A Generative Research Methodology for Implementing TQM in Small and Medium-sized Manufacturing Enterprises

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Abstract

Many researchers and practitioners have acknowledged the need to investigate the relationships amongst various criteria of implementing total quality management (TQM) in small and medium-sized manufacturing enterprises (SMMEs). There is a need to have practical research methodologies that take cognisance of the peculiarities of SMMEs and impact on their quality management practices in developing countries. This paper presents the theoretical foundation of a proposed Generative Research Methodology and configures the specification of a TQM implementation framework in SMMEs. The methodology combines rigorous research approaches, builds theory based on the dynamics of the environment and the firms' characteristics and incorporates various TQM criteria into the design of the framework. It synchronises inductive and deductive research methods in three phases and uses various means to acquire empirical evidence and examine the dependent and independent variables of TQM implementation. It is anticipated that the methodology could help SMMEs to develop, analyse and evaluate the framework for attaining quality performance goals.

Key Words: TQM, SMME, Generative Research Methodology

1. Introduction

Total quality management (TQM) is one of the most prominent operations management approaches [1]. However, there exists confusion in relation to definition, circumstances and

application, resulting in no comprehensive conceptualisation of TQM [2]. Because of having no universally accepted model for implementing TQM, its success is dependent largely on the alignment with the inherent characteristics and culture of an organisation [3,4]. Ho [5] describes TQM as a philosophy that fosters continuous improvement through a systematic, integrated, consistent, organisation-wide perspective involving everyone and everything. It focuses primarily on total satisfaction for both internal and external customers within a management environment that seeks continuous improvement of all systems and processes. There is also few published work involving the understanding of the dynamics of TQM in organisations [6]. Ahire *et al.* [7] argue that contemporary quality management literature lacks scientifically developed and tested constructs. Ahire and Ravicandran [1] add that there is a scarcity of research addressing the fundamental understanding of the cause-effect relationships among TQM constructs in the context of manufacturing and service operations. As a result, the implementation of TQM has become a challenge for many enterprises particularly small and medium-sized manufacturing enterprises (SMMEs).

According to Sila and Ebrahimpour [4], there has been no universally accepted TQM model and a lack of information about the nature and stage of TQM implementation endemic to specific regions of the world. Yusof and Aspinwall [8] also argue that many TQM frameworks have been primarily developed for large companies. Ahsok and Santhakumar [9] contend that the TQM implementation in SMMEs should be based on "managing quality at product level, process level and people level". Leonard *et al.* [10] argue that existing quality management models lack both a strategic formulation influence and a dynamic influence for TQM in organisations. It is expected that TQM systems could be developed in the least possible time frame using limited resources, and function on tactical, operational and strategic levels [6, 11]. In order for SMMEs in developing countries to implement TQM systems that would help build their positions vis-?-vis competitors, there is a pressing need for practitioners and researchers to adopt appropriate research methodologies for attaining this goal. The methodologies would help SMMEs to acquire knowledge of internal workings involving the interaction of the various functional processes in additional to the understanding of both socio-political and technical issues [10, 12].

Hill and McGowan [13] argue that traditional research approaches are not suited to management research. It is imperative to embark on an in-depth research programme which not only is qualitative, but also manifests much of the ethnographic tradition. Nachmias and Nachmias [14] advocate a process of systematic enquiry that is concerned with seeking solutions to problems and answering research questions in logical and scientific ways. A

qualitative methodology using ontological, epistemological and axiological approaches could be useful. This paper aims to propose a generative research methodology (GRM) for SMMEs for the development, analysis and evaluation of TQM implementation frameworks. The formulation of a Network Development Plan (NDP) is discussed, and the use of ethnographic research, analytic hierarchy process (AHP), and structural equation modeling (SEM) techniques is elaborated. It is recommended that the GRM can be used as a useful means for building and evaluating TQM practice in SMMEs.

2. Literature Review

Research in statistical quality control has evolved in a scientific and rigorous fashion, but the study of quality management has not evolved in a similarly rigorous fashion [15]. Ahire and Ravichandran [1] grouped published information on TQM implementation frameworks into three categories, namely 1) prescriptive teachings of quality experts such as Deming and Crosby; 2) quality standards (e.g. ISO 9000) and quality awards (e.g. the Baldrige Award); and 3) scholarly academic research that strives to conceptually and empirically elicit the components of quality management and their linkages to performance. While the first two categories are useful in stimulating firms' efforts in quality implementation, the differential abilities and successes of individual firms to benefit from TQM cannot be fully explained by these prescriptions. The third category contributed to the understanding of TQM implementation and possible interrelationships among the operational elements, but it is not clear how the use of TQM tools is affected by the "tacit behavioral and cultural elements" [1]. There is the scope for research in the development and testing of models that involve the systematic and effective implementation of ISO 9000 and TQM simultaneously [4].

Moreover, Ahire and Ravichandran [1] contend that the majority of studies on TQM implementation "were not driven by theory, and focused on identifying the relationships among TQM constructs and then interpreted these relationships using a variety of theoretical lenses". Wilson and Durant [16] state the need for more theory grounded and contingency based research rather than be restricted to deductive approaches. Forza and Filippini [17] also argue that there are "some shortcomings in the research on TQM and in particular the lack of adequate theoretical formulation suitable for empirical research. A possible reason for this is that management research has predominantly based on deductive theory testing and positivistic research methodologies [18]. These approaches fail to give deep insights and rich

data into TQM in practice within organisations [12]. As such, these methods alone will not adequately capture the complexity and dynamism of enterprise operations. Wilson and Durant [16] state the need for more theory grounded and contingency based research rather than be restricted to deductive approaches.

Leonard and McAdam [12] suggest that ethnography be used within grounded theory, "where researchers actually participate in TQM-based organisational change programmes to gain greater insights into the issues". Many authors (e.g. [19-21]) argue that case studies are especially appropriate within grounded theory methodology where real-life contexts are being investigated over a period of time. Yin [19] indicates that case studies are preferred when "how and "why" questions are being posed. Case studies allow for a more detailed documentation of practices and the explanation of findings on a more comprehensive basis [21].

Moreover, the implementation of TQM in SMMEs involves making complex multi-criteria decision problems. The AHP methodology has been proposed in recent literature as an emerging solution approach to dynamic, complex real world multi-criteria decision making problems [22]. The AHP methodology offers a means by which this could be done by organising, feelings, intuition, and logic in a structured approach to making decisions, which proves beneficial in an environment that has predominantly intangible attributes [23]. AHP enables one to structure a system and its environment into mutually interacting parts and then to synthesise them by measuring and ranking the impact of these parts on the entire system [23, 24].

Furthermore, hypotheses can be made with respect to direct and indirect casual effect among the different TQM criteria, taking the form of path, measurement and hybrid structural equation models [25]. Table 1 depicts the key features of these three models. SEM depicts causal relationships within a set of variables, and looks at how well a proposed set of relations explains the pattern of covariance among the set of variables. According to Bozionelos [26], the SEM technique examines relationships between and among one or more dependent variables and two or more predictor or independent variables. The relationships between these theoretical variables and factors are represented by regression or path coefficients between the variables. Its advantages include that 1) complex relationships among variables can be depicted with a single model, 2) total effects of cause variables on effect variables can be calculated and compared, and 3) the significance of complex models that are based on series of regression analyses or structural equations can be assessed [26].

Table 1. Main features of path, measurement and hybrid structural equation models

Models	Main features
Path Models	The models represent presumed causal relations among observed variables. The analysis of causal relations with the basic datum is the covariance, which includes correlation. The overall goal of a path analysis is to estimate causal versus non-causal aspects of observed variables
Measurement Models	These models feature the distinction between observed variables (indicators) and the underlying latent variables (constructs) that the indicators are presumed to measure. The models allow a multiple-indicator approach in the measurement of variables. Theory sets the stage for making predictions about the relations of indicators to each other based on the hypothetical constructs they are presumed to measure.
Hybrid models	The models can be viewed as syntheses of path and measurement models. As in path analyses, the specification of a hybrid model allows test of hypotheses about direct and indirect causal effects It incorporates a measurement model that represents observed variables as indicators of underlying constructs.

Source: Based on Kline [25]

3. Development of Generative Research Methodology

Many recent studies used grounded theory and abstract concepts to describe and analyse a series of general phenomena based on practical experience [27, 28]. Simon *et al.* [21] suggest a generative model for structuring and chronologically ordering the combination of qualitative and quantitative methods. Leonard and McAdam [12] contend that the generative approach is a rigorous base for building, testing and establishing TQM theory and practice while contributing to the organisation's TQM change effort. Table 2 contrasts the differences amongst inductive, deductive and generative approaches. The purist deductive and inductive research methods could be integrated into the generative approach in different stages of TQM implementation in SMMEs.

Table 2. Contrasting the differences amongst research approaches

Stages	Purist Deductive	Purist Inductive	Generative Approach
1. Theory	Develop theoretical framework	Area of enquiry identified but no theoretical framework	Develop theoretical framework based on constructs
	Variables identified for relevant constructs	Respondents identify constructs and explain the relationship between them	Some variables identified for relevant constructs- others can be identified by respondents
2. Instrument	Develop instrument	Broad themes for discussion identified	Researcher converts a priori theoretical framework into theoretical questions.
3. Data collection	Respondents give answers to specific questions	Respondents discuss general themes of interest	Respondents discuss the seemingly general questions and identify constructs which are meaningful to them and explain the relationships
4. Analysis	Answers analysed in terms of prior theoretical framework	Researcher develops theory on a purely inductive basis	Respondent data analysed according to existing theory; Or, theory is developed on an inductive basis and deductive basis without regard to existing theory.
5. Outcome	Theory tested according to whether hypotheses are accepted or rejected	Theory developed	Either Existing theory is adapted; Or, Alternative theoretical framework is presented

Source: Based on Simon *et al [21]*

A generative research methodology attempts to integrate purist inductive and deductive research, and provides a holistic picture in a unique way to generate quality data. By combining the grounded and empirical-based research, this paper introduces a 3-phase GRM for TQM implementation in SMMEs in the developing countries with reference to those in the Caribbean (see Figure 1).

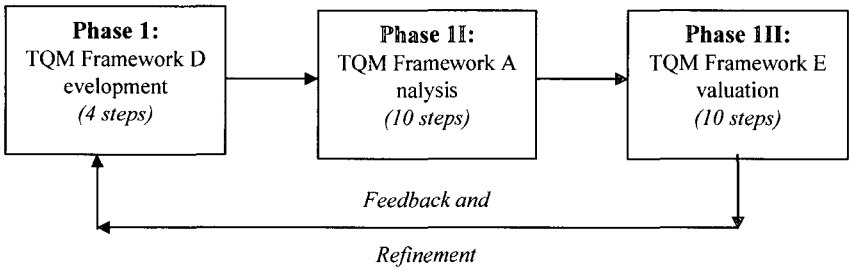

Figure 1. A 3-phase GRM for TQM implementation

3.1 Phase I: TQM Framework Development

In Phase One, a priori constructs and their underpinning theories consistent with TQM implementation and practice are determined through a literature review. Initially, existing theory from the literature is used to develop the theoretical framework in which constructs and some variables are identified for TQM implementation in SMMEs. This phase intends to determine 1) the quality management principles; 2) the hard and soft TQM factors; 3) the TQM criteria; 4) the barriers to TQM implementation, and 5) the characteristics of TQM implementation frameworks. The findings are used to formulate a network development plan (NDP) that involves the collection, verification and analysis of company data for meeting the ISO 9001:2000 standard. The logic flow of the development of TQM framework constructs is given in Figure 2.

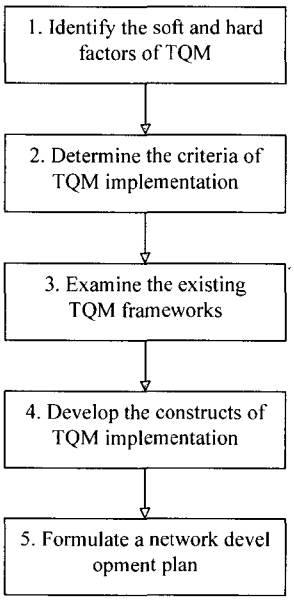

Figure 2. The development of TQM framework constructs

The NDP combines the TQM criteria with the compliance requirements of ISO 9001:2000 standard and includes the key activities and interrelationships required for certification. Some inherent characteristics of SMMEs would affect the NDP process to attain TQM goals. These include poor time management, resource constraints due to competition for resources resulting in overloading of employees, inadequate control and unclear goals and tasks to be performed [29]. Ghobadian and Gallear [30] suggest that an introduction of ISO certification process requires management to identify the nature and type of change required; plan and implement the necessary change; and have the desire and patience to see the change through. Besides, the implementation of NDP applies the concepts and techniques of project management [31].

3.2 Phase II: TQM Framework Analysis

The second phase combines ethnographic research, case studies and AHP methodology in developing grounded theory of TQM implementation. This encompasses several steps that help practitioners/researchers to use the NDP for adopting, implementing and maintaining ISO 9001:2000 quality system in SMMEs [32]. Using a combination of non-participant observation, participant observation and in-depth discussions, this phase seeks to refine theoretical framework and examine the effectiveness of TQM implementation. The data obtained would be analysed with TQM implementation factors in SMMEs. An AHP model is proposed to facilitate the investigation of the TQM status in SMMEs. Different levels of criteria are constructed in a hierarchical structure and used to compare the opinions of the combined judgments. Organising criteria in a hierarchy serves two purposes: 1) it provides an overall view of the complex relationship inherent in the situation; and 2) it helps decision makers assess whether the issues in each level are of the same order of magnitude, so homogeneity in comparisons is preserved [22]. The AHP findings help to identify and determine normalised criteria required for effective TQM implementation. Figure 3 shows the various steps involved in Phase II.

3.3 Phase III: TQM Framework Evaluation

The results obtained from the previous two phases are used to examine the hypothesised relationships amongst the TQM constructs and variables. In order to determine the pattern of covariance and causal relationships amongst variables, the third phase adopts the structural equation modeling techniques via the path, measurement and hybrid models. The specified and identified and data are collected, and the analysis of findings would assist practitioners/researchers to refine their NDP in SMMEs. A diagrammatic representation of the

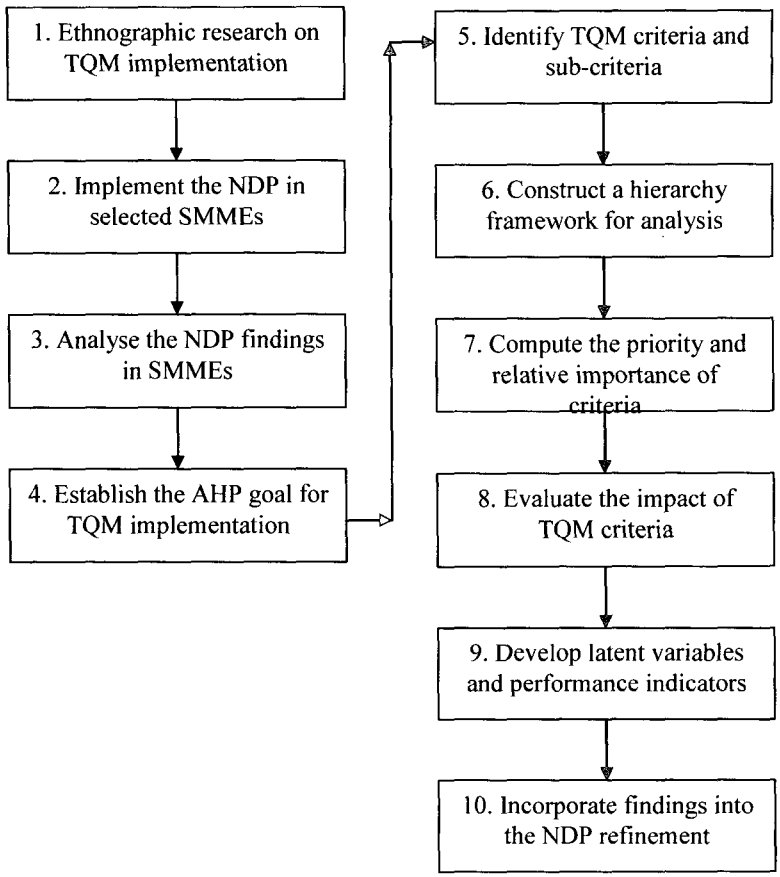

Figure 3. Steps of the TQM framework analysis

TQM framework evaluation processes in Phase III is given in Figure 4.

4. The TQM Network Development Plan

In the first phase of framework development, the network development plan incorporates various TQM criteria and interweaves them with the compliance requirements of the ISO 9001:2000 standard. The plan is formulated to help practitioners identify interrelation amongst the tasks, and provide a valuable benchmarking tool in achieving ISO 9000 certification [31]. The NDP process goes through four stages, namely 1) top management commitment, 2) gap analysis, 3) system deployment, and 4) continual improvement (see Figure 5). Individual stages are described below.

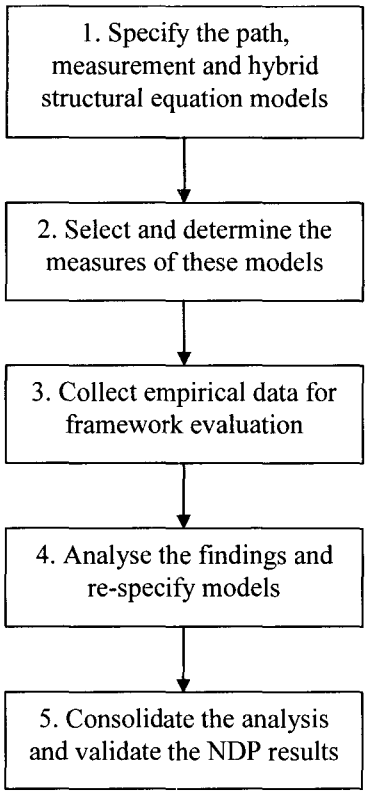

Figure 4. The TQM framework evaluation processes

4.1 Top Management Commitment

Top management need to take the leadership role in initiating the TQM process, and ensure their commitment through: 1) determining a direction of the organisation by establishing a quality policy as well as quality objectives; 2) communicating the quality policy and objectives, at appropriate levels in the organisation; 3) making decisions based on a wide range of knowledge and information; 4) monitoring the effectiveness of the quality policy and objectives against company performance; 5) identifying the need for changes to match company growth, business environment and customers' perceptions; and 6) ensuring the availability of necessary resources to achieve quality objectives.

4.2 Gap Analysis

The gap analysis assesses the current situation with respect to the people, products and

processes, and if the required objectives for improvement are set. A process approach is used to determine where the organisation is, where it wants to go and how it must get there. The main tasks of this stage are to 1) identify the processes, the sequence and interaction within the organisations; 2) identify inter-communication processes with the customers; 3) determine the necessary inputs, including information; 4) allocate adequate resources to support the operations; 5) use appropriate specifications, methods and documents for the realisation of the outputs; and 6) define planned and achievable results. Taskforce and/or project teams need to be formed to analyse the root causes of problems and identify possible solutions. It is essential that top management commit to the development with active participation in the formulation and finalisation of these objectives.

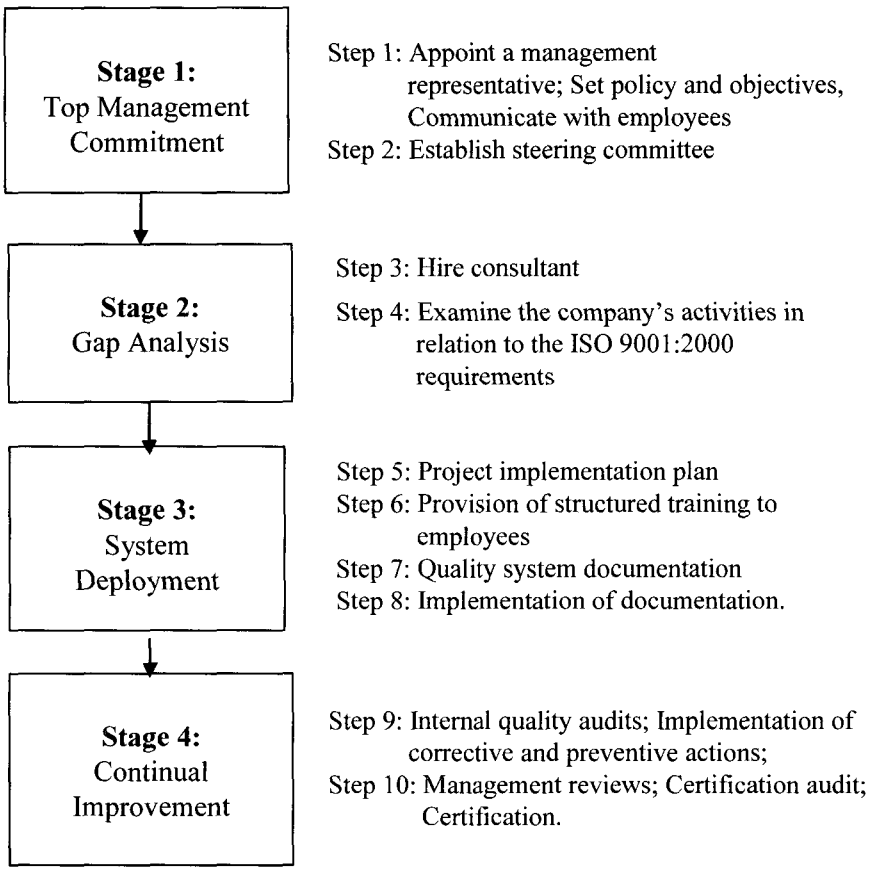

Figure 5. Four stages of the NDP process

4.3 System Deployment

At the stage of system deployment, the procedures and objectives that have been documented must be deployed and implemented throughout the organisation. These ensure that 1) the required resources are provided to implement and maintain the quality management system (QMS) and enhance customer satisfaction by meeting customer requirements; 2) ensuring that the required infrastructure and work environment achieve conformity to product requirements, the sequence and interaction of the processes of the QMS; 3) TM actively involve in the deployment and implementation audit of policies and associated strategies; 4) employees involve in the strategy/objective implementation process; 5) sound inter- and intra-communication is in place; 6) customer feedback is obtained; 7) personnel performing work affecting product quality is competent on the basis of appropriate education, training, skills and experience; 8) the design and development of quality products is being monitored; 9) the performance of the processes are being monitored; and 10) appropriate records are established and maintained.

4.4 Continual Improvement

The ISO 9001:2000 standard recommends that management should continually seek to improve the effectiveness and efficiency of the processes of the organisation, rather than wait for a problem to reveal opportunities for improvement [33]. Management should create a culture that involves people actively seeking opportunities for improvement of performance in processes, activities and products. Two fundamental ways to conduct continual improvement are: 1) breakthrough projects which either lead to revision and improvement of existing processes or the implementation of new processes; these are usually carried out by cross-functional teams outside routine operations; and 2) small step ongoing improvement activities conducted within existing processes. In this stage, customer requirements need to be determined and fulfilled with the aim of enhancing customer satisfaction. TM should ensure that their responsibilities, authorities and interrelation be defined and communicated within the organisation. The culture of the organisation should be determined and appropriate programmes be aligned to bring about the necessary changes and ensure the effectiveness and efficiency of the QMS processes.

5. The AHP Analysis of TQM Attributes

The TQM framework analysis phase of the GRP uses the case study approach and AHP

methodology to determine the extent to which: 1) TQM is implemented in SMMEs after obtaining the ISO 9001:2000 registration; and 2) the soft and hard criteria of TQM have been implemented in these firms. In addition, the dynamics of TQM in SMMEs would be researched in that a comparison would be made with respect to various stages of implementation. This allows for hypotheses to be made regarding the interrelations among TQM constructs and their associated indicators. Relevant and important performance attributes are structured into a hierarchy descending from the overall goal to the various criteria, sub-criteria and sub-sub-criteria in successive levels (see Figure 3). Invited evaluators (including industry experts and/or knowledgeable personnel) are asked to evaluate carefully the criteria of each hierarchy level by assigning relative scales in a pair-wise fashion with respect to the goal. Pair-wise comparison is a key step to determine priority weights of factors and provide a rating for alternatives based on qualitative factors. The procedure focuses on two factors at a time and their relation to each other with respect to the goal, so decision-makers will be more comfortable to offer relative (rather than absolute) preference information [22,34].

A nine-point scale was used to assign the relative scales and priority of weights of criteria [34]. Priority means the relative importance or strength of influence of a criterion in relation to a criterion that is place above it in the hierarchy. The normalised eignenvalues method has been recommended when the data is not entirely consistent [34, 35]. Since the levels or hierarchies are interrelated, a single composite vector of normalised weights for the entire hierarchy would be determined, using the vector of weights of the successive hierarchy. The geometric mean of evaluators' scores combines the pair-wise comparison judgement matrices. The weights of the criteria and its sub-criteria would be derived in a similar fashion. The process would continue until all comparison judgement matrices were obtained. Both local priorities (that is relative to the parent elements) and global priorities (that is relative to the goal) are generated. These are represented by total and sub-total percentage of priority scores.

6. The Modeling of Framework Evaluation

In the third phase, the GRM uses SEM to examine the causal relationships of TQM variables. The specification of TQM framework evaluation is guided by a combination of theory and empirical results through testing of hypotheses about variables (see Figure 4). The strong theoretical guidance is essential for the specification of SEM models of TQM

implementation that is provided in the previous phases. The causal relationships can be used to specify the structural equation models. The calculations are made to determine whether the variables are identified. Measures or indicators of latent variables are then selected. A hybrid framework that combines path and measurement models can be developed. Cross-sectional survey research methods are used for its data fitting properties, which refers to whether the model fits the particular set of data on which it is based. Causal path modeling does not depend on the statistical techniques used, but on rigorous research design. Therefore, the analyses evaluate and re-specify the model with respect to the data collected.

7. Discussion and Conclusions

The implementation of TQM in SMMEs requires complex real world decision making, planning and monitoring. It is essential for the implementation to address the continual improvement of an organisation's people, products and processes. In order to understand the causal relationships amongst the various criteria of TQM, many researchers and practitioners have recommended that both qualitative and quantitative methodologies be used. Unfortunately, there is no universe framework for SMMEs that specially addresses their problems and maximise the benefits in implementing TQM. It is suggested that an integrated research approach could combine inductive and deductive research methods for investigating the TQM implementation. This paper proposes the generative research methodology and introduces a hybrid TQM implementation framework for SMMEs with reference to those in the developing Caribbean.

The methodology combines the grounded and empirical-based research and has 3 phases of implementation. It is proposed that causal relationships amongst the multi-criteria of TQM be determined during the first phase of TQM framework development. How these criteria interact to effect implementation is then researched in the second and third phases of the GRM in SMMEs. The analysis phase employs ethnographic research and case studies, and the implementation of the NDP uses project management techniques. The exiting theory found in the literature is incorporated into the design an AHP model for analyse the causal relationships amongst dependent and independent TQM variables. This is done by acquiring the data, experience, insight and intuition from practitioners to determine the relative importance of the various TQM criteria represented in a hierarchical model. The percent parity of achievement of each level of criteria is calculated which determining the extent to which TQM is to be implemented in case studies.

The GRM stresses practitioner involvement and uses observation methods and in-depth interviews. Using a combination of inductive reasoning during the case studies and deductive reasoning from the results of the AHP analysis, it is possible to specify the constructs and their measurable indicators. This enables participants to tell "real" stories and permits the acquisition of insights and data into the requirements needed for effective implementation of TQM in SMMEs. The methodology combines the benefits of various techniques in such a way as to complement each other in specifying a hybrid framework for TQM implementation. This gives a deeper insight into the theory of generative research methodology that is substantiated through positivist/ quantitative methodologies.

Future research would validate the TQM criteria and elements identified for SMMEs of different operations nature in developing countries collectively. More work would be made on the development of the GRM and the hybrid TQM implementation framework. Their applicability could be extended to different industry sectors whereby new attributes and elements could be included. Longitudinal study, industry surveys and interviews would be conducted to acquire empirical data and evidence. Moreover, in order to reveal sector-specific characteristics, it is recommended that comparative evaluations of the GRM and the hybrid TQM implementation framework be conducted across various manufacturing sectors in the context of SMMEs.

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