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Understanding Quantitative Approach in Management Science Research: Issues and Policy Options

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Abstract

Quantitative approach is central to current discussions in management science research. For some, management science research is less quantitative. For others, management science research adopts quantitative approaches. Faced with this major research contention, and while there is now a considerable and diverse scholarship on quantitative research methods, including questions of data collection, and analysis, focusing on gathering numerical data and generalizing it across group of people or to explain a particular phenomenon, the practical implications or application of quantitative approaches in management science are still contested as little is known among scholars about the specific empirical or quantitative approaches in management science. The objective of this study is to to fill this gap. The study discusses and clarifies quantitative approaches in management science research. It builds on content analysis methodology and reviews quantitative method, which emphasizes objective measurement including statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by computational techniques. Findings among others, show that management science adopts quantitative approach. In the alternative, the paper contributes to the understanding of quantitative approach by addressing the relationship between management science and quantitative approaches, and also with policy makers and researchers involved in the debates about the role of quantitative research in management science for future research. Conclusion shows how the study will help better understand the importance of quantitative management science for researchers and policymakers.

Keywords: *Research, Quantitative Approach, Management Science, Empirical Study, Methodology*

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Background to the Study

The scientific study of organizational or institutional relations as well as problem solving, patterns of human and material resource use for the attainment of organizational goals and outcomes have been the primary focus of management science. Nolen, (2010) highlights that management science initially included any application of science to management problems or to the process of management itself; it thus encompassed operations research, systems analysis, and the study of management-information systems. Pinney and McWilliams (2019) elaborate that management science is also concerned with issues of soft-operational analysis, which examines methods for strategic planning, strategic decision support, and problem structuring methods (PSMs). Thus, management or managing is the administration of an organization, whether a business, government or its agency or a non-profit organization. Management includes various activities or strategies of an organization and how such strategies are coordinated through collective efforts to actualize set objectives using available resources such as human and material. Henri Fayol posits that to manage consists of six functions; forecast, plan, organize, command, co-ordinate and control.

In the past, management science research has often taken a less quantitative approach, premised on assumptions about organizational performance and decision (Albers,1973; Kamlesh and Solow, 1994). Such non- quantitative view of management necessarily results in a superficial and limited analysis. This in turn leads to the exclusion of certain perspectives of organizational administration such as, coordination, interactions, and analyses. Such superficiality has led to a framing of issues that have tended to ignore questions of objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, surveys, or deploying pre-existing statistical data using computational techniques to analyze key themes of management. This paper is concerned with quantitative approach. It discusses and analyzes quantitative research in management science and particularly, explores whether and how various quantitative measures could be understood in management science enquiry. Quantitative approach has both practical and policy implications, as certain individual and corporate interactions become empirically evaluated in management policy discourse. A greater attention to the debates surrounding quantitative approaches to management, and the various policy implications, create a more analytic and conceptual stance in management issues, one where a diverse range of perspectives may contribute, beyond qualitative analyses.

What then is quantitative research in management sciences? There is no consensus among scholars on the definition of quantitative approaches in management science. However, we may explore a few definitions. According to Earl (2010), quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques. Quantitative research focuses on gathering numerical data and generalizing it across group of people or to explain a particular phenomenon (Thompson,1982).

This study demonstrates that quantitative management research is important in contemporary management science scholarship. For instance, recently, Jean -Louis (2015) building on a review of Henry Fayol's scientific management treatise, explored the relevance of quantitative approaches drawing on its linkages with managers. Thus, recently, researchers around the world have increasingly explored the dynamics of quantitative management science (Kamlesh and Solow,1994; Achiru,2001; Waring,2016) including Frederick Taylor's scientific management and Lilian Gilbreth's psychology management to the use of various models, planning and decision making (Knowles, 1989; Kamlesh and Solow, 1994; Black, 1999). Several of these empirical studies have shown that in many contexts, management is essential for organizational performance, decision making and efficiency (Jones,1998; Luigi etal.2017). Much of the study highlight the growing importance of exploring the patterns of management science especially quantitative approaches rather than traditional approaches in management science research (Krajewski and Thompson,1981; Thompson, 1982; Samson and Daft,2005; Pinney and McWilliams, 2019).

Thus, following these studies, a number of management scientists have offered a greater potential for engagement with quantitative approaches including issues of precision, correlation, complexity, variability, models etc. (Stoner,1995; Deslands,2014), which have emerged in both the new quantitative research approaches and certain strands of management work including corporate management and similar relations. Against this backdrop, this paper asks what links are being forged in quantitative management sciences, what empirical and methodological common ground are established, and what are the prospects for and challenges of new types of interdisciplinary interaction? The paper focuses in particular on understanding the approaches to quantitative management science research and the implications of such approaches for advancing management science policy and practice.

A number of factors make quantitative approach important as the contribution of our study is in three folds. First, our review reveals the relevance of quantitative research. For example, quantitative approaches involve spatial and temporal dynamics developed in a detailed and situated analyses. In particular, quantitative methods are essential for new insights including empirical analysis as a way of explaining management trends across time and space.

Secondly, there is the growing understanding of changing contexts in contemporary management science following e-management, thus, the scientific study of management makes quantitative approach essential as both the process and outcome of human interactions, which link dynamics of organizational processes such as coordination as agency in organizational transformation, and particularly as part of management approach. Thus, quantitative approaches explore the relationship between various variables through systematic processes of empirical management analysis, where various variables (dependent and independent) are tested unlike experimental research, which tests causality factors.

Thirdly, the study demonstrates the evidence of quantitative research detailing its various merits and demerits, which contributes to the filing of research gaps in this area of inquiry. Although prior studies have considered quantitative research in management science by

examining some aspects of the inquiry (Thompson, 1982), the present study explores aspects of conducting quantitative research as well as the merits and demerits and identifies a new useful proxy that empirically deepens the understanding of quantitative research in management science. In particular, the study explores the emerging trends in quantitative management science debates focusing on understanding quantitative approach and in particular, exploring some key issues and policy options. The remainder of the paper is structured as follows; approaches and methods, conceptual framework, dynamics of quantitative research in management science, quantitative research processes, issues and policy options and finally conclusion.

Approaches and Methods

This paper adopts content review method to explore trends in quantitative research in management science. Content analysis has been defined as a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding (Krippendorff, 1989). This is a suitable approach as it offers deepened insight into the understanding of the various dynamics of qualitative research in management science. According to Krippendorff (1989:404), "the most obvious sources of data appropriate for content analysis are texts to which meanings are conventionally attributed: verbal discourse, written documents, and visual representation. Specifically, contents reviewed in our context include existing quantitative data detailing the processes, mechanisms and techniques in quantitative management science research procedure. Such studies were drawn from journal articles, policy papers, institutional documents and grey literature.

In reviewing these contents, the processes of conducting quantitative research including fundamental management issues in theory and practice, by a variety of scholars from a number of approaches and methods were explored as critical to understanding the relationships of inter -personal, social, political, and organizational processes. Such interlinkages are necessary to deepen investigation on review of quantitative management science research. Often influenced by a number of management models, a range of studies have emerged to demonstrate how for instance, content analysis debates about organizational performance, set goals, tasks and targets, or inter personal relationships influence the overall management performance, processes and outcomes (Samson and Daft,2005; Holmes,2012) and in particular, create new meanings in understanding quantitative research (Vilkaite-Varitone and Povilaitiene,2022). In early work in this field, management was seen as an element of or synonymous to administration. Henry Fayol highlights that management involves focusing, planning, organizing, commanding, controlling and coordinating systems, which are aimed at achieving organizational set goals and objectives. The actualization of these goals becomes the defining features of management. Scientific management theorists argue that management is a systemic process or organizational dynamics aimed at achieving organizational goals (Mathur and Solow,1994). This study sets to review a number of such discourses to make a new contribution in quantitative management research.

Conceptual Framework

A vast range of literature across various disciplines potentially adopts qualitative methods (Krajewski and Thompson,1981; Thompson,1982; Pinney and McWilliams,2019). To put some of the debates in the literature in proper perspective and in relation to the context of our study, conceptual clarification suffices. In what follows, a brief conceptual clarification on the concepts of management, corporate management and quantitative management will be explored.

Conceptual Literature: Management

The rise in scholarship on management science and new terminological issues have inspired scholars to focus more closely on studying management. Management is one of the most important fields of inquiry in organizational performance, particularly in contexts characterized by organizational or corporate efficiency. Conceptual clarification is important to distinguish management as activity in managing the affairs of an organization, firm or company from management as an academic field of inquiry.

As activity in managing the affairs of an organization, firm or company, management entails a wide range of corporate interactions and relationship including the structure of management or hierarchy involving "managers" or "management" -a specific group of individuals saddled with the responsibility of planning, budgeting, coordinating and controlling organizational performance in line to set goals and objectives. The structure or patterns of management is crucial because it can have positive or negative impact on the overall performance of a firm. institution or organization (Handy,2005; Scott,2008). Thus, management could be seen as the activity of managers in an organization such as firm or company and management as a field of study or academic inquiry. According to Nolen (2010), in practice, management could encompass various activities of groups that entail a managerial function, specifically it involves: (1) identifying, planning, implementing , and evaluating the goals of organizations as well as alternative policies that could aid the actualization of such goals, (2) making the organization adopt laid down policies, (3) examining the effectiveness of the policies adopted, and (4) initiating steps to change ineffective or inadequate policies. Nolen, (2010) further posits that management science often has drawn its concepts and methods from the older disciplines such as economics, business administration, psychology, sociology, and mathematics.

As an art of managing, management entails the use of human and material resources to formally coordinate or actualize activities in a formal setting. Proponents of new public management explore new trends in theory and practice in relation to management as an activity. According to Farazmand (2006), managing the affairs of an organization or a given entity to actualize specific set goals in a public setting constitutes management as an activity. The interaction or relationship of persons is not static in firms; rather dynamic. In fact, in any organization, the management team or managers and how they manage the organization matters. In this context, research on the relationship between management structure and firm performance has highlighted the relevant role of the quality of mangers, and sharing of control, which can guarantee the overall performance of both the management (top executives) and staff (line-workers) (Gomes and Novaes, 2005).

However, management is meaningless when laid down rules in a firm are not adequately implemented, either weak or the quality of enforcement is poor. The quality of management is often dependent on the corporate: statutory provisions and the degree to which such statutes are enforced in line with organizational goals (Dahya et al., 2008). This means that to ensure effective management outcomes or what is called management by results, it is not only important that laid down corporate rules define organizational activities' but also important that an efficient management system implements or enforces the rules.

On the other hand, the study of this process of actualizing set goals as an academic inquiry constitutes management as a field of study. As an academic inquiry, the term management sciences are the scientific study of management. The literature on management science is vast and draws on a multiple perspective. Other prior studies have provided insights into the role of efficiency in organizational management practice especially in the context of monitoring the managers (Agrawal and Mandelker, 1990). Against the backdrop of the reviewed literature, management science is studied at the institutions of higher learning in Nigeria. As a field of study, those who study the processes or art of management are known as management scientists. As an important aspect of the teaching-learning process, management science studies provide students with an opportunity to apply both quantitative and qualitative approaches to study a phenomenon, concepts, approaches, empirical and analytical tools of analyses. A review of the literature suggests that several empirical and theoretical studies have focused on various aspects of organizational interactions to understand management in a formal setting (Luigi, Paolone, Pisano, and Alvino, 2017).

Corporate Management

Corporate management is a management practice, which companies or organizations undertake, hence corporate. It is a formal management practice within the public setting aimed at decision making and problem solving among organizations. Corporate management dynamics provide assurance that those engaged in managing the affairs of an organization do so to uphold organizational goals and efficiency (Callen, Klein, Tinkelman,2003). Such practices according to Fayol include planning, organization, efficiency, coordination, reporting, budgeting. An important theme of recent corporate management debate has been efficiency, which examines how resources are used minimally to achieve maximal results (Callen etal.2003) or, what Wills and Ballow (2022) see as the key foundation of modernist management. Corporate management study has highlighted how the corporate relationships in various interactions in a variety of contexts affect management (Callen and Falk,1993). In a similar vein, corporate management encompasses a wide range of activities in the formal setting arguments.

With the emergence of modern technology, new forms of corporate relationship are created, and due to the globalized reach of such management approach, new interface with organization and corporate processes are evident. For instance, drawing on e-management, Vilkaite-Varitone and Povilaitiene (2022) suggest that rapid spread of digital technology provides solutions to constraints to traditional management-, management should be conceived as co-created and technology-based management strategy for achieving

organization goals through successful deployment of technological or electronic application. Equally, discourses on new practice of scientific management as Waring, (2016) elaborates on "Taylorism transformed" and suggests that the human-management relations can be sustained, where effective relations are built including networks and similar interconnected corporate relations seen to be essential in the processes of scientific management. This, in turn, requires the understanding of the boundaries of management sciences or, the creation of equal management opportunities where stakeholders can put in their best (Freeman, 1984). This is framed within the context of what Freeman (1984) termed 'strategic management', which draws on stakeholder approach and emphasizes distinct response to management issues including inclusive management. The literature suggests that such inclusion encompasses a broad-based management pattern and decision making. These dynamics help prevent managers or stakeholders from expropriating returns (Shleifer and Vishny, 1997).

There are numerous mechanisms in place that govern or control the actions of managers and similar stakeholders in corporate management. Some of these mechanisms are internal and are concerned, for example, with issues of problem solving. Others are external, such as the market for corporate control, competitive environments (Luigi etal.2017). In a related account, Anderson, and Gupta, (2009), discuss corporate governance and firm. Performance. In line with corporate management, corporate governance is a strategic tool of an organization's effective performance. These authors based their argument on a cross-country comparison of corporate governance and firm performance. The assumption is that corporate governance should guide strategic decisions among management executives including regular contacts at all levels of staff and other stakeholders to promote organizational efficiency.

Studies examining the effects of corporate management on the overall performance of a firm have supported the impact of members of a firm at all levels. Thus, the role of everybody counts in actualizing the overall goals of a firm. Kaplan and Minton (1994) found that large corporate shareholders play an important monitoring and disciplinary role for Japanese firms. Agrawal and Mandelker (1990), found the same result, which is consistent with the monitoring hypothesis, whereby the existence of large block holders leads to better manager monitoring. The literature reviewed reinforces the relevance of corporate management in overall organizational performance.

Quantitative Management Research

The literature on quantitative management research has largely focused on the use of various structured research instruments in gathering and analyzing data. According to Pinney and McWilliams (2019), quantitative management research involves various statistical or mathematical models of analyses. Thus, the literature suggests that quantitative management involves larger sample sizes which are representative of the population on which results are based (Hopkins,2000; McNabb, 2008). In their studies, Singh, (2007) and Nenty, (2009) argue that generally in quantitative research considering the high reliability of the results, the research study can be usually replicated or repeated. Such replication has been evident in the use of similar or related quantitative approaches to study various variables. For instance, in a study, McNabb, (2008) show the relevance of quantitative approach to study a wide range of themes such as planning, coordination, control. financing and directing.

Much of the academic research on the relationship between quantitative management research and other sub themes of management science studies derive from studies in various fields, such as public administration, marketing, accounting, finance, economics, education, business administration, organization, law, etc. (Demsetz and Villalonga, 2001; Gompers and Metrick, 2001; Bushee, 2001; Hoskisson et al., 2002; Bainbridge, 2003; Muijs,2010). A related literature posits that central to quantitative management science research model is the fact that objective answers are sought through a clearly defined research question (Nenty,2009). Thus, when questions are raised, to find answer to such questions involve a distinct research process.

In a similar study, Singh, (2007), found that quantitative studies provide reliable answers to research questions, which make for possible generalization. Langfield-Smith (2006) highlights the importance of quantitative research in management sciences pointing out the various components of the research, which are carefully designed prior to the collection of data. Langfield-Smith (2006), critiques quantitative research that focuses on the relation between management control systems (MCS) and strategy. Controls included cost controls, budgetary controls, and performance evaluation and reward systems. Building on survey evidence, interviews and archival data. The study concludes that our knowledge of the relationship between MCS and strategy is still somewhat limited rather provides an outline of methodological limitations and areas for future research.

Langfield-Smith (2006) identified the differences in management techniques and the importance of empirical analysis of management processes through quantitative approaches pointing out the robustness of quantitative management. In particular, Ouyang (2008) and Nenty, (2009) affirm that a common element in quantitative research is objective analyses and explanations of both the relationship and differences among variables. Moreover, Krajewski, and Thompson, (1981) argue that quantitative management research could be an all-encompassing approach to study firms, large companies or similar corporate organizations including corporate governance or management system. Essentially, Luigi et al. (2017) found that while companies in the developed countries such as, the USA, Germany and Japan, are governed in contexts characterized by good legal protection, corporate governance systems in most other countries, including poor developing countries, transition economies and some rich European countries, for example, Italy, lack some essential elements of a good system. Thus, the lack of effective management techniques in most cases, makes the adoption of quantitative management essential to understudy empirical dynamics of management failures and limitations.

In a related account, among the developing countries, Shleifer and Vishny (1997), Denis and McConnell (2003) and Luigi et al. (2017) observed that many emerging countries lack strong institutional frameworks such as those existing in developed countries, which are essential for efficient corporate governance. As Boubakri et al. (2005) argued, "such deficiencies point to the possibility that internal mechanisms [such as management] may substitute for external mechanisms in providing efficient governance". McNabb, (2008) identified the importance of quantitative research and found that commitment to organizational or administrative ideals are essential for positive management outcomes, which they measured through commitment

to organizational gals, management response to stakeholders needs, which in their findings have significant effect on corporate management.

Furthermore, Vilkaite-Varitone and Povilaitiene (2022), in reviewing management approaches found that organizational management structure is relevant to the relationship between company's performance and the overall level of corporate governance including e-management. Strands of quantitative research literature have been enormously influential in management science research in the past decade or so. For management scientists, coordination issues have largely been discussed in terms of the ability to deploy requisite tools to achieve desired or expected organizational goals and the rational allocation of suitable resource for achieving such goals. For coordinators, inclusive approach is adopted whereby effective and efficient systems are seen to emerge in unison (Callen et al,2003).

Finally, for organizational planners, a significant concern has been efficiency; the collective action issues central to the management of common pool resources (Callen, et al,2003). In each of these areas of discussion, a dynamic approach to management is explored. A major focus is that of efficiency and quality management. For these reasons, this study explores quantitate approach in management science to better analyze the various processes of conducting such research in management sciences because quantitative approach is an objective measure of organizational activities and performance, which can be used to examine the various aspects of management practice and science research. Following a review of quantitative research and in particular, drawing on evidence from previous perspectives, the study makes a contribution to the broader debates on quantitative research methods and approaches in management science by filling knowledge gaps on approaches to quantitative management research. The next section examines dynamics of quantitative research processes and approaches in management Science.

Dynamics of Quantitative research in management Science

A whole new approach has emerged discussing various elements of quantitative research in management sciences (Krajewski and Thompson ,1981; Thompson 1982; Pinney and McWilliams,2019). Such terms as modeling, correlation, sampling, variables, indicators etc all emphasize some elements of quantitative research processes. Notions of sampling, correlation, modelling have a long tradition in quantitative research. Thus, there have been a long line of quantitative management thinking that could be evident in present management science research, as well as in broader public administrative studies. Some of these terms have subsequently become widely used, informing broader debates about organizational performance, efficiency and corporate management indices (Anderson, and Gupta, 2009).

Although this recent interest in quantitative approaches created a certain level of contradiction, and a multitude of articles often full of astounding mathematical calculations, it did provoke much of a new wave of empirical enquiry, focusing on management processes and complexities, and the implications of quantitative dynamics in computation and or empirical analysis. Some of the approaches include, organization studies, modeling, human resource management, innovation management, scientific management, human and material

resource management, management cybernetics, total quality management (TQM)and management by results, managerial economics.
management engineering,

So, what does quantitative management science research explore? Three themes stand out, each of which has some important potential, yet often unappreciated, resonances with parallel debates in the management sciences. First, the understanding of variables in management science research has led to work that has moved the management dynamics debate beyond the prevailing assumptions to a wider appreciation of complex dynamics, of human and institutional capacity measurement in formal organizational settings. Second, the exploration of "quantification or empirical dynamic in management science simply how do we measure or engage in empirical analysis? Engaging in such dynamic processes have led to works on nonlinear interactions across organizational hierarchies in systems analysis, and to a wider understanding of the spatial patterning of management processes from small and medium scale organizational management to wider corporate organizations. Third, a recognition of the importance of temporal dynamics on current management patterns and processes has led to a wide body of new work in quantitative approaches to management. These quantitative approaches have provided new insights on some organizational management problems. For instance, new quantitative approaches in firm behavior and management have challenged non technological notions of management processes as a basis for effective management. Thus, management science scope and enquiry has been broadened following issues of e-management, such technology driven management appears to be more dynamic approaches in contemporary management practice (Vilkaite-Varitone and Povilaitiene, 2022).

Similarly, in institutional management, a growing emphasis on efficiency in management dynamics suggests alternative management approaches and strategies that accept quantitative approaches following variability in management performance and outcomes. The recognition of quantitative dynamics in a variety of management science settings challenges some basic, often deeply embedded, conceptions of mainstream management and suggests new empirical or quantitative thinking about management including policy and practice that were often rejected in more conventional management science perspectives. Yet the debate in understanding contemporary quantitative management science has been scant.

McNabb, (2008), emphasizes the importance of research methods in public administration and nonprofit management building on both quantitative and qualitative approaches. Kamlesh and Solow (1994) came to a similar conclusion exploring the exceeding relevance of quantitative management science. Despite such commentaries, however, quantitative management science, over much of this decade, has been less discussed in most developing countries of the South. A number of management science enquiry have not detailed the qualitative approaches (exploring how statistical data and its analyses could be assembled. From the 1990s, particularly following. the empirical study by Moore, Lee, and Taylor (1993), quantitative management science has centered on correlational dynamics and, particularly, the relationship between one variable and the other in a given population or sample thus establishing relationship between dependent and independent variables. Drawing on the work

of Thompson, (1982) such approaches have often been based on samples and modelling, describing various features of a given elements.

By the 2000s, empirical concepts such as modern quantitative analysis formed the basis of quantitative management science research where variables, and their interactions are defined. Management science concepts identified complex, yet well-integrated, corporate, administrative and organizational relational interactions including performance indicators and assessment. Finally, quantitative approaches, based on the principles of empirical management science study constitute central areas of management science and has added impetus to quantitative research.

At the core of its approach and as fundamental to its assumptions and findings, quantitative management science study and practice has stimulated new research inquiry which emphasizes statistical models, as a guide for understanding management science research and measurement tools and thus, how coordination, administration or other aspects of management are assessed; and understood thereby providing a basis on which management policy could be formulated and implemented.

Although there is absence of consensus on quantitative approaches and models, disputes within each of the various area has little departure from broader quantitative thinking despite wide ranging interest in mathematical or quantitative management science (Krajewski, and Thompson,1981). Subsequent decades have seen the emergence of key concepts making up some of the disputes. These concepts have been based on the elements of empirical research, especially those that are dominated by divergent indicators and variables. Some key concepts provide useful hypotheses and questions regarding multiple variables; and the recognition of various empirical dynamics, where systematic interactions and processes are linked for possible generalization.

Conducting Quantitative Research

How have the management sciences attempted to articulate with quantitative approaches in recent decades? Too often, management science analysis whether in human resource management or organizational performance management has remained attached to a less quantitative analyses, despite various challenges to such a view within management science over many years. Different disciplines have adopted different perspectives over time. The framing of ideas of management as a science, is informed by the various systematic process of inquiry, a number of related approaches in the management sciences have discussed vrous articulations of quantitative approach. For instance, Gerald E. Thompson (1982) provided an early attempt to shift the focus of quantitative management science away from an equilibria based research agenda toward modern quantitative analysis and decision-making responses to management interactions and corporate relations.

Although the results-based versions of management have long been explored, its basic elements have persisted in perspectives linked to concepts of performance management and corporate adaptation including change management in corporate settings. Some of the early

literature in this vein drew from corporate management perspective, drawing on the concepts of organization performance, to describe patterns of firm behavior in relation to management of human and material resources, an approach that Drucker (2001) terms the processual approach in management science. Such work echoes evolutionary approaches in management such as rational choice perspectives and strategic institutional approaches (Suchman, 1995), organizational managerial behaviour (Jensen, and Meckling, 1976), strategic management (Freeman, 1984), transactional analysis (Barth 1966), actor-based approaches (Vayda, 1983). and, more recently, e-management models and approaches.

Others have concentrated on decision-making models of individual behavior, prompted in part by the rise in interest in sociobiology of management (Thompson, 1982). Often in parallel to this work, other studies have highlighted the close fit between indigenous knowledge and practice in a wide range of management settings. To strengthen quantitative management research, Pinney and McWilliams, (2019) provide a detailed introductory approach linked to decision making in an organization. However, against the backdrop of the literature reviewed, with some important exceptions, much of the previous studies fail to interrogate the complexities of both empirical and quantitative dynamics, and thus remains largely static. The consequence has been the collection of much data that have been poorly situated in the complexities of management science analysis. To fill this gap, a detailed discourse on quantitative management research processes follows.

Quantitative Management Research Processes

What then are the processes of quantitative research processes in management science? In management sciences as in other disciplines, quantitative research starts with setting out the research goals. Such goals primarily include to determine the relationship between one thing [an independent variable] and another [a dependent or outcome variable] within a given population. Quantitative research designs in management science falls withing two broad categories namely, descriptive where key subjects are typically measured only once or experimental where subjects are usually measured twice notably pre and post treatment. According to McCombes (2022) descriptive research establishes only relationships or linkages between two or more variables; such as observational research, survey and case study research while experimental research establishes causality through experimentation processes.

In their study, Pinney and McWilliams (1987), highlight that quantitative research focuses on numbers, objective stance and logic. It is numeracy research since it deals with numbers or statistical methods. Thus, quantitative approach deals on detailed, numeric and static data and convergent rather than divergent reasoning [this entails creating a wide range of ideas regarding a research problem in a free flowing, and spontaneous way].

The key features of a quantitative research include:

1. Structured research instruments are usually used in gathering data.
2. There are larger sample sizes which are representative of the population on which results are based

3. Given high reliability of the results the research study can be usually replicated or repeated
4. Objective answers are sought through a clearly defined research question.
5. Various components of the research are carefully designed prior to the collection of data.
6. Data which are often arranged in tables, charts, figures, or other non-textual forms are presented in the form of numbers and statistics.
7. Research findings can be used to investigate causal relationships, generalize concepts more widely or predict future results.
8. Numerical data are collected by researcher through the use of tools, such as questionnaires or computer software etc. The central aim of a quantitative research is to identity or classify features, count, and design them using a statistical model to explain observations.

Design for Quantitative Management Research

Generally, weather in the management sciences or any other sub-field, the design for quantitative study is often similar. There are two types of quantitative design namely descriptive or experimental. Before designing a quantitative research study, it is necessary to decide whether it will be descriptive or experimental. This is important to help the researcher decide data gathering, analysis, and interpretation of the results. In a descriptive study the following processes must apply usually, subjects are measured once; the reason is to establish linkages between variables; and, the research may comprise a population sample of hundreds or thousands of subjects to arrive at a valid estimate of a generalized relationship between variables obtained. Experimental design often may be very small and purposefully chosen population sample, items are often measured before and after a given treatment, intended to establish causality between variables.

Introduction

In quantitative study, the introduction is often in the third person point of view and written in present tense. It includes some of the following:

(1) **Research Problem** – What are the specific research problems to be investigated?

(2) **Literature Review**– the key relevant literature or scholarship on the topic investigated is reviewed in most cases identifying previous studies that used similar methods of inquiry and analysis. And in particular identifying gaps in the literature which the study seeks to fill or clarifies existing knowledge.

(3) **Theoretical Framework** –Identify a specific theory for the study and justify its suitability for the study. The researcher may, define or clarify some concepts or terms that are not clear or complex or ideas.

Methodology

The section on methods in quantitative research should be presented in the past tense. The method describes how specific objectives of the study will be achieved. It is proper to provide

sufficient detail to enable reader to make proper assessment of the methods adopted to obtain results in relation to the research problem.

(1) **Population of Study and Sampling** – This section shows where the data for the study were collected, their robustness, possible gaps or items excluded, with particular attention to the procedures adopted for the selection.

(2) **Collection of Data** – What tools and methods were used to collect information and what variables were measured; what was the methods used to obtain the data; are they already existing data (secondary data) or data the researcher gathered. If the researcher gathered it, the type of instrument used in gathering the data and the reasons for using the instrument should be explained. Generally, no data set is perfect-therefore the researcher should -describe possible limitations in date gathering processes.

(3) **Analysis of Data** – How was the data analyzed? the researcher should describe the procedures for processing and analyzing the data. Possibly, the specific instruments of analysis used to study each research objective should be described including mathematical techniques or computer software used to manipulate the data.

Reporting results of a study in Quantitative Methods:
Results
The result is key to research. It should be presented in the past tense. In quantitative study the result should be objectively written and clear. The results could be presented in various formats such as the use of charts, graphs, tables or non-textual formats to create an understanding of the data. It should be ensured that non-textual elements are not isolated from the text rather should be used to supplement the overall description of the results and to clarify key points made.

Statistical Data Analysis – Data analysis is important in quantitative management science research. After identifying the key findings from the study, the next thing is to analyze the data Various statistical methods of analysis could be used depending on suitability and focus of the research The findings should be presented in a logical and sequential order without definitive interpretation of trends either positive or negative results; rather the analysis is made and definitive statements are set aside for the discussion section.

Discussion
Discussions should be clear, logical, analytic and comprehensive and presented in the present tense. An important aspect of discussion is that it should logically bring together findings in relation to similar issues identified in review of the literature and linked within the context of the theoretical framework of the study.

Interpretation of Results – In interpretation of results, the research problem that is investigated is reiterated, the finding is compared and contrasted in line with the research questions underlying the study. The essence is to ascertain if they affirm the predicted

outcomes or whether the data refutes it.

1. **Description of key trends, possible comparison, differences or relationships among variables** – Key trends which emerged from the analysis should be described as well as explanation of all unanticipated and statistical insignificant findings.
2. **Discussion of implications** – In arriving at the results what are the implications of the findings? Such key findings should be highlighted based on the overall results and including taking note on specific findings that the researcher considers important. Further, the researcher should highlight how the results have helped fill the identified gaps in understanding the research problem.
3. **Limitations** – The researcher should explain any limitations or unavoidable bias in the study and, possibly, identify why such identified limitations did not inhibit the conduct of the investigation as well as inhibit effective interpretation of the results.

A number of issues must be put into consideration in reporting results in quantitative research.

1. **Explanation of the collected data, the** statistical treatment and relevant results in line with the research problem being investigated. Result interpretation is unsuitable in this section.
2. **Reporting of events that were unanticipated** that occurred while collecting data. An explanation of how the actual analysis is different from the planned analysis. Explain the processes of handling missing data and why any missing data would not undermine the validity of the analysis.
3. **Explaining techniques** adopted to "clean" the data set.
4. **Choosing a suitable statistical procedure**; provide a rationale for the use of the procedure and a reference for it. Specify any computer programs used in the process.
5. **Explaining assumptions of the research** for each procedure or steps taken to ensure that such assumptions were not violated.
6. **In inferential statistics**, provide the descriptive statistics, confidence intervals, and sample sizes for each variable as well as the value of the test statistic, its direction, the degrees of freedom, and the significance level [report the actual *p* value].
7. **Do not infer Causality**, particularly in nonrandomized designs or without further experimentation.
8. **Tables should be used to provide Exact Values**; use figures to convey global effects. Keep figures small in size; include graphic representations of confidence intervals whenever possible.
9. **Explain the items in the tables and figures**.

NOTE: Where the researcher is using secondary data, the methods used to gather the data should also be reported. Any existing missing data and why it is missing should be explained clearly including why such missing data will not undermine the validity of the final analysis.

Conclusion

There is no consensus on writing conclusion in quantitative research. However, conclusion entails brief summary of the topic and a final appraisal or overview of the study.

1. **Summary of Findings** – The findings should be reported in a clear plain text without

statistical data rather a detailed narrative of the summary of the key findings should be described including lessons learned which were not known before conducting the study. Further the researcher should synthesize the answers to the research questions.

2. **Recommendations** – Based on the aim of the results and the findings, it is always proper to tie key findings with practical actions to be taken often in the form of key policy recommendations.
3. **Future research** – It is always proper to understand that research is a continuous process, this makes it proper to devote a line or two to the need for future research linked to the study's limitations or any gap the study did not fill.

Issues and Policy Options

A whole new process has emerged in exploring the various elements of quantitative research. Such terms as sensitivity, robustness, variability, dependent and independent variables, criterion variables, predictors etc. all capture some elements of complex dynamics of quantitative research. Some of these terms have subsequently become widely used, informing broader debates about quantitative management science research.

Although this explosion of interest has strengthened research in management sciences. There is evidence in a wide range of management fields of enquiry which have begun to question various management notions that framed the contours of debate within quantitative management science enquiry. For instance, Scoones (1999) argues that such quantitative ideas produced a certain level of confusion, and a multitude of articles often full of arcane mathematics, yet it did provoke a new wave of empirical enquiry.

What are the merits and demerits of quantitative research? Some of the merits of quantitative methods in management sciences could be explored from a number of perspectives. According to a particular perspective, one of the merits of quantitative research is that quantitative researchers try to recognize and isolate specific variables contained within the study framework, seek correlation, relationships and causality, and attempt to control the environment in which the data is collected to avoid the risk of variables, other than the one being studied, accounting for the relationships identified (Thompson,1982).

The merits of quantitative methods in management science research could be summarized as follows.

1. Quantitative methods allow for possible generalization of results through a broader study, that involves a wide number of subjects.
2. Replicability is another key merit of quantitative research since it uses established standards, analyzes and compares with similar studies.
3. Quantitative approach helps to summarize vast sources of information and makes specific comparisons across categories and over time; and place.
4. It helps to overcome personal bias by using accepted computational techniques and in particular keeping a 'distance' from participating subjects.

Similarly, there are a number of limitations of quantitative methods. One of the key demerits is that, because it is presumed that quantitative methods have an objective approach to investigating research problems, as data are controlled and measured, to address the accumulation of facts, and to determine the causes of behavior, the results of quantitative research may be statistically significant but often humanly insignificant. Some specific limitations include:

1. Data in quantitative research is more efficient to test hypotheses but may miss contextual detail.
2. Quantitative method often deploys an inflexible process of discover as it uses a static and rigid approach.
3. Quantitative methods are prone to "structural bias" and false representation, through the development of standard questions by researchers where the data really reflects the view of the researcher rather than the participating subject.
4. Results often provide less detail motivation, behavior, and attitudes,
5. Collection of superficial and narrow dataset by researcher may sometimes be possible,
6. Because results provide numerical or statistical descriptions results are limited rather than detailed as there are less elaborate narratives of human perception.
7. The research is often limited by level of control that can be applied to the exercise as well as contradictions between "laboratory' and "real world results" as research is often carried out in an artificial and unnatural environment. This level of control might not normally be in place in the real world thus yielding "laboratory results" as opposed to "real world results.
8. Results may not truly reflect real life outcomes as most times preset answers will not necessarily reflect people real perceptions or what they feel about a phenomenon and, in some instance, the preconceived testing of hypothesis could just be the nearest match by the researcher.

Conclusion

This study has attempted to link the understandings of quantitative approach in management science research to ongoing issues and policy options, with broader elucidation of the processes of quantitative approach in management science research. In particular, discussing the systematic processes of quantitative research in management science and provides clarification regarding the notion of management as practice involving the management or administration of organizations, firms or companies and management as an academic field of inquiry.

Building on the later perspective, the study provided an understanding of the processes of quantitative research, detailing its various procedure, features, merits and demerits. In particular, demonstrates that quantitative management research as empirically constructed procedure, which has been central to this discussion. Thus, quantitative approach in management science research has resulted in important work on how management science theory and practice must be understood from various perspectives (Moore, Lee, and Taylor, 1993).

This theme has been taken up by more recent studies on innovative approaches to management science research, which seeks to move beyond qualitative approaches (Waring, 2016). Yet, the understanding and application of quantitative knowledge, and approach in relation to management practice requires more research work. This discussion has taken on new understandings of wide range of gaps, that is increasingly essential in advancing and promoting quantitative research.

This is not to say that all management science arguments are bound up by only quantitative models or approaches that do not take into account qualitative research. Some authors have clearly taken cognizance of the relevance of qualitative research in management science seriously, incorporating various elements and models including ownership and control (Villalonga and Amit, 2006).

Thus, research insights offered by both quantitative and qualitative approaches are essential to set a research agenda that can advance management science studies and in particular, develop a theory of the dynamic study of interrelated management systems, including attention to issues such as management by results, corporate efficiency, organization planning, monitoring and evaluation, scaling and hierarchy, management continuities and complex dynamics etc, as emerging and suitable contexts and contours to undertake management science research. However, an aspect of our argument is that, despite the more nuanced reflections on management science dynamics mentioned above, the vast majority of management science thinking continues to predominantly deploy qualitative approaches in framing the discussions in management studies. Thus, in quantitative management science, narratives informing policy and practice, a range of concepts central to quantitative research thinking in management should be central to the dominant discourses of analyses. The way practice in management science is undertaken, classified, understood, and interpreted emerges from particular scientific approach or methodology adopted and, in turn, becomes embedded in management and administrative study or research, regimes of firms, companies, institutions, state agencies, non-government organizations (NGOs), and development projects. Such research outcomes inform perspectives of what an organization is, what management principles or elements are, what efficiency is, and what boundaries of management is etc, derived from a particular view or terminological expression of management. The point our study has been emphasizing is the need to adopt quantitative research approaches to broaden the scope of management science research, theory and practice.

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