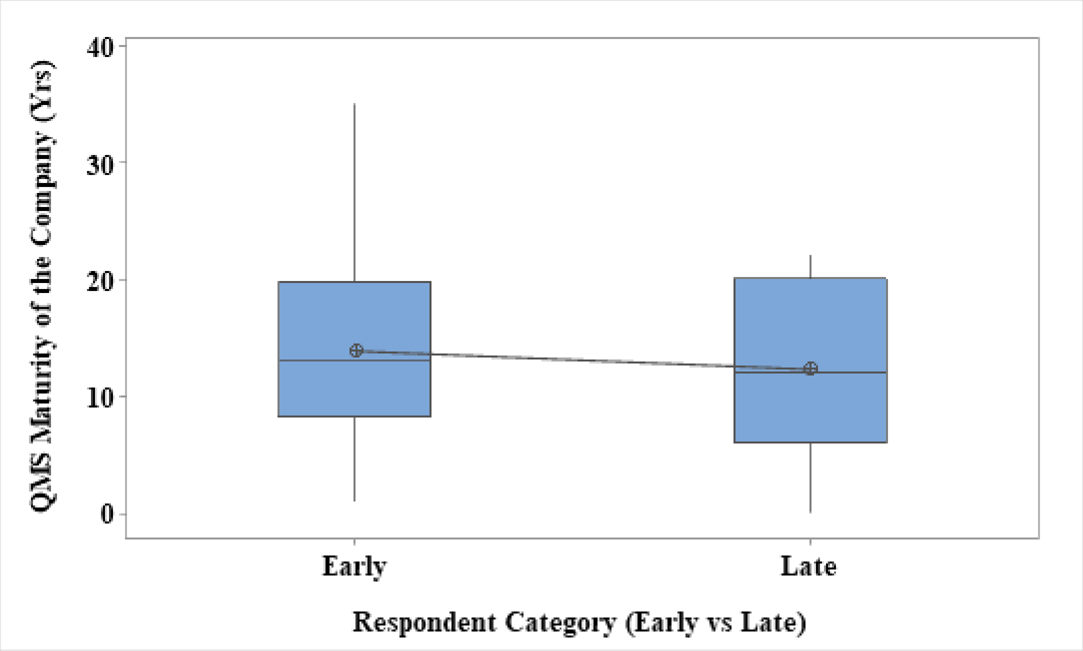

Figure 8.2: The Box Plot for QMS Maturity

Table 8.1: Two-Sample T-Test Results for Response QMS Maturity

Method

μ_1: mean of QMS Maturity (Yrs.) when Respondent Category = Early

μ_2: mean of QMS Maturity (Yrs.) when Respondent Category = Late

Difference: μ_1 - μ_2

Equal variances are not assumed for this analysis.

Descriptive Statistics: QMS Maturity (Yrs.)

Respondent Category	N	Mean	StDev	SE Mean
Early	40	13.85	7.54	1.2
Late	23	12.28	7.75	1.6

Estimation for Difference

Difference	95% C.I. for Difference
1.57	(-2.48, 5.61)

Test

Null hypothesis	H_0: $\mu_1 - \mu_2 = 0$
Alternative hypothesis	H_1: $\mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
0.78	44	0.439

Table 8.2 depicts the number of Large, Medium, Small, and Micro sized companies belonging to the groups (i.e. Early respondents and Late respondents). Table 8.3 depicts the comparisons base on proportions. Although there are apparent differences in the proportions of Large, Medium, Small and Micro companies between the two groups (Early vs Late respondents), the statistical significance tests (95% confidence interval for difference in proportions) show that the difference are statistically nonsignificant, because the 95% confidence intervals of the differences in proportions cross zero (Table 8.4). The reader should note that the proportions of Micro sized companies were not compared for inferential purposes due to small sample sizes (there is one a solitary Micro sized company belonging to Late respondents' group).

Table 8.2: Number of Early Versus Late Respondents by Company Size

Category	**Size**				**Total***
	Large	Medium	Small	Micro	
Early Respondents	3	16	18	3	40
Late Respondents	3	8	12	1	24
Total					64
* One Early respondent could not be classified as they have not indicated their company size					

Table 8.3: Proportion of Early Versus Late Respondents by Company Size

Category	**Size**			
	Large	Medium	Small	Micro
Early Respondents	0.075	0.400	0.450	0.075
Late Respondents	0.125	0.333	0.500	0.042

Table 8.4: 95% Confidence Intervals for Differences in Proportions

Large Companies		Medium Companies		Small Companies	
Difference	**95% C.I. for Difference**	**Difference**	**95% C.I. for Difference**	**Difference**	**95% C.I. for Difference**
-0.05	(-0.205464, 0.105464)	0.0666667	(-0.175444, 0.308778)	-0.05	(-0.302555, 0.202555)
Confidence Interval based on normal approximation		*Confidence Interval based on normal approximation*		*Confidence Interval based on normal approximation*	
Note: The proportion of Micro sized companies were not compared due to small sample sizes					

8.3 CONCLUSION

It can be concluded that at 0.05 significance level (95% confidence interval), there is no evidence to suggest that there is a difference between Ealey respondents and Late respondents, in terms of their QMS maturity and Size (the proportions of Large, Medium, Small, and Micro sized companies), apparent differences notwithstanding. These apparent differences may be attributed to small sample sizes. Thus, it is concluded that there is no strong evidence to suggest that a response bias of Greece respondents exists (similar and even clear evidence of nonresponse bias exists for New Zealand and Australian respondents).

APPENDIX 8 TEST RESULTS ON THE ROBUSTNESS OF THE HYPOTHESISESD DIRECT EFFECTS ON QMS RESULTS

The purpose of this appendix is to review the robustness of the hypothesised theoretical model when direct effects of LDQMSP and Check are being induced on QMS Results. This appendix covers test results of a repertoire of models.

- Model 1 means the hypothesized theoretical model. For the convenience of the reader, the hypothesised theoretical model is shown below (Figure 9.1), which is of course a reproduction of Figure 3.2 in section 3.3.3 in Chapter 03.
- Model 2 (the fully augmented model or the saturated model) is obtained when Model 1 is being augmented by adding the two additional paths LDQMSP → QMS Results and Check → QMS Results.
- Model 3 is obtained when Model 1 is being augmented by the Check → QMS Results path only.
- Model 4 is obtained when the Do → QMS Results path is being replaced by the Check→ QMS Results path.

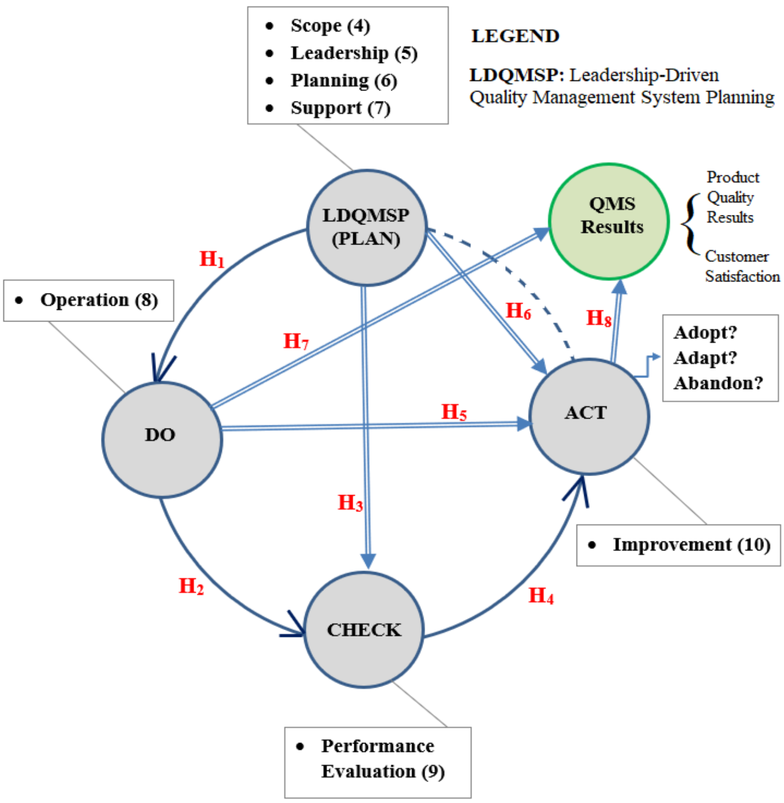

Figure 9.1: The hypothesised theoretical model (Model 1)

For the convenience of the reader, the path coefficients and their *p* values of Model 1 (details were given in Chapter 05) are shown in Figures 9.2 and 9.3 respectively.

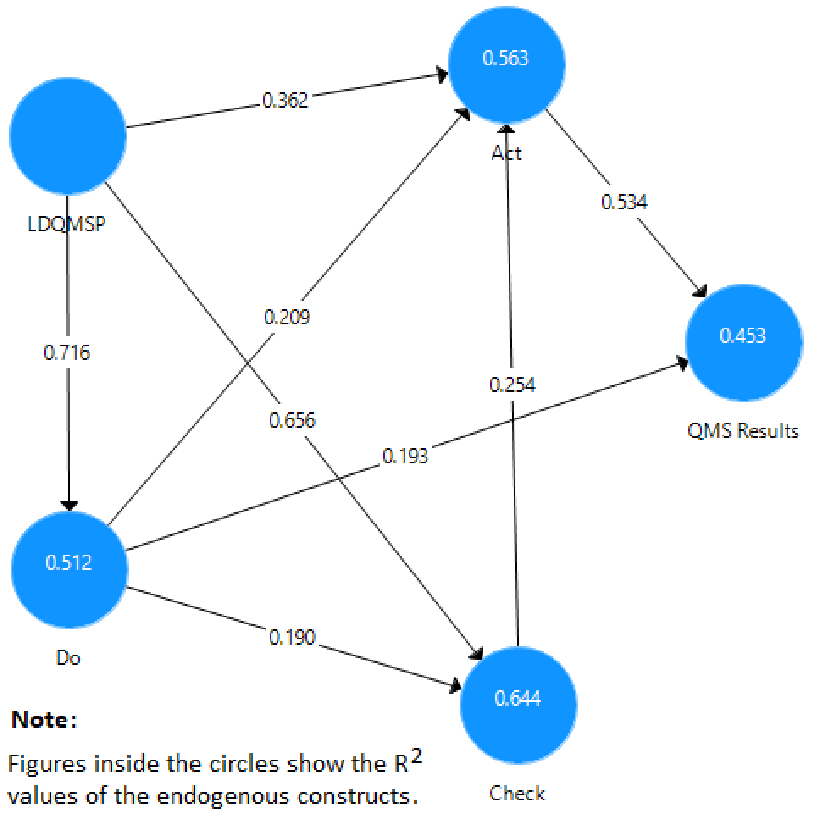

Figure 9.2: The path coefficients of Model 1

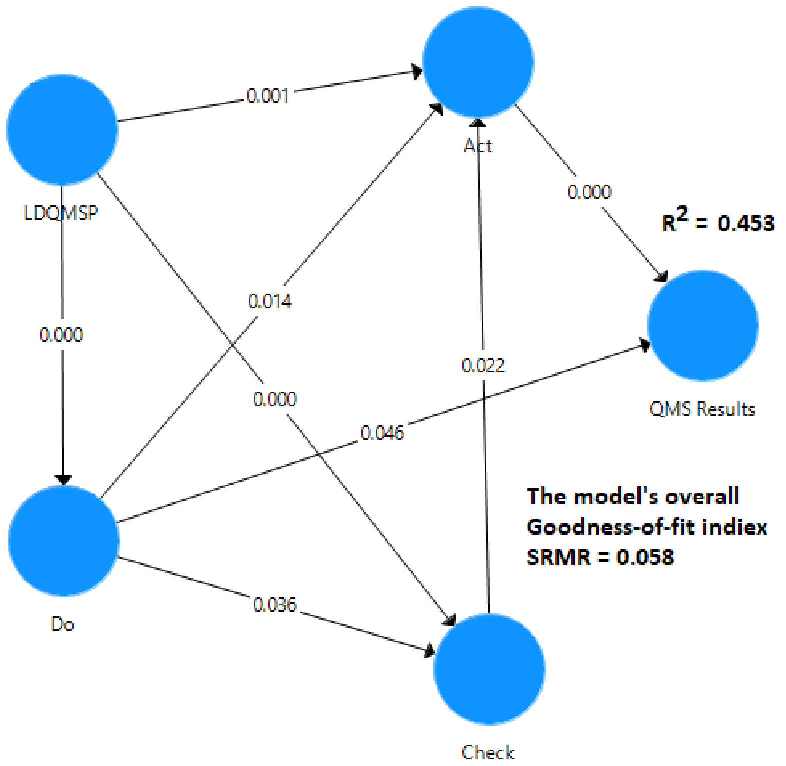

Figure 9.3: The *p* values of the path coefficients of Model 1

Based on the hypothesised theoretical model, only Do and Act have direct effects on QMS Results. One can always raise the question why LDQMSP and Check have no direct effect on QMS. Through conceptual reasoning, it is easy explain why LPQMSP should not directly relate to QMS Results. The answer is, as explained in the model development stage (section 3.3.2 in Chapter 03), no plan achieves results, unless the plan is being implemented (thus at least the Do stage is necessary for LDQMSP to bear fruit). However, the conceptual reasoning provided by the researcher on why Check should not be directly related to QMS Results (see section 3.3.2) can be challenged. The researcher argued that checking itself makes no direct impact on QMS Results, unless appropriate action is taken (this action comes only covered in the Act stage). Using the assertions of Deming, one can argue that a considerable amount of learning takes place at the Check stage — the very reason why Deming insisted on the word "Study" in favour of the word Check — and therefore, this learning can directly affect QMS Results (Deming, 1982; Gorenflo & Moran, 2011; Moen & Norman, 2010). The fully augmented model (Model 2) tested for the purpose of testing the robustness of the hypothesised theoretical model is shown in Figure 9.2. As mentioned earlier, the additional paths induced are LDQMSP→ QMS Results and Check→ QMS Results.

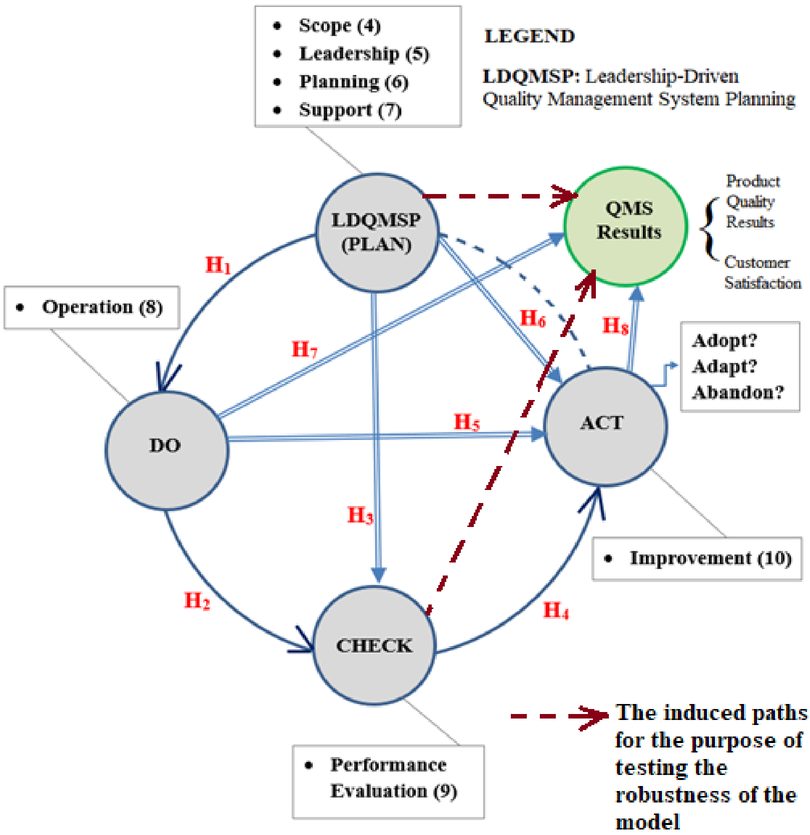

Figure 9.4: The fully augmented model containing the two induced paths

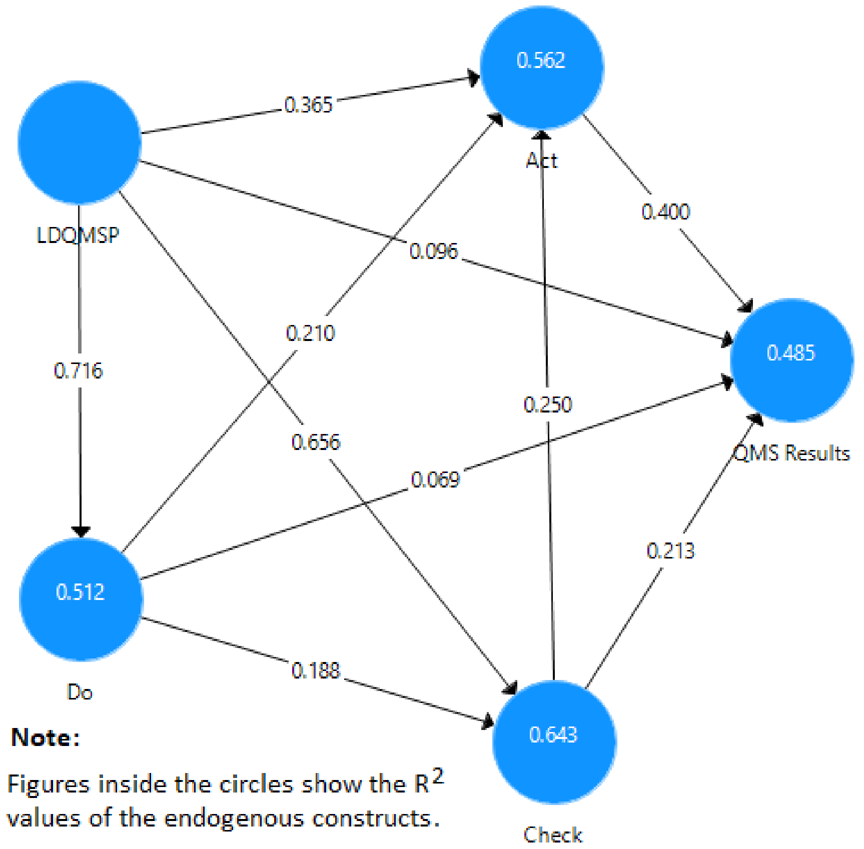

Figure 9.5: The estimated path coefficients of Model 2

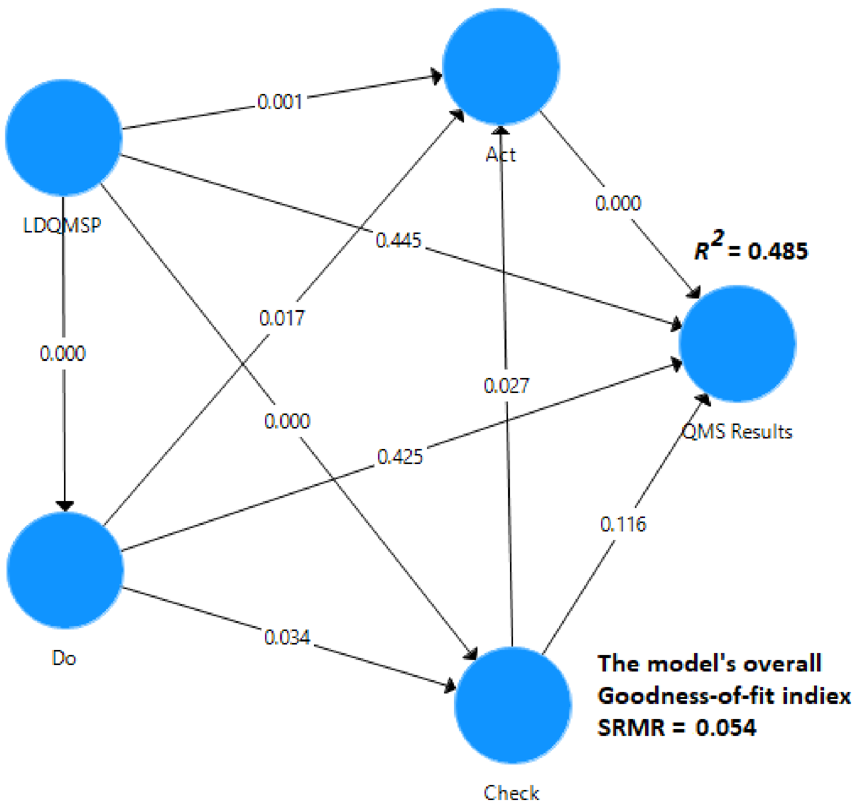

Figure 9.6: The *p* values of the path coefficients of Model 2

Figure 9.5 and 9.6 depict the estimated path coefficients of Model 2 and their *p* values respectively. Even though the R^2 of QMS Results of Model 2 (= 0.485) is greater than the R^2 of QMS Results in Model 1 (= 0.453), it is clear from Figure 9.6 that the *p* values of the induced paths LDQMSP → QMS Results (*p* = 0.445) and Check → QMS Results (*p* = 0.116) are nonsignificant at 0.05 significance level. Now however, the *p* value of the Do → QMS Results path (*p* = 0.425) also becomes nonsignificant. Therefore, it is necessary to progress from the saturated model containing all conceivable predictors of QMS Results (there are 4 predictors of QMS Results in a multiple regression sense) to a theoretically justifiable set of predictors of QMS Results. In the next step, the LDQMSP → QMS Results link is removed to form Model 3, because as mentioned earlier, it is easy to argue that LDQMSP → QMS Results link is theoretically unconceivable (no matter how good a plan is, one cannot expect results, unless the plan is being implemented via the Do phase within a PDCA framework).

Figure 9.7 and 9.8 depict the estimated path coefficients of Model 3 and their *p* values respectively. It is clear from Figure 9.8 that the Check→ QMS Results path now becomes significant (*p* = 0.019) but Do→ QMS Results path continues to be nonsignificant (*p* = 0.216). The overall goodness-of-fit of this model to data, in terms of the SRMR fit index is 0.054, which the same as the value returned for the saturated Model (see Figure 9.6). This result statistically vindicates the elimination of the LDQMSP → QMS Results on theoretical grounds. Furthermore, the results show that only two models remain in contention: Model 1 (the researcher's hypothesised model) and Model 4 (the hypothesised Do → QMS Results link being replaced by the Check → QMS Results link. Both models return statistically significant paths (see Figures 9.3 and 9.10). In addition, the estimated path coefficients of Model 4 are depicted in Figure 9.9. The 9.1 depicts the goodness-of-fit (GoF) indicators of the two completing models, along with the Lack-of-Fit F test generated by Minitab19 software within its multiple linear regression (MLR) module. The regression analysis concerning the Lack-of-Fit F test is based on the factor scores of constructs generated by Smart PLS software that performs the PLS-SEM method.

Table 9.1: The GoF Comparison of the Two Models Remaining in Contention

Model	SRMR (Global fit)	The R^2 of QMS Results	Comments on Multiple Linear Regression Results (MLS) Based on the Factor Scores of the Response QMS Results and its Predictors*
Model 1	0.058	0.453 (i.e. 45.3%)	Based on the results shown in Table 9.2, this model does not show lack of fit (F = 0.95; p = 0.695)
Model 4	0.054	0.478 (i.e. 47.8%)	Based on the results shown in Table 9.2, this model shows a significant lack of fit (F = 2.51; p < 0.001)
* In Model 1, the predictors of QMS Results are Do and Act, while in Model 4, the predictors of QMS Results are Check and Act			

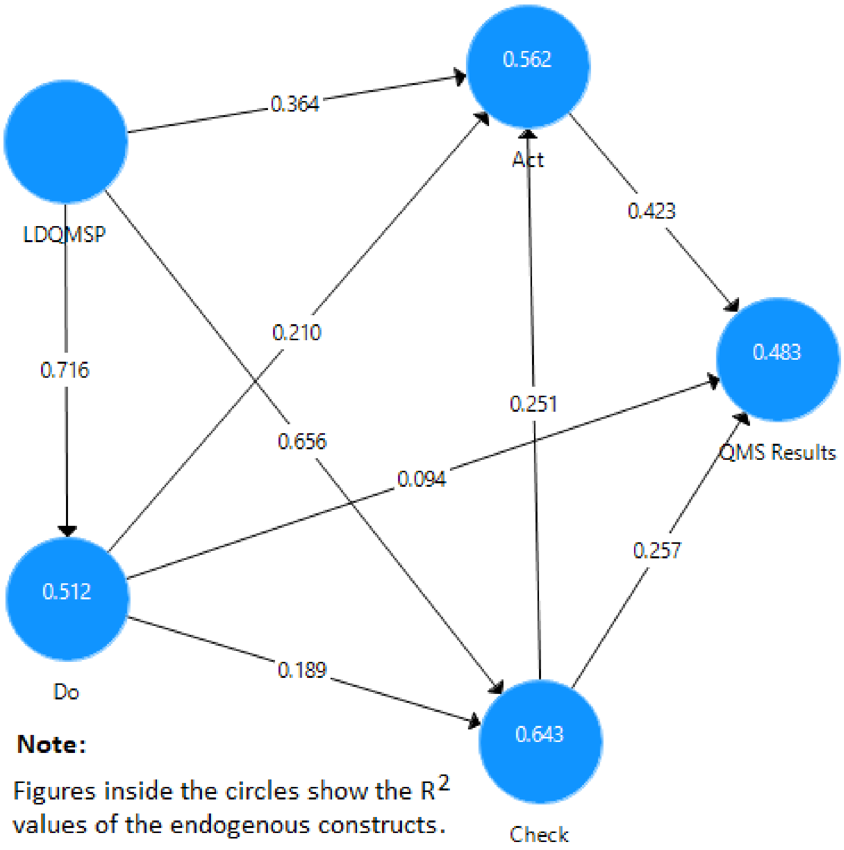

Figure 9.7: The estimated path coefficients of Model 3

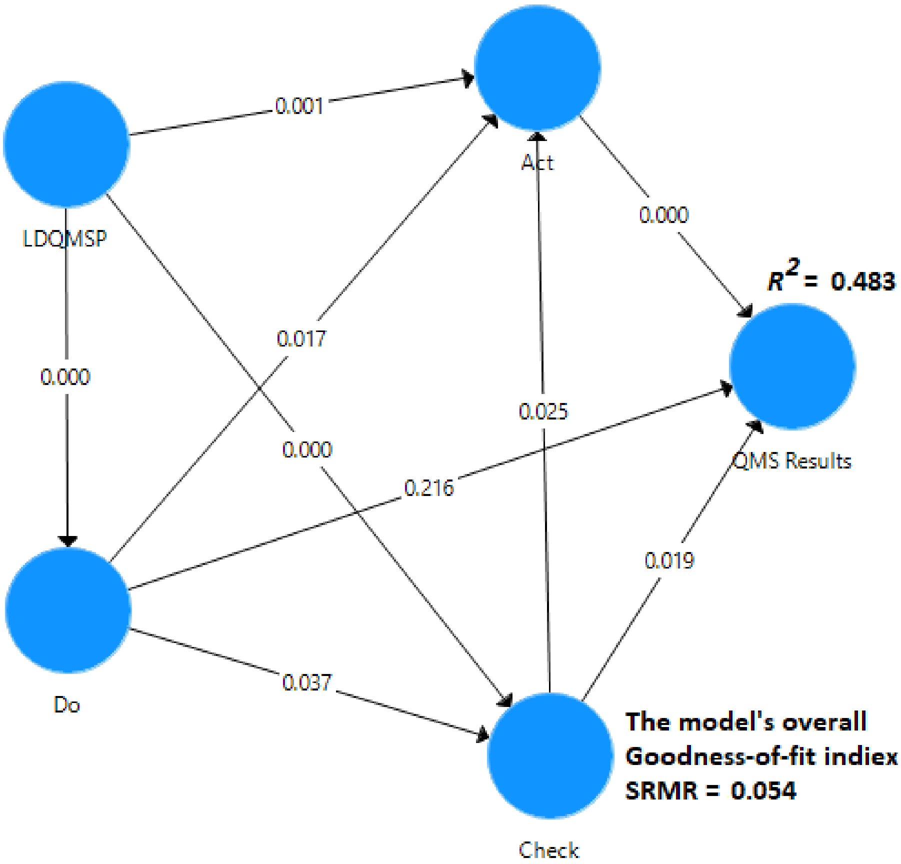

Figure 9.8: The *p* values of the path coefficients of Model 3

Based the figures reported in Table 9.1 on the overall (global) GoF indicator SRMR and the R^2 of QMS Results, it appears that Model 4 is a better fit to data than Model 1. In particular, the R^2 of QMS Results of Model 4 is 2.5% higher than that of Model 1. Unfortunately, unlike CBSEM, PLS-SEM is not a very good method for testing two competing models (Hair, Jeffrey, Sarstedt, & Ringle, 2019; Rönkkö, McIntosh, Antonakis, & Edwards, 2016). For this reason, the factor scores generated by the PLS-SEM method were used to perform a standard MLR anaysis to determine whther or a Lack-of-Fit could be detected either in Model 1 or Model 4.

Table 9.2 depicts the results of MLR. Minitab 19 software was chosen to perform MLR because IBM SPSS software does not report Lack-of-Fit F test results within its MLR module. From the results reported in Table 9.2, it is clear that Model 1 is superior to Model 4 because unlike Model 4, Model 1 does not have a significant Lack-of-Fit, even though the R^2 of the former is about 2.5% higher than the latter, a fact onserved via PLS-SEM anaysis also. A Lack-of-Fit of a regression model basically indicates that the model is inadequate to describe the data (Aerts, Claeskens, & Hart, 2000). One possibility is that Check and Act is related to QMS Results in some nonlinear way, based on the data. In the balance, it is concluded that Model 1 is superior to Model 4.

Table 9.2: Minitab 19 Multiple Regression Results on the Two Competing Models

Model 1

Regression Equation

QMS Results = 0.1927 Do + 0.5336 Act

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Do	0.1927	0.0636	3.03	0.003	1.68
Act	0.5336	0.0636	8.39	0.000	1.68

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.743141	45.26%	44.77%	43.23%

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	103.637	51.8187	93.83	0.000
Do	1	5.072	5.0724	9.18	0.003
Act	1	38.889	38.8885	70.42	0.000
Error	227	125.363	0.5523		
Lack-of-Fit	226	124.780	0.5521	0.95	0.695
Pure Error	1	0.583	0.5827		
Total	229	229.000			

Model 4

Regression Equation

QMS Results = 0.2933 Check + 0.4572 Act

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Check	0.2933	0.0653	4.49	0.000	1.85
Act	0.4572	0.0653	7.00	0.000	1.85

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.726455	47.69%	47.23%	45.52%

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	109.20	54.6019	103.46	0.000
Check	1	10.64	10.6390	20.16	0.000
Act	1	25.85	25.8525	48.99	0.000
Error	227	119.80	0.5277		
Lack-of-Fit	181	108.78	0.6010	2.51	0.000
Pure Error	46	11.01	0.2394		
Total	229	229.00			

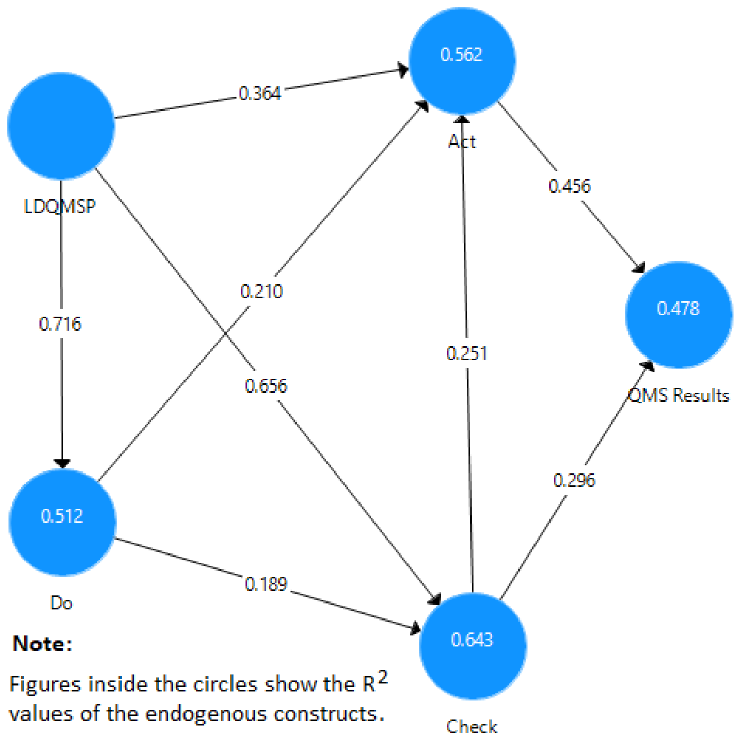

Figure 9.9: The estimated path coefficients of Model 4

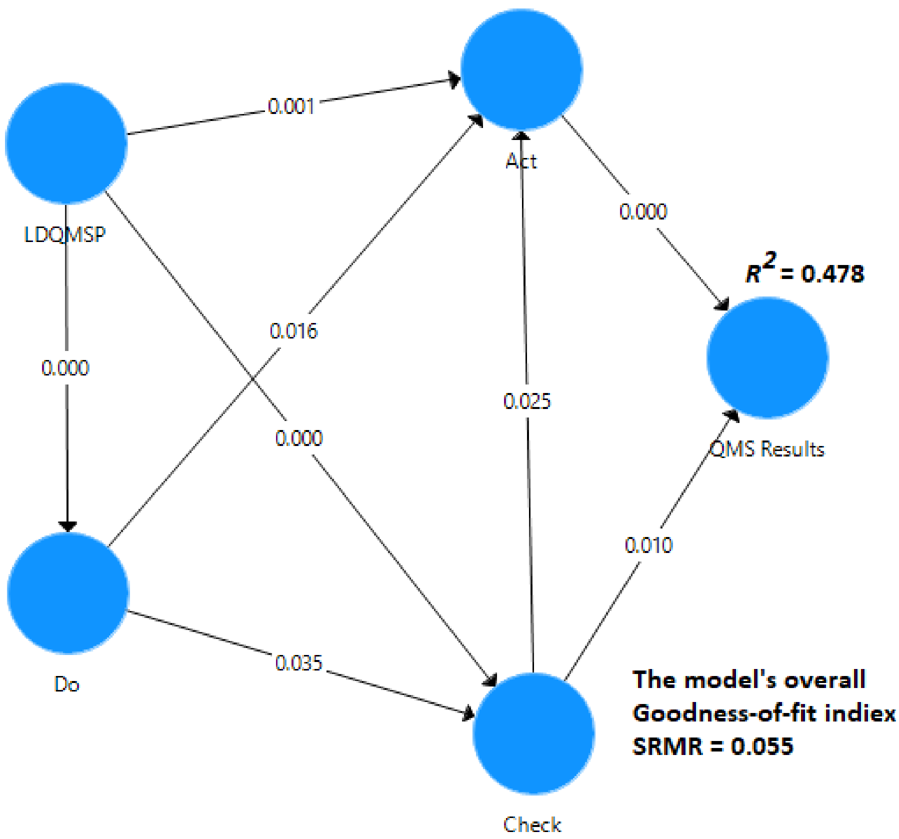

Figure 9.10: The *p* values of the path coefficients of Model 4

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